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OMNI

NOVEMBER 1978 $2.00

THE REAL BIONIC MAN

EXCLUSIVE: INTERVIEW WITH ALVIN TOFFLER PLUS:
ALL NEW FICTION · UNSEEN WORLDS · COMPUTER LIB
BATTLESTAR GALACTICA · JOHN LILLY ON DOLPHINS

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November 1978

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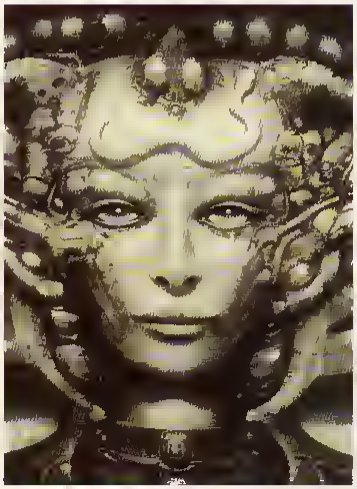

The cover art for this month's OMNI is an imaginative portrait entitled Li 1. Painted in 1974 by the Swiss 'fantastic realist' H.R. Giger, it appears in Giger's first book Necronomicon *published last month by Big O Publishing, Ltd*

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BOB GUCCIONE

"Who can put a dollar value on the tremendous uplifting of the human spirit that occurred on July 20, 1969, when Neil Armstrong walked on the surface of the moon?"

In last month's OMNI science writer Alton Blakeslee reported on astronomers' efforts to detect intelligent signals from outer space. The implications of such contact, and the dialogues that must inevitably follow, are enormous, almost too staggering to conceive. Imagine the questions we could ask a visiting extraterrestrial: Do you have a cure for cancer? Is there life after death? Are the physical laws in your part of the universe the same as in ours? Is there a way to overcome the burden of gravity, prolong youth, exceed the speed of light? Think of the things we could learn, among them, as Carl Sagan put it, how "possibly to avoid the dangers of the period of technological adolescence we are now passing through."

Yet despite the obvious benefits to be reaped from such contact, there exist a vociferous few who appear to oppose any and all efforts to make it. Most notable, of course, is Wisconsin senator William Proxmire, who this winter gave one of his infamous Golden Fleece awards to the National Aeronautics and Space Administration, which, "riding the wave of popular enthusiasm for *Star Wars* and *Close Encounters of the Third Kind*, is proposing to spend $14 to $15 million over the next seven years to try to find intelligent life in outer space. In my view," said Proxmire, "this project should be postponed for a million light-years."

Following this attack on NASA, a subcommittee of the House Committee on Appropriations (chaired by Representative Edward P. Boland) recommended that the fiscal year 1979 budget for NASA's search for extraterrestrial intelligence (SETI project) be cut from $2 million to $600,000. (The final decision is now before the House.) As one NASA official put it, "This is not enough even to start design work on the antennae."

The SETI project is not the only golden space opportunity to be fleeced by Proxmire. Funds for the Solar-Polar Orbiter (a spacecraft designed to fly over the poles of the sun) were cut as were funds slated to outfit the *Enterprise* (the space shuttle that flew from a 747 in recent atmosphere tests) for space. As one writer put it, the cuts left "barely enough to keep the *Enterprise* from being cannibalized for spare parts." Similarly, Proxmire vigorously opposed the *Apollo-Soyuz* rendezvous on the ground that the Russians were somehow inferior to us in aerospace. He seems blind to the fact that the Russians were there first with *Sputnik* and that while the Soviets are regularly sending men into space, we remain about as airworthy as a prize Kentucky swine with paper wings.

The arguments behind this depreciation of the space program are simple—the program itself is too expensive, we get too little for the money spent, and, besides, it could be better deployed on such things as medical research.

The arguments are, of course, specious.

First, it is difficult to make a case for spending too much money on the space program since the Department of Health, Education and Welfare spends the equivalent of the total NASA budget *every eight days*.

Second, we get a great deal for the money we do spend. The development of communications satellites alone, an advance that has done more for human understanding than all the social welfare projects funded to date, would seem worth the cost. Moreover, who can put a dollar value on the tremendous uplifting of the human spirit that occurred on July 20, 1969, when Neil Armstrong walked on the surface of the moon?

Finally, it is foolish to think that money cut from the space program will actually be used to better the quality of life here on earth. Lumped under the general category of "defense," more than 60 percent of the federal budget for research and development, for example, still goes to the creation of newer and more sophisticated means of destruction. Similarly, we now spend the equivalent of NASA's entire budget to develop the conventional methods of generating nuclear energy, an enterprise that is risky at best.

Yet the budgets continue to be cut, and Senator Proxmire continues to dispense his Golden Fleece awards in what seems to be a propensity for buffoonery. It may be entertaining—if not vote fetching—to award the Golden Fleece to an FAA study unfortunately titled "The Anthropometry of Airline Stewardesses." Proxmire gave such an award in 1976. The fun goes out of it, however, when you learn how many flight attendants have been killed or incapacitated because of outdated equipment described in that same FAA study.

The existence of such things as Proxmire's Golden Fleece awards poses one of the most profound and enigmatic questions of our time: Is there intelligent life on the planet earth?

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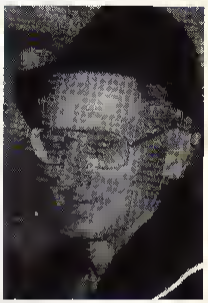
LILLY

I can never speak with you again." That's what Dr Willem Kolff, head of the University of Utah's artificial organs division, told our reporter *Dick Teresi* after reading a pre-publication copy of "The Real Bionic Man" [page 44]. Kolff was upset because he believes that some of the information in the story—never before published—is too revealing and could be used against him by his competitors in the fight for government grant money.

The battle for funds in the bionic world is particularly fierce. There are four major research centers building artificial hearts and a whole slew of universities, clinics and hospitals hard at work developing artificial limbs, eyes, ears, skin, blood vessels, and other organs.

But at the top of the bionic heap is the wild bunch at Salt Lake City, headquarters of the University of Utah. The school has snared $8.4 million in grants for 1978, thanks to Kolff and a staff of profoundly creative bioengineers. Too creative, say some of the university's critics, who feel that many Utah projects are too far out and that Kolff's hopes for them, too optimistic.

Yet when Teresi, an award-winning public affairs reporter, visited Salt Lake, he found the Utah group to be a sober team of researchers—with realistic goals, the technology and brilliance to accomplish them. Their stories will convince you that the creation of "bionic people" is not as crazy as it seems.

Several years ago, a charming young woman walked into *Dr. Wallace Ellerbroek*'s office. She was prudish, sexually inexperienced, and the glands in her neck were chronically swollen. Then she met a man . . . and her swollen glands disappeared. Then she found out the man was married. And the swollen glands returned. It is the theory of Ellerbroek, who is both a surgeon and a psychiatrist, that this woman is *not* unusual. *All* of us, he says, get sick or stay healthy because of how we feel emotionally, how we think, and how we talk. His strong case for the connection of "Language, Emotion and Disease" begins on page 92. (Dr. Ellerbroek is a staff psychiatrist at Metropolitan State Hospital in Norwalk, California, but the ideas he expresses in *Omni* are not necessarily those of the California State Department of Health.)

"There are human vampires," writes *Lyall Watson*, an animal behaviorist who also holds degrees in biology and anthropology. But his statement doesn't mean what you probably think it does. Watson is a legitimate scientist trying to make sense out of the supernatural. He talks about ESP, ouija boards, reincarnation, psi-trailing, and how we are all vampires in "Lifetides" [page 112].

Test tube babies have dominated headlines for the past several months, but *Tabitha Powledge* thinks they'll prove to be a short-lived phenomenon—and deservedly so. "Too much fuss about making babies," she says, "and not enough effort to take care of the kids we've got." Powledge, of the Hastings Center's Institute for Society, Ethics and the Life Sciences, tells her side of the story beginning on page 76.

And speaking of short-lived phenomena, we sent writer *Timothy Bay* up to Cambridge, Massachusetts, to check out the Center for Short-Lived Phenomena [page 64]. The Center has correspondents all over the world reporting on hurricanes, earthquakes, bird kills, frog wars, "rogue waves," and anything else unusual, catastrophic, or . . . short-lived.

Our key book excerpt this month is "Communicating with Dolphins" [page 104] by the dolphin-man himself, *John Lilly*.

What's *Alvin Toffler* been up to lately? *Omni* editor and publisher Bob Guccione found the author of *Future Shock* alive and well and still predicting the future. Among other things, Toffler says we'll be taking a giant step into the ocean soon—not only growing our crops there but building our own custom-made islands [page 96].

And don't miss our exclusive interview with Gregory Peck. He talks about cloning and his role in the movie *The Boys from Brazil* with *James Delson*, *Omni*'s film and tv critic. Delson is a screenwriter and owner of one of the largest private film research archives in the U.S. Writing on books is *Robert Anton Wilson*, author of *Cosmic Trigger* and co-author of the *Illuminatus* trilogy currently being staged for the theater. Read both Delson and Wilson in "The Arts" [page 28].

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NOVEMBER

LETTERS

COMMUNICATIONS

Strategic Gases

I was one of those passing through Kansas in August near McDonnell Air Force Base, when I saw that mile-long orange cloud of gas blowing across the sky. I barely escaped being poisoned by the toxic stuff, which I later found out was nitrogen tetroxide leaking from a Titan missile silo. I'd like to see an article in *Omni* on how strategic arms affect our daily lives and the dangers these missiles present to the people they are supposed to protect.

Marcus Littlefeather
Boulder, CO

Urban Desires

As an urban designer, I would like to know what concepts and ideas are being developed for the future of cities; what explorations are being made towards designing cities that are more workable, functional—like Disney World with its superefficient infrastructure; what the technical possibilities are of expanding human personal space, both habitats and work places.

Homer Bruce
New York, NY

Running Into the Future

Why not run a story on jogging as it applies to physical maintenance programs in the year 2000?

John Bartlett
Boston, MA

Look for a story on "Future Sports" in an upcoming issue. —Ed.

More to Come

In promotional material about your new *Omni*, I notice that you are printing stories by Theodore Sturgeon, James B. Hall and Ron Goulart all in one issue! All three are terrific writers. And Ron Goulart, creator of *Star Hawks*, is just as powerful behind a piece of prose fiction. I hope that this kind of an SF lineup is a promise of things to come.

Bill Grant
Los Angeles, CA

Tigrons and Jagards

I have heard it is possible to bring about hybrids between the large, closely related mammalian species, especially subspecies maintained in captivity. Zoologists have successfully crossed tigers with lions (thus obtaining a "tigron" or "liger") and jaguars with leopards. Please run some photographs of these animals.

Gail Schwartz
St. Louis, MO

Omni is planning a feature on future animals coming up soon. —Ed.

Ripped Off

I'm pleased that there's a new science magazine on the market, but I do hope you'll avoid a common mistake. I'm talking about giving credit to the wrong people. I'm a research chemist working in the lab of a large university. On no fewer than six occasions over the past five years, my colleagues and I have been ignored in news releases about projects we gave our hearts and souls to (not to mention our evenings and weekends). Credit is always given to our department head, who frankly never visits the lab unless he wants to bum a cigarette. Most of us who "do science" do it because we love it, not because we want publicity. But it hurts sometimes when our work is ripped off to help make someone else's career.

Name withheld by request

We're well aware of this problem—and it is our policy to go directly to the researchers involved when reporting on new developments. —Ed.

Ballpark Cutt

When archaeologists of the future dig up one of today's sports pages and read, "Star sacrifices with fly in infield," will they think that our ballparks were religious centers?

Frank Gambardelo
New Brunswick, NJ

Omnivorous

I saw the advertisements for *Omni*, and I'm looking forward to buying it every month from now to the year 2000.

Salvador Gonzales
Taos, NM

Why do you plan to stop then? —Ed.

WHALE PILOTS

EARTH

By Kenneth and David Brower

I fly whales " said Charles Hubbard, shaking hands. *'I fly spitfires.'* said his manner and dress, which were devil-may-care.

We met late last June, in London, where the 30th annual meeting of the International Whaling Commission (IWC) was about to convene. Hubbard was one of those types that whale conferences draw. Slight, blond, and bearded, he had a patch over one eye and a flask of brandy in his hand. He wore what could have passed for a flight jacket. The emblem on the shoulder said 'Flo."

Flo is the largest of the whales that Hubbard flies. She is, he explained to me fondly, a humpback 33-meters long and five stories high, and she carries a gondola under her belly. Deflated and crated, she is much more compact than that but still too large to send from California to London. Hubbard brought along several smaller models instead. Made of Ripstop fabric, they are pumped full of compressed air, the air is heated, and the whales rise. Fumes from the heater and excess pressure are vented, and Hubbard, in directing the venting, gains a small measure of control. The flights are tethered, and all his effort goes to keeping the whale's head to the wind. The last thing a whale-pilot wants, he said, is to have his ship swinging broadside to the breeze and "kiting." Hubbard has no training as a pilot or balloonist. All he navigates is whales, and he has learned by trial and error. He had been invited to London to fly missions at various save-the-whale demonstrations to be held around town.

Hubbard sat and unfolded a map of London. With his thumbnail he traced the course he planned to fly the next day down the Thames, his thumb dipping three times to indicate passage under bridges. Then he folded the map again. He sighed and set about filling out flight plans. To fly whales legally in London, one must complete a stack of forms and applications. Dirigible whales may soar, but not high enough to slip the tethers of bureaucracy.

A beach provides the backdrop for this whale graveyard, strewn with bone from end to end

Hubbard worked fast—clearly he was good at this paper aspect of his work—but after five minutes the romantic in him rebelled. He looked up at me. In the coming week, he confided, he would do all the flying legally permitted him, *then maybe a bit more.*

What else? I wondered. Buzz Parliament? Buzz the *Queen?* Hubbard smiled and wouldn't say.

About real whales Charles Hubbard was poorly informed. In the fin of a whale, he told me, there are five bits of gristle where fingers once were—strong evidence that whales once were land animals. The truth is even better than that, Charles. There are finger *bones* in the fins of whales. And no one, unless it's some fundamentalist jury in Tennessee, doubts that the ancestors of whales once lived on land.

In sleep, Charles Hubbard was a tooth grinder.

I know, because we were roommates for a night, Hubbard kept me awake for hours. What, I wondered, is he dreaming? Then, suddenly, I saw it, as clearly as if it had been my own. An enormous whale, a humpback the size of the Hindenburg, swung slowly, slowly broadside to the wind, and I, Charles Hubbard the pilot, frantic at the controls but unable to turn her, felt her begin to kite.

Hubbard's copilot in London was Steve Sipman, a former dolphinkeeper. Sipman, like Hubbard, is American.

On first arriving in England, Steve Sipman was aggressively low-browed, as if to discourage the British from roping him into tea and crumpets or tinkering with his accent. When I first saw him, he was sprawled on a sofa in southeast London, conspicuously scratching himself and discussing his criminal past.

Sipman's crime was grand theft. On May 29, 1977, on the island of Oahu, he and another dolphinkeeper, Kenneth LeVasseur, drained the tanks of their two charges, Puka and Kea, Atlantic bottle-nosed dolphins, the subjects of language experiments at the University of Hawaii.

On the night of the "liberation," the moon was full. The Milky Way bridged the

subtropical sky "We ate peanut buffer and honey, and drank black, black coffee," Sipman remembers "Puka was pretty hep She just lay back and said, I know I'm going someplace and it's got to be better than the tank ' We got to this secluded beach on the far side of the island, and we carried them down to the water I swam out on a surfboard to say good-bye. I didn't get so much as a thanks even "

He and LeVasseur returned to the van, and for the rest of the night they just drove around the island, figuring it would be their last chance for a while. Then they turned themselves in LeVasseur has been convicted of grand theft and is appealing Sipman has yet to be tried

In London a year after the "liberation," a delegate to the IWC approached Steve Sipman in the lobby and asked about the minds of dolphins

"There s no doubt in my mind that dolphins have a high sense of ethics,' Sipman said 'I had the opportunity to live with two dolphins for two and a half years They have a sense of ethics and they're Intelligent I *know* it It's hard to explain, though, to someone who hasn't had direct experience. It's like trying to explain to a blind person what rainbows look like '

If Steve Sipman has known cetaceans for two and a half years, then John Oktollik, another observer at the conference, has known cetaceans for half a century. Oktollik saw them in an entirely different light

John Oktollik is an Eskimo, a veteran whaling captain from Point Hope He is a stocky, genflemanly, bespectacled man who is missing most of his lower incisors Sometimes back home, Okfollik takes novice Eskimos from inland villages out on hunts, and he listens as their first bowhead whale breeches nearby 'They say, 'Aaahhhhhh,' " he reports. "That's their expression, you know, at the bigness.' Yet then, with Oktollik directing, they pursue this object of their wonder and do their best to kill it

"I'm fifty-eight," Oktollik told me, as we sat together in the lobby outside the conference hall ' I've been exposed to whaling since I was a seven year old. At first I had to stay in the tent It was cold—the first part of April I was getting snow to make wafer, or cutting up some blubber for fuel Later, when I was twelve or fourteen, I started getting a little bit of training When you first go out in the boat, it's very exciting It's sort of scary—going after that monster in a small boat five to six meters in length Sometimes, when we take people from the outlying villages and they see the whale before they know it they're paddling backwards "

The problem of the bowhead whale was one of the most difficult facing the IWC this year

Last year, at the annual meeting in Tokyo, the Commission for the first time had limited the Inupiat Eskimos of Alaska in the number of bowheads they could kill, setting the quota for 1978 at 18 whales struck or 12 taken, whichever came first. The Eskimos were appalled They are accustomed to striking and killing far higher numbers (In the spring hunt of 1977, which had concluded several weeks before that momentous Tokyo meeting, they had struck 82 bowheads and had taken 26) So this year they came to London in force Some were official members of the U S delegation, others were observers, but all were dedicated to revising the quota upward

Few environmental issues have had the divisive power of the debate on bowhead whales The controversy has divided Eskimos and environmentalists, two groups whose sympathies normally would be

Whales dismembered to be sold commercially

mutual It has divided the environmental movement itself. The Greenpeace Foundation is for an immediate end to bowhead whaling. Friends of the Earth, Inc , is for a limited subsistence hunt Friends of the Earth Ltd the British branch of the organization, is against such a hunt The controversy has made for strange alliances as well In London the Eskimos found themselves on the same side as the Russians their old enemies from the days of Baranov The Russians are whalers too, newer at it, but conducting their operations on a much larger scale. And the controversy has made for happy reunions The Japanese and the Koreans, two whaling peoples who share with Eskimos racial origins in the north of Asia, were reunited in London with cousins they last had seen in Paleolithic times

The Eskimos in London had two distinct approaches to international diplomacy John Oktollik's group, the older Eskimos, were unfailingly polite The second group, the younger Eskimos, were almost invariably rude

"The questions you ask show how ignorant you are " Billy Neakok told me in the hotel coffee shop. "It is impossible to explain it to you "

Neakok is a young whaling captain from Barrow In London he wore a white parka, a bone necklace, and dark glasses His hair was long and parted down the middle His opinion of me was lower than usual, for yesterday the IWC technical committee, most of whom owned Nordic faces like mine, had recommended a bowhead quota of 24 whales, a number unsatisfactory to the Eskimos, who promptly walked out of the conference declaring themselves free of IWC jurisdiction

Neakok had a low opinion, too, of the U S scientists who conducted this spring s bowhead census The scientists had counted 1734 whales and had estimated the population at between 1783 and 2865, but they had spotted only 19 calves, from which they extrapolated a total of 29—an alarmingly low recruitment figure

"There was a May 1st cutoff of the count, just when the calves start coming through,' Neakok told me, having decided to try to explain after all "The mothers and calves usually come by when it's most difficult to hunt them It's hard then because the ice is dangerous The ice is rotten, disintegrating from the heat It's shaved by the current Sixty-centimeter-thick young ice can get shaved to two centimeters in an hour We can live on the ice when it's only ten centimeters, and you can see through to the waves underneath. For a hundred thousand years we've been compiling information We don't have to use figures The language has names for all these ice conditions We evolved in that manner We can't express it It's racially uncommunicable

"The people doing the count were from National Marine Fisheries They had brand-new snow machines and gear But they didn t know how to live on the ice They didn't understand the danger We had to tell them when to go inland

"After they finished the land count, they started a half-assed aerial count Airplanes are noisy Everyone knows—every Eskimo, even a child—that a mother and calf react to noise. Of course they didn't count many calves

"We have our own research program We're going to educate the scientists The Eskimos and the whales are here because of the success of Eskimo management "

Later, as we got up to leave, I asked Neakok how he liked London For a moment he didn't answer. Clearly he found it a foolish question

"It's like any white man's town " he said finally "More barbaric than the place we come from. "

TIME ZERO

SPACE

By Mark R. Chartrand III

At the tone, the age of the universe will be 14.5 billion years. Beeeeeeep!

That figure was obtained by astrophysicists Demosthenes Kazanas, David N. Schramm, and Kem Hainebach in a recent study that, they think, represents the best estimate so far of the elapsed time since our universe was formed in an explosion commonly called the "Big Bang." Previous estimates, reached by using a variety of methods, have ranged from 8 billion years to 20 billion years. Now Kazanas and Schramm, of the Enrico Fermi Institute of the University of Chicago, and Hainebach, of the Lawrence Livermore Laboratory, have put together all available evidence in a consistent way. They believe that the true age of the universe is within a billion years of their estimate—a mere blink of the eye viewed from the perspective of cosmic time.

The universe we now inhabit is mostly empty, with an average density of about one hydrogen atom for every cubic meter of space. Most of that material is gathered into galaxies, of which our Milky Way is just one. A major unsolved question is how much matter is diffused throughout space between the galaxies.

As we look outward beyond the Milky Way we see distant galaxies flying away from us. This motion of recession causes the famous "red shift," so called because the spectral lines of receding astronomical bodies shift toward red wavelengths. The curious thing is that the more distant galaxies are rushing away faster than the nearer ones. There is a constant ratio between speed of recession and distance, called the Hubble Constant after Edwin Hubble, who first discovered the effect. A galaxy recedes at a speed of about 17 kilometers per second for each million light-years it is distant. The most distant things we have seen are 10 to 15 billion light-years away and are retreating at 91 percent of the speed of light.

(By the way, when we see all galaxies receding from us, it does not mean that we are in some kind of preferred center of the universe. Astronomers in any other galaxy would see the same thing—as if *they* were at the center. But there is no center. The illusion is caused by the geometry of the universe.)

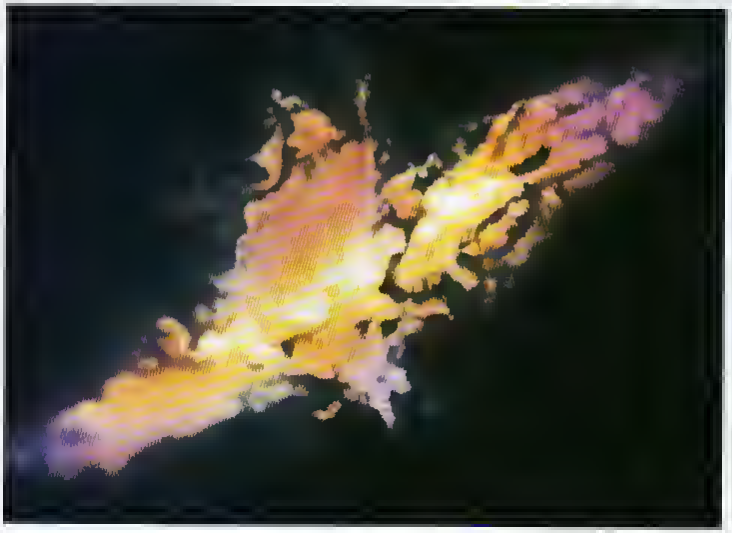
We also know that the chemical composition of the universe is fairly simple. There are 92 natural elements, but about 75 percent of everything is hydrogen, the simplest element, and about 25 percent is helium, the next simplest. Only about one atom of every thousand to ten thousand is a heavier element. (Because of their scarcity, astronomers often call these heavier elements "metals," even if they are not metallic. It is a convenient shorthand.)

Finally, we live surrounded, immersed, in a sea of gravitation and radiation. In addition to starlight and other forms of radiation from cosmic bodies, all of space is suffused with a whisper of radiation left over from the tremendously energetic genesis of the universe. Detected first in 1965, this fossil radiation shows that there indeed was once a Big Bang.

Some 14.5 billion years ago there was the cosmic egg. Some have called it the primeval fireball. What came before and how large it was are not known—and are perhaps unknowable. It exploded, if so tame a word may be used for the beginning of all we know. Temperatures and densities of this beginning are inconceivable but not incalculable. We can calculate what the conditions were at a time about a hundredth of a second after T=0. For a while the universe was mostly energy, but as it expanded it cooled, and matter formed from the energy (remember $E=mc^2$).

After about half an hour the primordial chemical elements, mostly hydrogen and helium, formed. In addition, a small amount of deuterium, hydrogen with an extra neutron (sometimes called "heavy hydrogen"), was formed. The temperature then was some 300 million degrees Kelvin.

Slowly the universe cooled off, and not much happened for about 700,000 years. Then, when the temperature decreased



Helmut Wimmer

Exploding galaxy (above) is thought to give birth to new solar systems, much like our own.

to a few tens of thousands of degrees complete atoms began to form (Above these temperatures only atomic nuclei can exist.)

The amount of deuterium and helium formed in the universe's first few minutes would depend on the exact temperature and pressure of the fireball. By measuring the amounts that exist now and extrapolating backwards, cosmologists get an idea of what the birth pangs of the universe were like.

The earliest stars to form were those we now see in the vast spheroids called globular clusters, which are found in the outskirts of galaxies. In forming, they used up all the primordial gas in those regions, and so star formation stopped long ago in globular clusters. These stars presumably retain in their outer layers the original composition of the universe.

Deep in the interior of stars, however, nuclear fusion "cooks" hydrogen to form helium and other heavier elements, up to the atomic weight of iron. This occurs only in the core of stars whose temperatures reach millions of degrees. A few extremely massive stars, at a later stage of their evolutionary life spans, explode and flare briefly into supernovas, each as bright as the entire galaxy of which it is a part. Elements heavier than iron are then formed and spewed outward into space.

In the flat disk of our galaxy, as well as in other galaxies, there is still a fair amount of primordial gas left. It has been enriched by the supernovas, and so later stars are also enriched. Our own sun is a second- or third-generation star and so cannot be used to study primordial abundances.

We must look back to the globular clusters for answers. Their evolution depends on their original amounts of helium and heavier elements. These abundances are some of the data that Kazanas, Schramm, and Hainebach used to find out how long the universe has been around.

AN OPEN UNIVERSE

Another important factor in the discovery of its age was the present density of the universe. This is difficult to determine, but some idea can be gained from "weighing" galaxies in clusters. If a galaxy is not to fly away from its cluster there must be a certain amount of matter in the galaxies to bind them gravitationally. We can measure their speed with respect to one another and thus infer the amount of material in them.

The same sort of thing is done for the universe as a whole. A major question is whether the universe is flying apart forever or whether it will eventually stop and contract. One number determines which is the case: the average density of the universe. The critical density, the dividing line between an open, ever-expanding universe, and a closed universe that will eventually confract is about 3 hydrogen atoms per cubic meter. Current estimates of matter within galaxies show that the present density is between 6 percent and 30 percent of the critical density, so the universe is open. It will continue to expand.

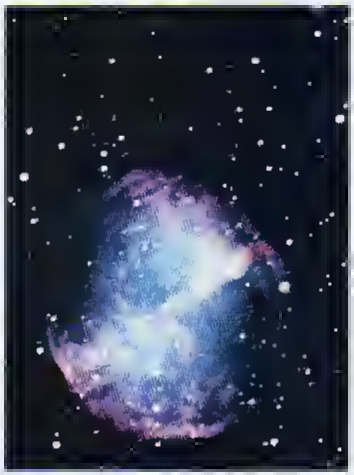
Kazanas et al used these estimates to help pin down even further the age of the universe. They essentially drew a graph of age versus the primordial amount of helium. Then they plotted on the graph the best estimates of the amount of heavy elements in the universe and the average density found from studies of galaxies. Putting all this data together led them to conclude that the best estimate of the age of the universe is between 13.5 and 15.5 billion years.

They claim that if in the future the measured age of the universe turns out to be outside this range, we will have to seriously examine our standard models of the Big Bang. The only major potential source of error is the possibility that there is a lot of unseen material not in galaxies, but between them.

Some of the first evidence showing intergalactic material came from the UHURU satellite, which found that some superclusters—clusters of clusters—of galaxies showed intense x-ray emission. Astronomers at the Center for Astrophysics in Cambridge, Massachusetts, think that the x-rays come from an intensely hot gas lying between the galaxies. They estimate that the amount of gas may be five to ten times the amount of material in the galaxies themselves. That may, if confirmed, raise the density above the critical point and necessitate a reevaluation of our age estimates. As is true in every branch of cosmology, more observations are needed.

So far, though, the estimate of 14.5 billion years, plus or minus a billion years or so, is consistent with our best observations and theories. One check on the result is that it provides an estimate of the Hubble Constant of 18 kilometers per second per million light-years. For the field of cosmology, that is in amazingly close agreement with previous observations.

But more amazing yet is that in the last third of the age of the universe, certain chemicals have combined in hospitable places to produce creatures, perhaps not unique, that can look up into the sky and contemplate their origin. ∞



NASA

NASA

The Sagittarius star cloud (top) is a densely populated region of stars found toward the center of the Milky Way. The Dumbbell Nebula (below), located on the farther outskirts of the Milky Way, is thought to be an expanding cloud of gas originating from a star in later stages of its evolution. The gaseous shell is formed by the star expelling its outermost layers into space.

UNREASONABLE LEAPS

LIFE

By Dr. Bernard Dixon

An abiding tascinetion of science is its propulsive creativity. Why does the occasional lone genius succeed where a lavishly funded mission-oriented project has failed? Even odder why should Alexander Fleming, helf a century ago, have made his mightily significant discovery of penicillin—yet leave its consummation to Howard Florey and Ernst Chain more than ten yeers later?

Part of the explanation, *part* of the dramatic contrast between what Thomas Kuhn terms "normal science" and the scientific revolution, must lie in freedom of the mind. Despite their command ot conventional knowledge, some great scientists, like some great artists, remain intellectually unfettered, able to take giant leaps of unreason.

One of the most intriguing insights into closed and open minds eppeared in a survey presented to the British Association by Ronald Stansfield ot the City University, London. Its conclusion was grim: many trainee scientists already suffer from "trained incapacity," such that theoretical learned aftitudes dominete and even eclipse natural talents for original observation.

Ronald Stansfield did something very simple. He asked 75 university science students to "look at a tap slowly dripping water into a bowl and write a description of what you see as you watch the water coming out of the tap and joining the water in the bowl below." That was all.

When the results came in, Stansfield found that about half of the undergraduates had written imeginative rather than factual sentences. One of them reflected upon the Chinese water torture, images of which had passed through his head as he watched the tap dripping. Really disturbing, however, were several of the reports by students who genuinely set out to write objective accounts. Many contained meterial that could not possibly have been gained by simple observation. For example, "The droplet essumes a spherical shape, surface tension providing an elastic bag to contain the water as it falls." It is, in tact, impossible to see simply by watching water dripping that the droplets are spherical. The concept of surface tension end the bizarre idee of an elastic beg must have come from scholastic instruction, not from earnest observation.

Worse was to come. When Stansfield asked 13 students whether, since doing "O" level exams at school, they had written about what they had observed in the laboratory (in contrast to writing down what some authority had told them they *ought* to see), not one claimed to have done so. Learning the correct answers from teachers and textbooks still, apparently, counts for more than direct observation. Could this simple, unpalatable fact—this discouragement of native wit and senses—explain the closed minds of so many scientists when confronted with the unexpected?

BLOODPRINTS

Few of us bequeath pieces of tissue that will be exploited by future generations. A substantial number, however, do provide samples of another bodily material that is retained for decades in laboretories. Blood, particularly that which we give to help diagnose an illness, and that can thus be identified by neme, is a vast store of potential information. Epidemiologists have alreedy applied "serological archaeology"—the search for telltale antibodies in blood—to trece the nature and spread of past plegues such es the 1918 influenza pandemic. Decades hence, technicians may be able to use the same method to tind out whether you or I suffered measles, tuberculosis, or venereal disease.

Looking tor chemicel clues in his own blood (preserved by freezing), Dr. Robert Shope established that part of the "Shope papilloma virus" had been incorporated into his DNA 30 years earlier—one of the first, albeit unintentional, experiments in genetic engineering. What, then, could future scrutineers learn from the hereditary material in stored blood samples? Nothing from red cells—they are unique in that they lose their nuclei when they mature. But the white scavenger cells are nucleated, and as the business ot "sequencing" DNA becomes increasingly sophisticated, there seems little doubt that tomorrow's genetic monitors will find out a good deal about the living bodies from which they came. Antigens on the same cells will betray much about our ancestry and identity. Crimes may be solved many years after the event.

DECRYING ORTHODOXY

Speculating thus brings an apt moment to welcome *Speculation in Science and Technology*, published by the Western Australian Institute ot Technology. This is a splendid effort, within the format of a learned journal, to seduce orthodox scientists into taking heterodox risks of thought—and to hell with the consequences. "Archaeological chromatography" is one bizarre discipline that makes its appearance in the first issue. Chromatography is a well-established method ot seperating different materials from a mixture. The simplest demonstration of it is when one end of a piece of blotting paper carrying a dried spot of blue ink is dipped into water. As the water rises, it seperates out two or three different dyes from the ink, which migrate at different rates and thus appear as distinct bends of color.

Professor John McCarthy of Stanford University applies the same notion to archaeology. A castle crumbles to pieces, and the site is rained on. The water dissolves materials from the building and deposits them in the ground beneath. Subsequent rains move them farther down. Thus the earth underneath a ruin may contain well-ordered information about substances and even objects the building contained. In principle, we could retrieve this information by analyzing material trom different depths below the site.

John McCarthy's idea is not, I believe, as barmy as it will sound to some. Conservationists lamenting the glory that wes Greece might do well to engage heterodox chemists, not just excavationists to study the ground beneath their feet. DO

MOONGLOWS

STARS

By Patrick Moore

In our present phase of post-Apollo enlightenment, it would be wrong to suggest that all the mysteries of the moon have been solved. Curious things, seen now and then—faint glows, flashing lights, patches of "mist"—still provoke argument and continue to enlist scientific inquiry and speculation.

Men have been to the moon, brought back samples of rocks, monitored the recording devices left behind, absolutely no trace of life has been found. We are confident the moon has always been biologically sterile. We had expected a total lack of atmosphere on the moon, but were disappointed to detect no 'watery" material in the rocks. Lunar surface eruptions of volcanic proportion, possible sources of the moon's craters, would have to be consigned to ancient history: the moon looks much the same today as it did when the first telescopic observations were made of it in 1609. Even so, and however quiet, many astronomers readily concede that the moon is not so inert as was once thought. In fact, can we be sure that *nothing* ever happens there?

Historically, bright lights have been described on several occasions. Sir William Herschel, in 1787, saw several points he believed to be active volcanoes. Modern observers have described faint glows, sometimes red, which are now generally known as TLP—Transient Lunar Phenomena—(a term I coined myself).

Many who study the moon with powerful telescopes have reported these elusive glows or local obscurations. I have done so myself on several occasions, though the procedure requires many hundreds of hours of fruitless searching before even a glimmer can be spotted. Following the War, most TLP reports came from amateurs but this was understandable enough. Professional astronomers were not then particularly interested in the moon; it was regarded as somewhat dull and parochial. Far more important were the stars and distant star-systems (no doubt true enough). When the Space Age drew near, however, opinions changed, and the moon, in its accessibility, once more became newsworthy.

At the Crimean Observatory in the U.S.S.R., Nikolai Kozyrev was using the 50-inch telescope to observe the moon. He was interested in the TLP reports, and I had been in correspondence with him about them. Once he was looking at the large formation Alphonsus, which is an enclosure over 110 kilometers in diameter, with a central mountain and a system of cracks or 'rills' on its floor. Suddenly, Kozyrev saw a red patch not far from the central peak. It did not last for long, but he was able to obtain definite proof that *something* had happened. It was not the first time strange phenomena have been seen in Alphonsus. Even more interesting is Aristarchus, a 36-kilometer crater—the brightest object on the moon—which can even be seen when illuminated only by light reflected from the earth. Reddish glows have been seen here too, and the reports are too numerous to dismiss easily.

These odd lights are not confined to Alphonsus and Aristarchus. They appear elsewhere on the lunar surface, and most astronomers (though not all) are now convinced that the color spots are genuine. They are not always red. Some merely take the form of blurred patches, temporarily hiding the surface features beneath. Observers found that the lights were most common when the moon was closest to the earth (perigee), so that its crust was under maximum strain from earth's gravity.

In 1969, the first manned landings left recording equipment behind on the lunar surface. It was found that mild moonquakes do occur most frequently at the time of perigee, which may indicate a link between moonquakes and the transient phenomena.

Still, what then causes the lights?

We can certainly rule out conventional volcanic eruptions. Violent cataclysms on the moon ended at least a thousand-million years ago, when life on earth was still at a primitive stage. But there have been suggestions that such glows are due to the escape of trapped gases from beneath the lunar crust, an entirely credible theory.

Meantime, observers—both professional and amateur—are continuing to keep a close watch, searching for the strange, will-o'-the-wisp lights that appear so timidly from the density of lunar rocks. The moon has yielded up some of its secrets, but by no means all.

Photo Researchers

Some puzzlement remains as to what causes occasional patches of light on lunar surface

THE ARTS

TELEVISION

Battlestar Galactica is the most expensive series ever created for television. Its price tag averages nearly a million dollars per hour for the episodes seen this fall. The usual fees for a big budget series are compounded by an inspired move from creator/writer/executive producer Glen Larson. In signing John Dykstra, multiple Academy Award-winning special effects supervisor for *Star Wars*, Larson hired a formidable talent. Dykstra created the dazzling array of effects that highlight this otherwise pedestrian program, making *Galactica* the hottest new series of the season.

"Certainly nothing like this has ever been attempted before in television," Larson told me. "We tried to get the best people in the business to create our images, the most creative minds in the field, including Dykstra and a bunch of other people who've been involved in everything from *2001* and *Silent Running* to *Star Wars*." This "bunch" includes Dykstra's production team at Industrial Light and Magic (the special effects unit assembled for *Star Wars*), which was kept more or less intact for *Galactica*.

"Initially, I didn't want to do episodic tv," Dykstra commented, "but the challenge of the shows I'll be working on was to do something *really* good for television." Although he is leaving *Galactica* after seven episodes, Dykstra has created a "library" of special effects footage that can be endlessly rearranged. "I'm a little burnt out on this now," he told me, "but rather than simply walk away from it, I set up the three thousand individual elements that we shot of individual ships moving in individual directions so they can be put together in different combinations—as long as the scripts are out in time to do anything."

Producer Larson is planning to take the effects work even further. "We're not looking to do a good pilot and just cannibalize it forever," he said. "We've taken over a building in which we plan to build the most advanced special effects studio in the world. There we'll create new effects to keep that aspect of the show as fresh as the rest."

Star Wars special effects wiz John Dykstra. Says Dykstra: "The challenge of this show was to do something really exciting for tv."

Both Larson and Dykstra are aware of the dangers in trying to create anything new in prime time television. Regardless of the show's visual imagery, the series must survive on the quality of its characters and stories. Judging from the pilot and a visit to the set where one of the early hour-long episodes was in production, *Galactica* recalls a number of tv shows and feature films and thus will be very much in the mainstream of television drama.

An old hand at adapting popular film subjects for television, Larson produced such series as *Alias Smith and Jones* (its original episodes reminding one of *Butch Cassidy and the Sundance Kid*), *Switch* (*The Sting*), *McCloud* (*Coogan's Bluff*), and *It Takes a Thief* (from the film of the same name). There are similarities between *Battlestar Galactica* and *Star Wars* beyond the visuals, among them the use of costume-drama dialogue, props, and the central characters, who clearly parallel Luke Skywalker, Han Solo, and even R2-D2. *Star Wars*, of course, was equally guilty of "adapting" images and ideas from a score of films, including *Buck Rogers* and *Flash Gordon*, Japanese samurai films, *The Time Machine*, *The Creature from the Black Lagoon*, and *The Dam Busters*.

As can be expected, Larson is hoping to attract the fanatical "Trekkies," who religiously follow the oft-repeated *Star Trek* episodes. Larson is *hoping* to attract them but not counting on them for, despite a mass mail campaign to save *Star Trek* from cancellation by NBC, the Trekkies didn't constitute a large enough audience to keep it on the air.

"*Galactica* is an all-time challenger," Larson figures, "because the kids are naturally going to compare us with everything from *Star Trek* to *Star Wars*. Then there are the dyed-in-the-wool science fiction fans. We aren't going to do enough in that area to please them, either. We didn't want to limit ourselves because that would result in instant oblivion. Although the television version of *Logan's Run* came on television in the wake of *Star Wars*, and at the same time as *Close Encounters*, the excitement of the films didn't do it any good. Our concept is wide open. We can go in any number of directions with it, adapting it as we see fit. But regardless, a lot is riding on *Battlestar Galactica*. With our budget and talent, if we go under we'll set the TV sci-fi field back a long way."

The elements that make up *Galactica* are not merely drawn from mainstream science fiction. One observes bits and pieces of everything from *Davy Crockett* and *Prince Valiant* to *The Bridges at Toko-Ri*, *War of the Worlds*, even *Mod Squad*. The dialogue is fairly reeking of supercilious self-importance, but Dirk Benedict, playing the Han Solo-ish Lt. Starbuck, has the talent to harpoon the most leaden scenes. "You certainly have a way of cutting through the felcagarb," he quips to the "sociolater" with a heart

of gold after he rescues her from some fellow passengers in the pilot episode. One almost expects her to ask him, as he draws her to a dark spot for some pre-action romance, "Will you still respect me in the next solar system?"

Having experienced a great deal of creative freedom on *Star Wars*, Dykstra must have felt more than a bit confined at times on *Galactica*. Even with the position of line producer, an added inducement to his regular tasks as director of special effects, he still came up against the bottom-line decisions of the executive producer. "It's Glen Larson's show, his story," Dykstra conceded. "I did whatever I could whenever I could to support him when we agreed—and argued with him when we disagreed. He wrote it. He supervised the editing. He was there for the dubbing. I was there as much as I could be to say 'Oh, this is really terrible' or 'That's good,' and any time I came across anything that smacked of *Star Wars*, I tried to get rid of it. But some of the things are just part of the genre, and there's no way to get rid of them. Once they were in the film, I just said, 'Well, screw it.' That's not really a rip-off from *Star Wars*. It's really just part of the same genre, and it's important to the show for it to be there."

The areas of *Galactica* where Dykstra's hand is most evident are those where he was left relatively free to pursue his own personal tastes and visions. The remarkable flying sequences fulfill the promise of *Star Wars*'s "dogfights." Where the starfighters seemed confined to very strict maneuvers in the film, they appear more realistic here, able to dip, glide, and turn in exceptionally fluid flight.

Although it was produced for U.S. television, *Battlestar Galactica* was edited down to two hours and released as a feature film in Europe and Canada. While visiting Universal Studios (production and distribution company for the series), I was able to see the film by invitation of the Mattel Toy Company, which is merchandising a line of toys and model kits based on the series. Having spoken to Dykstra and Larson before seeing the film, I was aware of its shortcomings. Made for television, it's unfair to judge the visuals on a big screen, but the quality of Dykstra's work is evident throughout. Those faults he mentioned in our conversation were barely noticeable.

"I'm very dissatisfied with the quality for theatrical release," Dykstra said. "It's bothersome. The scope of a show with this quantity of special effects material is not made for a forty-foot screen format. There's a myriad of things that are sophistications for television. They make it work on tv but are wrong for a feature release."—*James Delson*

John Dykstra's special effects for Galactica *bring space to life (below), a villain (top).*

FILM

Given Hollywood's exhaustive efforts to mirror our times, a new blockbuster about cloning comes as a surprise to no one. Cloning caught the human imagination months ago and for good reason; it suggests personal immortality. So defines the driving force behind *The Boys from Brazil* from 20th Century-Fox, starring Gregory Peck, Laurence Olivier, and James Mason.

In his 51st film, Peck plays Dr. Mengele, the Nazi war criminal who masterminds the cloning of 94 little Hitlers in an attempt to establish a Fourth Reich. As we began our interview, he explained the cloning process, including the way it was used in *The Boys from Brazil*. "In laymen's terms, which are the only ones I can use to describe the process, a human cell is taken from the donor." He is careful with his words, thinking out the sentences one at a time to make things as clear as possible. "The cell can be from a blood sample, a tissue sample, or from bone marrow. The cell is inserted into a female egg that has been 'hollowed out,' which means the genetic characteristics of the mother have been removed. The egg is then implanted in the female womb. It produces an embryo that eventually becomes a child, *entirely* the product of the donor. It is not artificial insemination, the child is a true clone, the genetic duplicate of the donor."

"It's cellular xeroxing," I respond, drawing a smile from Peck. "That's it, yeah," he says. "Doctor Derek Bromhall, the technical adviser on the film, has actually done some incredible work in the field. We used his lab equipment in the sequence where I'm in my secret laboratory in Paraguay performing some terrible operation on one of the women who serve as 'incubators' for the Hitler clones."

In reality, cloning has been carried through to completion only on lower orders, such as axolotls and frogs, but Bromhall gained worldwide recognition for his work in Oxford, England, where he cloned a rabbit through to an embryonic state. Unable to finish his work because of a lack of funds, Bromhall nevertheless proved the viability of the experiment. Peck is certain that it's the most advanced cloning work that's ever taken place.

"Since I had to simulate this operation on screen," Peck reassured me, "Bromhall was there to see that everything was as it should be." But how did this cloning scheme arise? Instantly changing his posture, straightening up to sit on the edge of the couch, Peck transforms himself into Mengele, "The Angel of Death," affecting a convincing German accent with a clipped, formal, lifeless voice.

"On a certain day in 1943," Peck/

Mengele says, each word as brittle as if it were chipped off a marble block, "*he* allowed me to take half a liter of *his* blood and some skin tissue. We preserved and protected the samples for twenty years, until the technique was perfected. Until I was *sure* I could make the clones properly." I am growing visibly uneasy. Seeing this, Peck drops the accent and continues. "Twenty years later, Mengele has 94 women brought to his laboratory in Paraguay. He plants the Hitler-impregnated eggs in them to be brought to term, the women acting as incubators until the children are born."

Creating life is one thing, but how do the infant Hitlers get a proper start in life? "Once they're born," Peck explains, "they're distributed to Nazi agents around the world by means of a secret organization of adoption agencies. The infants are shipped out of Brazil, hence the film's title. The agents have sought out childless, but "decent" married couples who would like to adopt but can't because the father is too old. This *works* for the Nazis, because the families cannot tell anyone of the adoptions for fear of having their children taken away.

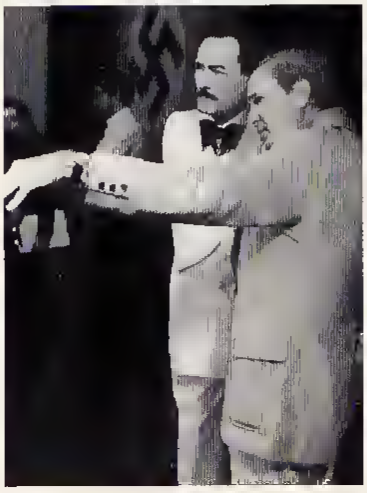
"The families have been chosen because they fit into a specific profile designed by Mengele to duplicate, as closely as possible, Hitler's home situation. The fathers are 52-year-old civil servants, and the mothers, 34-year-old housewives. In addition, the households, all hand-picked by Mengele, provide the same economic, religious, and social environment as Hitler had. The couples receive these black-haired, blue-eyed healthy babies from what they take to be a black-market ring. They're happy. They have a child. They don't have a clue that this is a little clone of Hitler.

"The diabolic nature of the scheme is revealed right at the beginning of the film, when the boys are fourteen. The fathers must die, just as Hitler's father died when *he* was fourteen. The clones must undergo the same psychological trauma as their genetic father. Under Mengele's plan, it is necessary to organize and execute 94 assassinations in Austria, Holland, England, Germany, America, and so forth. The deaths must appear accidental. They must leave the children fatherless and, one would assume, a burden to their mothers.

This year we've already seen rumors and a book about supposed human clone experiments, but all have been unsupported by factual evidence. Regardless of the truth, however, the amount of publicity generated by newspaper stories, interviews, and other material available to the public has created a kind of "clone fever" in the U.S. The release of a film with cloning at its core is amazingly well timed. "Oh, it's all to the good," Peck admits. "Johnny Carson has a cloning joke almost every night now. Everybody's talking about it, so sure, we're hoping it'll help us out."

Peck's forthright image, the man of conscience forever struggling to uphold the best traditions of honor and decency, might finally be broken with his portrayal of Mengele. Still at large and living in relative luxury in Paraguay, the unrepentant Nazi was responsible for the deaths of 300,000 people at Auschwitz concentration camp during World War II. Now under the protection of the Paraguayan government, Mengele is currently advising them on their internal affairs, most notably the extermination of their indigenous Indian tribes. The character is not unlike what we imagine Hitler might be like today if he were still alive. Mengele's name was not changed. As Peck says, "We would be *delighted* if he would start a lawsuit against us. Nothing could please us more."

—*James Delson*



Photographs by Cecil H. Peck

Peck as a mad scientist who attempts to clone Hitler in the new film The Boys from Brazil

BOOKS

One year after the introduction of the antiaging pill, traditional religions warn against death control, a campaign similar to the earlier crusade against birth control; the economy is destabilizing as employees desert their jobs; government has moved in to monopolize distribution of the pill; and the divorce rate is increasing. Ten years later, organized religion is disgraced and disbanded; virtually everyone is taking the pill; divorce rates soar, the economy is staggering because of an increase in absenteeism, and all dangerous sports are phasing out as people everywhere reorient themselves to the quest for physical immortality.

This is not the plot of a new SF novel. It is part of a scenario developed by 31 graduate students in the department of future studies at the University of Houston given the assignment of predicting how a longevity pill would change our society.

Although *Omni* does not regularly review articles, it is worth making an exception for "The Impending Society of Immortals," by Jib Fowles, in the June 1978 issue of *The Futurist*, where this study is described and the group's predictions are given for 20 years and 50 years after the introduction of the life-extension pill. It has become as stale as King Tut's socks to repeat Alvin Toffler's warning that since there are more scientists alive today than in all previous history, we should expect more sociotechnological change in the next generation than we saw in *all* previous centuries; but Fowles's summary of the University of Houston study gives one a gut-level feeling of how one possible breakthrough can produce in just a few decades more social upheaval than Galileo, the Industrial Revolution, the Wright Brothers, and the atom bomb did in three centuries.

That such a longevity pill (or some alternative antiaging device) is imminent is the thesis of Albert Rosenfeld's *Prolongevity* (Knopf, New York). Rosenfeld, science editor of the *Saturday Review*, has done his homework; the bibliography lists over 500 scientific papers, and he seems to have personally interviewed nearly every important researcher of life extension in the United States. While the degree of optimism varies among the authorities cited, there is a solid consensus that we already understand a great deal about what causes aging and are close to understanding how to reverse the process. Some of the investigators have already achieved an impressive amount of life extension and rejuvenation in laboratory animals, and they all expect to achieve much more—perhaps not by next Tuesday but certainly in the foreseeable future.

No More Dying, by Joel Kurtzman and

Phillip Gordon (Dell, New York) makes a good companion piece to *Prolongevity*, since each book includes a few areas of research that the other inadvertently overlooks. The jolting difference between the titles does not reflect any real disagreement between authors: both texts deal mainly with those who are seeking longevity, rather than with the ultraradicals who admit they are aiming for immortality—and both authors agree that antiaging research will eventually go beyond longevity to immortality.

In attempting to guesstimate the timing of the longevity revolution, it is useful to think back 20 years to 1958 and ask: What would have seemed a reasonable scenario for the opening of the Space Age? Obviously, only the most radical would have predicted that *Sputnik* would be aloft within a year and that the first man would walk on the moon within 11 years. Similarly, going back 40 years, it was clear to many scientists in 1938 that the Atomic Age was coming, but few indeed would have expected the first chain reaction in five years and the first nuclear bomb in seven. Of course, the life-extension problem may be harder to crack than the atom or space flight, but Dr. Benjamin Schloss of the Aging Research Institute in Van Nuys, California, has already adopted the slogan, "An End to Aging by 1989." He seems radical now; might he seem conservative by 1981?

The possible chaos resulting from a quantum jump to immortality is the theme of the most disturbing satiric novel of the year, Alan Harrington's *Paradise I* (Little, Brown, Boston). The predicament Harrington has imagined is indicated by these figures: roughly 67 people die every minute, about 100,000 every day, approximately 36 million a year. What happens if a group of brilliant but politically naive scientists announces a successful immortality pill but have only a limited supply for the first few years? In Harrington's mordant novel, every special interest group and every conniving scoundrel on the planet attempts to steal the formula; the government staves off anarchy by establishing a monopoly on distribution (as in the University of Houston projection), but charges of governmental corruption and favoritism lead to steadily rising insurrection, until—well, until the next twist of a plot that it would be unfair to reveal in full. Harrington writes with an eloquent wit superior to Mailer, with a gift for black comedy comparable to Vonnegut, and with an obvious sense of urgency. It is no secret that the scientists in this fable are based on real researchers alive today (whom you might recognize under their real names in the books of Rosenfeld and Kurtzman-Gordon), everything Harrington imagines just might happen, if we stumble into immortality backwards, philosophically unprepared for the death of Death.

Harrington is also raising ultimate questions in *The Immortalist* (Celestial Arts, Millbrae), which carefully considers every argument in favor of death offered by philosophers or theologians and then tears them apart with relentless logic and savage sarcasm. Originally published in 1969, *The Immortalist* received several rave reviews (including one by Gore Vidal) but then sank into oblivion because it was simply too far ahead of its time. This new edition, nine years later, may finally attract the audience deserved by a book that dares to open with the mind-boggling sentence, "Death is an imposition on the human race, and no longer acceptable."

Even further out is another book with

"Is it nucleic-acid mysticism to suggest that current breakthroughs in life-extension sciences are inevitably synchronous with the emergence of space technology? Life extension is unthinkable without space frontiers."

the same title. Heathcote Williams's *The Immortalist* (Open Head Press, London). Williams, generally regarded in England as one of the most brilliant dramatists alive but not yet widely known over here, has written *The Immortalist* as a script equally suitable for theater, tv, or even radio, since there are only two characters and all they do is argue. The Immortalist claims he is 278 years old; the reporter skeptically challenges him; the debate is as resonantly ambiguous as *Waiting for Godot* and often as screwball as the Marx Brothers. The Immortalist may be a mad imposter, a clever put-on artist, or exactly what he claims to be; the audience can never be quite sure. The methods of extending life urged by the Immortalist range from ancient alchemical and occult ideas through recent scientific proposals right out of Rosenfeld, Kurtzman, and Gordon to a kind of anarchist metaphysics reminiscent of William S. Burroughs. (We only die, according to this argument, because we allow capitalists and governments to take time from us; this is presented with the same mixture of intensity and absurdity as all the rest of the debate.) At the end, the Immortalist is blatantly inciting the audience to demand further antiaging research, and his last words to the presumably reeling reporter are: "There are people alive now who are never going to die. Put *that* on the news."

One can only wonder why there are no American playwrights dealing with such important scientific-social issues.

Woody Allen obviously speaks for most of the churchless and faithless when he says: "Some people want to achieve immortality through their works or their descendents. I prefer to achieve immortality by not dying."

—*Robert Anton Wilson*

SPACE + INTELLIGENCE = LIFE EXTENSION

"Microbiology and genetics are deciphering the DNA code thus providing the possibility of rejuvenation and indefinite Life Extension. Biochemists assure us that there is no scientific reason why a healthy person cannot extend her or his life span several years. All of the religious and philosophic systems constructed by human beings have concerned themselves with the basic issue of death. The Western religions have offered immortality in a post-mortem, heavenly realm to be attained by the socially virtuous. The Oriental religions, addressing themselves soberly to the gloomy fact that human life ends inevitably in sickness, senility and death, have offered passive resignation and a detached individual yoga.

Life Extension, however, without Space Migration and Intelligence Increase is clearly an impossible nightmare. Until now it was necessary for post-menopausal humans to die and get their bodies off the scene to make room for the new arrivals. Is it nucleic-acid mysticism to suggest that current breakthroughs in life-extension sciences are inevitably synchronous with the emergence of space technology? Surely life extension would be unthinkable without space frontiers. And with limitless space available immortality becomes a migratory tool. *No rejuvenation without migration!* could well be the motto to protect us from the horrid possibility of John Denver and Frank Sinatra at age 500 still re-appearing at Las Vegas.

Extended life span will obviously require a sudden quantum jump in neural efficiency, the knowledge of how to reimprint realities, to create new identities, to absorb new mental styles, to learn new tricks.

If there is any goal beyond narcissism for the new generation of hedonic consumers freed from the constrictions of the work-aesthetic and the old-time religions, if there is any social or genetic purpose to this new, self-conscious individualism, perhaps it is in preparation for the greatest challange our species has faced in millennia—the expansion of space and time."

—*from* Neuropolitics *by Timothy Leary with Robert Anton Wilson and G. A. Koopman*

BETTY HILL

UFO UPDATE

By James Oberg

Among the most influential and widely known UFO incidents is the story of Barney and Betty Hill, a middle-aged New Hampshire couple who in 1961 were returning from vacation. Driving late at night through the White Mountains, the Hills encountered a UFO whose alien occupants reportedly took them on board and subjected them to a thorough medical examination.

Several factors seemed to argue strongly in favor of the authenticity of the case. First, the narrative of the abduction was not consciously remembered by the Hills but was extracted by a psychiatrist using hypnosis. This fact seemed to rule out any chance of a deliberate hoax. Second, one particular piece of information (similarly retrieved from Betty Hill's subconscious) was a "star map," which was subsequently deciphered by experts to indicate the alien ship's home solar system.

Over the years, the "Barney and Betty Hill UFO Abduction" has become accepted as a 'classic" close encounter of the third kind. Since then, dozens of similar cases have been reported. A best-selling book (*Interrupted Journey* by John Fuller) and a made-for-tv movie (NBC's *UFO Incident*) have boosted the case's fame. Betty Hill (Barney died in 1969) has become a popular feature at UFO conventions nationwide.

Two questions come to mind concerning this famous case. First, can anything really be concluded about the authenticity of the original incident? Second, have UFO organizations and the news media generally handled this case in a responsible fashion?

While no final conclusions can be drawn (as in most UFO cases there is enough uncertainty and doubt to hide the Seventh Fleet), some very interesting insights about the UFO phenomenon can be gained by examining the Hill incident.

The case would almost have to be labeled authentic if the hypnotic interrogation of the Hills had turned out to be based on true subconscious memories of real events. Also, the case would be very strong if the astronomical information revealed in Mrs. Hill's "star maps" was valid. And, of course, any corroborative testimony on the part of other possible witnesses would lend further credibility.

Indeed, as reported in the books and magazines that cover the Hill case, all these criteria have been satisfied. But have they really been?

Hypnotic regression (or abreaction) can be a useful tool in psychoanalysis and has been gaining wider acceptance as an interrogative technique in police investigations. Cooperative witnesses can recall details about an event they may have forgotten or may never actually have noticed consciously.

But the technique has its pitfalls. A subject in the highly suggestible state may actually concoct fictitious details or an *entire imaginary theme* to please the subconsciously sensed desires of the interrogator.

Researchers in California recently hypnotized subjects with no previous UFO experiences or interests and asked them leading questions about a nonexistent UFO abduction that the subjects were led to assume they had just undergone. They responded with a wealth of details conjured up from their imaginations. The stories sounded no different from any of the classic abduction cases already on record, including Betty and Barney Hill's.

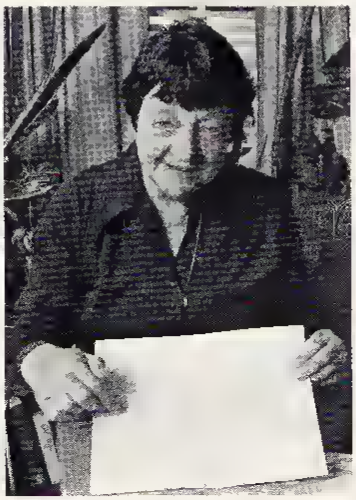
Dr. Benjamin Simon, the Boston psychiatrist who conducted the hypnosis sessions with the Hills 15 years ago is still convinced that the entire UFO abduction story was this kind of phenomenon, an innocent fabrication based on subconscious anxieties and vivid imaginations. Dr. Simon, whose psychoanalytic expertise is generally portrayed as the backbone of the Hill case's authenticity, does not believe the incident as reported ever took place!

Under hypnosis, Betty Hill drew a pattern of dots, lines, and circles that she said was a star map shown to her by the UFO commander. Several years later, an amateur astronomer in Ohio produced a view of nearby stars that seemed to match Betty's drawing. Astonishingly, the map's viewpoint was from deep in space, looking back at our solar system. Most of the identified stars on the map were similar in size and brightness to our own sun, although such stars (the only kind likely to have planets with intelligent life orbiting them) are a distinct minority in the galaxy.

The alien home system was identified as a double star called Zeta Reticuli.

Skeptics claimed that an "identification" of the alien world could be made with any random collection of dots and lines and that the predominance of sun-like stars on the decoded map should not have been surprising since to shorten the work all others had dropped from consideration. Some sun-type stars should have shown up but didn't; the remaining dots on the drawing were assigned to handy non-sunlike stars or dismissed as "background" decoration.

With that, any number of different (and mutually exclusive) map interpretations could be made. And so they have. At last count, four different interpretations had surfaced, all very convincing.



Betty Hill, whose close encounter of the third kind made UFO history, holds star map that depicts solar system of her alien hosts

It's also odd that Betty Hill recalls her UFO abductors telling her that earth is off the beaten galactic track and is rarely visited. Where are all those other UFOs coming from?

Mrs. Hill's ability to accurately reconstruct events and details became suspect when UFO investigator Robert Sheaffer showed that she was unable to draw a reliable chart of the alleged UFO's position in the sky. In place of the moon and two bright planets that were actually there, the Hill account shows the moon, a bright planet, and the "starlike" UFO. Sheaffer concludes that the original UFO sighting, which so frightened the sleepless Hills, was a not uncommon "car chasing UFO" phenomenon caused by the sporadic appearance of the bright planet Jupiter from behind clouds.

As for the current credibility of Betty Hill, she has become something of an embarrassment to the UFO movement. Her latest stories tell of a secret UFO landing field, of her car being blasted by a UFO's heat ray, of UFOs with their undersides painted to look like ordinary airplanes, of the local plunderings of a supernatural chicken mutilator, of her neighbor's levitating cat, of her own precognitive and clairvoyant ESP powers, of her continual harassment by sinister government agents, of the visit to her home by the capricious poltergeist of a dead six-year-old orphan, and other equally unbelievable tales. UFO buffs find these fables hard to swallow, but they swallow hard and point to the details of her original testimony. Skeptics suggest these new stories simply underline her vivid imagination and her propensity for fantasizing whether conscious or under hypnosis.

Moreover, studies critical of many aspects of the original Hill abduction have reportedly been circulating among pro-UFO groups for several years. According to people who claim to have seen these documents, they are stamped with the UFO equivalent of TOP SECRET. That is, there are embarrassing facts about the original Hill case that some UFO groups believe the public is better off not knowing.

Defenders of the original Hill abduction case dismiss Dr. Simon's incredulity by suggesting that the Boston hypnotist was unaware of other similar reports and thus believed the Hill testimony was an anomaly. Proponents defend the legitimacy of the decoded star map (but they disagree on *which* interpretation is the legitimate one). They believe there *were* many corroborative radar reports of UFOs that night, though the reporter who revealed that information in a local newspaper has since lost his notes and cannot now say where he learned those facts.

So there is adequate uncertainty to warrant further study of the Hill encounter. What is apparent, however, is that the most publicized accounts of this case are heavily biased in favor of its unsolvability, even to the extent of deliberately helping the case stay "unsolvable" by slanting key pieces of evidence and omitting others.

As long as this remains the standard approach to UFO documentation, so will UFOlogy remain an unborn science. The Betty Hill case is an excellent touchstone against which such standards of behavior can be measured.

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Ex-astronaut L. Gordon Cooper has become something of a celebrity recently with his tv talk show accounts of personal UFO sightings in Europe and California in the 1950s and his present cooperation with international UFO investigators.

Aerial Phenomena Research Organization

Books and magazines are full of detailed accounts of Cooper's encounters with UFOs in space during the *Mercury* and *Gemini* programs.

An exciting and provocative UFO revelation attributed to the astronaut appears on the package of a "Close Encounters Alien Doll," distributed by Columbia Pictures Industries as part of the commercialization of the famous UFO movie. Says the quotation: "Intelligent beings from other planets regularly visit our world in an effort to enter into contact with us. NASA and the American government know this and possess a great deal of evidence. Nevertheless, they remain silent in order not to alarm people. . . . I am dedicated to forcing the authorities to end their silence."

The problem is, claims Cooper, he never said that and never even attended the New York City UFO conference at which he is alleged to have made those comments. And to express his profound displeasure at having his name exploited by Columbia, he is suing them for two million dollars. Columbia, meanwhile, refuses to comment on which UFO buff gave them the alleged quotation and why they never tried to verify it.

Nor did Cooper see any UFOs on his space flights, it turns out. "Complete fabrications," he calls the stories that for more than 15 years have enlivened UFO literature.

Cooper does remain intrigued by the real UFO problem, he maintains, and his own UFO experiences remain uninvestigated and unexplained. But the UFO movement evidently was unsatisfied with the honest realities of an astronaut's UFO stories and piled fantasies and fabrications upon them. Cooper's legal action against Columbia may help de

Robert Sheaffer

The UFO phenomenon has produced thousands of photographs. Typical of the more stunning (and controversial) are top, a metallic disk spotted over a Yugoslavian field in 74, and below, two UFOs flying side by side in the night sky above Santa Ana, California.

termine just how far the media can go in carelessly perpetuating profitable UFO frauds.

• • •

WRONG ENCOUNTERS Navigation across the vast gulfs of interstellar space would require the most precise computations imaginable. If UFOs are coming to us from hundreds or thousands of light-years away, their location-finding skills must be honed to a sharpness unimaginable in contemporary terms.

But the UFO pilots of Steven Spielberg's epic *Close Encounters of the Third Kind* must have become lost in a galactic fog bank when they attempted to make contact with human representatives at Devil's Tower, Wyoming.

The latitude and longitude given in the UFO movie were grossly in error. The aliens asked to be met at 104-44-30 by 40-36-10, a location near Lone Tree Creek, about 80 kilometers north of Denver, Colorado. Devil's Tower, where the spectacular ending of *Close Encounters* took place, is 451 kilometers farther north.

Presumably, the UFOs swooped over Lone Tree Creek and found nothing but a few hungry coyotes and a lost reporter. They then frantically circled the entire Rocky Mountain area until they just happened upon the human base camp at Devil's Tower.

The rest is history—or, if you will, hysteria. But it was the biggest navigation error since Columbus thought he had hit China.

• • •

Any popular mystery attracts all sorts of solutions and insights, usually contradictory. The UFO phenomenon has had more than its fair share of opportunists, among the most common being the psychic fortune-tellers. People interested in UFOs love to read thrilling predictions about future sightings, imminent final confirmations, and impending diplomatic recognition of aliens. So a continuous stream of new predictions distracts the public from ever checking up on the old.

Jeanne Dixon, billed as "the world's most phenomenal seer," made such a prediction in the summer of 1976. Said the famed psychic, "I know that these aliens, who are really just better developed humans from a planet on the opposite side of the sun, will begin transmitting their secrets to us no later than August 1977. They will also land by then. Their help will enable us to eventually cure everything from cancer to heart disease, feed the world's hungry, and end war."

These are certainly beautiful forecasts and one might be forgiven if one hopes they will come to pass. But, sad to say, the deadline is more than a year past. Nor is there any secret planet "on the opposite side of the sun," a favorite gimmick of UFO buffs and science fiction writers alike. Its natural gravitational forces on other planets would have made it abundantly evident centuries ago.

Well, UFO devotees can respond, perhaps Jeanne Dixon's predictions did come true but the government is hiding it from us. This theory (and of course it is barely conceivable—but better still, it cannot be disproved by skeptics) is the motivation behind the recurring cycle of predictions that "this year" or maybe "by next year" the government will finally admit that it has been in contact with UFOs.

Understandably, UFO clubs and authors have been the main source of such reports, which began as early as 1952. But from time to time a more reputable (presumably more responsible) press source stumbles on the story again.

The latest reincarnation of the government secrecy story appeared in *US News and World Report* early last year. Said a brief note in the "Washington Whispers" page, "Before this year is out, the government will make unsettling disclosures about what it knows about UFOs."

But once again, the time limit ran out and nothing showed up. As it turned out, Jody Powell had made some incoherent and poorly researched remarks about the ongoing declassification of the old Air Force "Bluebook" files.

By the time this present column is in print, readers should be able to judge the accuracy of some additional predictions. A year ago, various tabloid newspapers listed the following prognostications.

"Top psychic" Clarisa Bernhardt told the *National Enquirer* in December 1977 that "within one year, sightings by government officials will be made public." Also, famed Miami psychic Mickey Dahne told the tabloid that "the first real concrete evidence that there are such visitors from outer space will be with us next year."

Top UFO expert Leo Sprinkle of the University of Wyoming was even more hopeful last January when he announced that "we expect 1978 to be the year that mankind takes its biggest step forward to solving the mystery of the UFO. We will learn more about UFOs in 1978 than everything we have learned about this phenomenon in the last fifty years."

As 1978 draws to a close, these psychics and UFO experts are running out of time to be proved right. Sadly, the repeated failure of such predictions never seems to prove anybody wrong. There is surely going to be a new spate of predictions and "informed sources" for 1979 being the "big UFO year." And if these guesses, too, fail to materialize, there is always next year. ☐

Aerial Phenomena Research Organization

Aerial Phenomena Research Organization

Microscopic blowups of UFO photographed over Brazil (top) show an equally distributed grain pattern, which rules out darkroom retouching. Could be genuine, unlike the below UFO, which experts call a rare, needlelike cloud formation photographed near White Sands, N.M. in 1957.

There may still be places on earth where Grand Marnier isn't offered after dinner.

For free recipe booklet, write Carillon Importers, Ltd., [illegible] New York | ©82 Product of France. Made with fine cognac brandy. 80 proof.

CONTINUUM

WHO OWNS LIFE?

As the controversy over safety measures for recombinant DNA research slowly simmers, a new but related political debate has arisen. Should the products of genetic engineering, new forms of life, be patentable?

Already a long list of patent applications for various aspects of recombinant DNA techniques has built up at the Patent and Trademark Office (PTO), but the outcome of these cases will have to await the Supreme Court's ruling on two earlier cases reviewed before an appeals court late last year. Besides the philosophical ramifications involved in permitting patents for living organisms, the court's decision will have an important impact on the development of industrial processes using biological techniques.

The issue of whether a living organism is unpatentable per se was first raised by Dr. Ananda Chakrabarty, a microbiologist working for General Electric, who developed a strain of the bacteria *pseudomonas* that is capable of degrading all the different blends of oil in an industrial spill. Chakrabarty imparted this new ability, absent in naturally occurring strains, to the *pseudomonas* by incorporating extrachromosomal rings of genes, or plasmids, into individual bacterial cells. Despite the novelty and obvious utility of his invention, the PTO turned down the patent on the grounds that the bacteria were "products of nature" and, as such, were unpatentable, and that as living organisms the bacteria were nonstatutory subject matter and hence did not qualify for a patent under existing legislation.

In a second case concurrently appearing before the PTO, a group of scientists working with the pharmaceutical manufacturer Upjohn Company sought a patent for a "biologically pure culture," nonexistent in nature, of the microorganism *Streptomyces vellosus*, which had been isolated to produce high yields of the antibiotic lincomycin. Again, the PTO rejected the patent application but significantly focused on the fact that this is a "living" organism as the sole basis for its classification as unpatentable. The PTO argued that if Congress had intended living organisms to be covered by patent legislation, then it would not have passed a separate Plant Patent Act in 1930, making an exception for certain types of plants.

Upjohn appealed to the Court of Customs and Patent Appeals (CCPA), which, in a widely publicized verdict, reversed the PTO's decision and awarded the patent. The CCPA rejected the distinction between living and nonliving matter as irrelevant to the question of the culture's patentability, arguing that it was "illogical . . . that the existence of life in a manufacture or composition of matter . . . removes it from the category of subject matter which can be patented. . . ."

On similar grounds, the CCPA subsequently awarded Chakrabarty a patent for his oil-devouring strain of bacteria, but in June, the Supreme Court ordered the CCPA to reconsider its decision to allow the Upjohn patent, thus bringing the dispute back to square one.

The intention behind the Supreme Court's ruling has been hotly debated in Washington, but one interpretation is that since existing patent legislation is not explicit about the patentability of living organisms, the matter should be decided by congressional committee rather than in the courts. In preparation for this event, Congress has already begun to discuss under whose jurisdiction the case should fall and will probably seek assistance on the case from the Office of Science and Technology Policy.

With companies investing millions of dollars in biotechnical research, the outcome of this issue may have important consequences on the future funding of this developing industry. Denying the owner or creator the protection and economic benefits of the patent system may prove a deterrent to the development of useful technologies in this field. Under existing legislation, patents on biological processes afford some protection for new technologies, but patenting living organisms would further safeguard against others profiting from their commercial usage.

In this regard, the Plant Patent Act of 1930 was introduced to remedy what was then seen as a deficiency in the patent system that hindered progress in the botanical sciences. The act's purpose was described in both Senate and House committee reports to be to "assist in placing agriculture on a basis of economic equality with industry" and to "remove the existing discrimination between plant developers and industrial inventors."

Congress may soon be facing a similar issue of "discrimination" against the biological sciences. But elaboration or outright addition to existing patent legislation will not be easy for the very crux of this issue is that Congress may have to address the problem of defining life itself. —*KATHLEEN MCAULIFFE*

CONTINUUM

PICTUREPHONE

Whatever happened to the Picturephone? Introduced at the 1964 World's Fair AT&T's television telephone that lets callers see each other while they talk had been generally dismissed as a prohibitively expensive gimmick born before its time

The Picturephone however is alive and well in a different form The Picturephone Meeting Service Quietly for almost two years hundreds of people have been using the service, which allows a group of people in one city to meet face to face with a group in another city

Hookups are available between two of any four cities New York San Francisco Chicago and Washington D C The rates range from $2 50 per minute (between New York and Washington, D C) to $6 50 a minute (between New York and San Francisco) An hour's business meeting from coast to coast costs $400—less than one person's roundtrip airfare

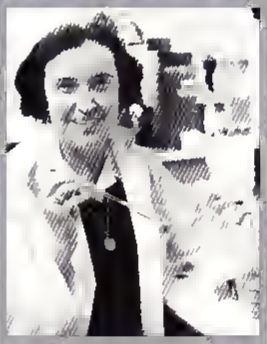
Picturephone meeting rooms are like small tv broadcasting chambers They have three automatic cameras and two viewing screens—one to receive incoming images and another to monitor your own Everything is controlled by the participants, there are no technicians present Customers can show slides documents and other objects and instantly transmit photocopies of them from one end of the hookup to the other The entire meeting can be videotaped for future reference The service will be offered in color within a year and AT&T is increasing the number of cities in the network

Picturephone in the home? The Bell System predicts they'll have it by 1981

A group of businessmen in New York hold a meeting with their branch office in San Francisco using the Picturephone Meeting Service

WOMAN OF THE YEAR

Rosalyn Yalow, last year's Nobel Prize winner for work on the development of radioimmunoassays, has turned down the *Ladies' Home Journal* Woman of the Year award because she feels that it is "inconsistent and unwise to have awards restricted to women or to men in fields of endeavor where excellence is not clearly sex-related "



Prize-winner and woman of the-year Yalow Told she'd better get her nose out of a test tube "

According to the *Washington Post*'s account of the reception held for the ten awardees (among them was First Lady Rosalyn Carter) Yalow's stand was met with some annoyance "I think she'd better get her nose out of a test tube," said Liz Carpenter, former press secretary to Lady Bird Johnson And Lenore Hershey the magazine's editor expressed the opinion that "when 51 3 percent of the Nobel Prize winners are women I will agree that the Woman of the Year award is old-fashioned "

ANTI-AGING DRUG

The drug is called Gerovital H3 and it may be instrumental in halting or even reversing the aging process

The rejuvenating qualities of GH3 were first discovered in the early 1950s by Ana Aslan at Rumania's Institute of Geriatrics in Bucharest when she was treating elderly patients suffering from rheumatism Aslan found that injecting her patients with the common local anesthetic procaine (known in the U S as Novocaine) along with two other ingredients—benzoic acid and potassium salts—not only reduced pain but alleviated a wide range of old-age ailments

At a scientific meeting held in 1956 at Karlsruhe West Germany Aslan presented the results of five years of intensive research on more than 2500 elderly patients She reported that GH3 eliminated depression helped to restore mental awareness produced muscular vigor and reduced hypertension, arthritis, and angina pectoris In addition, it had regrown hair on some patients and recolored hair on others

Further positive results from successive tests led the Rumanian government to set up treatment clinics all over the country By 1975 more than 100,000 elderly patients had received GH3 treatment in these clinics including such world-renowned figures as Mao Tse tung, Nikita Khrushchev, Saudi Arabia's King ibn-Saud, W Somerset Maugham and former U S Vice-President Henry Wallace

In the U S there has been considerable controversy over GH3 However a recently pub-

lished book, *GH3—Will It Keep You Young Longer?*, by science writer Herbert Bailey presents a formidable amount of evidence from both European and American studies that corroborate the beneficial effects of the drug Moreover, none of the studies have revealed any harmful side effects of GH3 If further tests confirm its positive effects the Federal Food and Drug Administration may eventually lift its ban on the manufacture and sale of GH3—making it available for the treatment of old-age ailments in thiscountry

DOUBLE PENIS

Male lizards and snakes have not one penis but two, called hemipenes each of which is connected to its own testis

How does an aroused snake or lizard decide which hemipenis to use? David Crews of Harvard's Museum of Comparative Zoology is trying to find out So far he's discovered that lizards of the species *Anolis carolensis* do not naturally favor one hemipenis over the other And when Crews surgically removed one hemipenis, the lizards simply chose the mating posture that allowed them to use their remaining organ

But when Crews half-castrated the animals removing just one testis the lizards tended to favor the hemipenis that still had its testis intact Crews thus concludes that sensory feedback from the testis is important in helping these reptiles decide which hemipenis to use

Wary of taking a sexist approach, Crews is now studying the female lizard's role in mating behavior The female produces its eggs on alternate sides and the male always appears to mount on the side with the biggest follicle Crews intends to find out what happens when a female with only one ovary tries to mate with a male castrated on that same side

Why do snakes and lizards have two penes? Is there an evolutionary advantage? No, says Crews, who points out that single penised animals have survived in similar environments He says it appears to be just a random biological curiosity

—Kieran Colman

Anolis Researchers

Lizards mating The male has two sex organs No one yet knows how he–or any male snake or lizard–decides which one to use

BIRTH CONTROL FOR DOGS

This pill is strictly for the dogs The FDA recently approved Upjohn's oral canine contraceptive, and now Fido can have sex without fear

Trade-named Cheque, this planned parenthood for pups is dispensed by veterinarians for about five cents a day and is claimed to be 90 percent effective in stopping estrus (heat) in bitches of all sizes and descriptions

Cheque contains mibolerone a non-progesterone steroid which, unlike former progesterone-based dog contraceptives has virtually no harmful side effects

Although the U S has a birthrate of up to 10 000 pups an hour most dog owners do not spay their pets because of the irreversibility of the surgery Now Cheque-mated canine couples can breed a reasonable number of pups a few months after being withdrawn from the drug

'The actual building of roads devoted to motor cars is not for the near future, in spite of many rumors to that effect
—Harpers Weekly, *1902*

SMILING BOWLERS

Bowlers are much more likely to smile when talking with other bowlers than they are after knocking down a lot of pins In a bowling alley says psychologist Robert Kraut, friendly interactions

Keystone Press

This bowler finds nothing to laugh at here But wait until he gets back with his companions

produce more smiles than athletic accomplishments

At the annual meeting of the Animal Behavior Society in Seattle Washington Kraut showed videotapes of bowlers reacting to strikes and spares with stony faces then breaking into smiles during conversations with other bowlers Kraut and Robert E Johnston, both of Cornell University checked the reactions of 350 bowlers The bowlers laughed 37 times when facing friends but only four times when facing the pins

This may indicate that it's more likely that people smile to promote friendly interactions than to celebrate something good that's happened

—Barbara Ford

CONTINUUM

ENERGY BEAM

A radio wave beam that does the job of a laser has already found a wide range of applications in industry and research. Energystics Inc. of Toledo, Ohio, calls its new device the Energy Beam and expects it to replace laser and electron beams for a number of purposes because it is more compact, less expensive, and more efficient than competing devices.

The Energy Beam may look and function like a laser, but it is an "entirely new phenomenon," according to Thomas E. Fairbairn, its inventor and Energystics's senior vice president of research and development. Lasers get their power from a concentrated beam of coherent light, but the Energy Beam works by focusing high-powered radio waves through a column of conductive gas. The electromagnetic energy in the gas is then transmitted to the target material, producing temperatures of 19,500°C.

Laboratory tests have shown the Energy Beam to be a highly versatile device. It can be used to cut, drill, weld, surface alloy steel, and impregnate and heat-treat a wide range of materials. Other potential uses of the Energy Beam include spectro-analysis of chemicals, space heating, and pollution control.

One of the most effective applications of the Energy Beam, however, involves using it as a modulator for a large laser beam. This patented system is called the Laser Energy Beam (LEB) and combines the best of both technologies. A million-watt laser normally requires a million-watt laser modulator. But when the Energy Beam is used instead, a much smaller energy input is necessary. The Energy Beam also enhances the laser's power, and since its cost per watt is one tenth that of the laser's, the result is a very powerful beam at relatively low cost.

Energy beam solders a brick back together with a 19,500°C blast. Not a laser, it's a beam powered by radio waves sent through gas.

WHY BATS HANG UPSIDE DOWN

Bats hang upside down to reduce the strain on their slender hind legs, or so believes Purdue University biologist Donna J. Howell. Generally, the thickness of leg bones in mammals increases in proportion to body weight. Bats are an exception to this rule.

Photo Researchers

India fruit bats assume the time-honored upside-down position. Their thighbones are too slender to support their body weight.

Howell and biologist Joe Pylka of Princeton University measured the femurs (thighbones) of the skeletons of 167 bats representing 45 different species. They found that, according to engineering models, the femurs of bats are "too long and slender to support their weight."

Hanging upside down apparently reduces the strain on the hind legs. The tension (stretching) of hanging is easier to bear than the compression stress of standing upright.

Howell and Pylka speculate that bats may have evolved skinny femurs as a result of their feeding habits. A bat must snare insects on the wing, and heavy bones would be a deterrent to agile, darting flight.

The biologists found one notable exception to the slender-femur rule. The infamous vampire bat has thighbones 30 percent thicker than those of other bats. Because vampires go for bigger game, they have evolved sturdier thighbones to support themselves so they can stealthily approach their victims from the ground "almost as if they were on tiptoe," explains Howell.

MEMORY TRANSPLANT

The transfer of "time memory" from one honeybee to another by means of a brain transplant operation has recently been reported by German researchers at the Institute of Zoology, University of Rontgenring, according to *New Scientist* magazine.

After training bees to receive food at the hive at a set time every day, the German research team cut off the heads of donor bees and transplanted a part of the brain known as the mushroom bodies into the brains of untrained recipients. Two to three days later, the new owners of the extra set of mushroom bodies began to approach the feeding site at the donors' feeding time. In fact, over 60 percent of the bees' visits to the hive during the day occurred in this short period. Neither sham-operated bees (whose brains were opened up but with no new structures implanted) nor

bees receiving the mushroom bodies of untrained donors showed this change in their feeding habits

Once the experiment was completed the scientists examined the bees' brains and discovered that no nerve connections between the donors' mushroom bodies and the brains of recipients had been made. *Something* was transmitted that made the bees' biological feeding clocks change their pace, but what it is and why it takes two to three days to work still remain elusive.

LONESOME GEORGE

Find a mate for Lonesome George and win $10,000!

Lonesome George is the last *known* surviving member of the Pinta subspecies of the Galápagos tortoise. Several decades ago, his subspecies was declared extinct. It seems that Pinta, a tiny island in the Galápagos group off the western coast of South America, has been overrun by goats, which love to eat tortoises.

Nevertheless, five years ago Lonesome George suddenly appeared from behind a rock and was safely carted off to a protective pen by local scientists. Since then, the Charles Darwin Research Station on the island has been searching in vain for signs of a female. Now, according to *New Scientist*, the station has put out an appeal to zoos all over the world asking for a Pinta female. A $10,000 reward is offered to anyone who can find George a mate.

"Man masters nature not by force but by understanding. This is why science has succeeded where magic failed, because it has looked for no spell to cast on nature."
—Jacob Bronowski

"The Russians have put a small ball up in the air. That does not raise my apprehensions one iota."
—Dwight D. Eisenhower

Photo Researchers

Lonesome George. Find him a mate and $10,000 is yours. This last member of the Pinta-Galapagos tortoises faces imminent extinction.

THE CHANGING SHAPE OF WOMEN

After measuring more than 4000 women, Berlei, Britain's leading manufacturer of women's undergarments, has come to a rather startling conclusion—women are becoming tube-shaped!

Berlei found that British women have not only become taller during the last 25 years but they've also developed smaller breasts and hips along with thicker waists. "One might even say they're becoming man-shaped," a Berlei spokesman said.

These findings, reported in the London *Observer*, support those of a similar investigation conducted in the United States by Sears Roebuck. Sears found that American women were experiencing the same "straightening of the curves" phenomenon as their British counterparts, with one marked difference: the American hip has been increasing, rather than diminishing, in size over the years.

The explanations for these changes in shape range from poor eating habits to hormonal abnormalities caused by additives in food. Whatever the cause, the traditional hourglass shape is no longer symbolic of today's woman. Berlei believes a more accurate representation of its typical customer would be "something rather like a thickened broomhandle."

Bettmann Archive

Bettmann Archive

Mae West to Audrey Hepburn. Women go from hourglass to tube.

CONTINUUM

VIDEODISC

The long-awaited home-videodisc may be here by Christmas A silvery plastic platter resembling an LP record, the videodisc is played on a special device hooked up to your television It lets you watch movies right at home

MCA Video-Vision Inc promises that videodiscs of a

Over 300 video recordings will be on sale before year s and

wide assortment of movies—including old cinematic hits by Charlie Chaplin, W C Fields and Mae West, along with more recent films—will be sold in stores before the end of the year

The videodiscs run 60 minutes per side in black and white or color, with sound The player to be made available at the same time under the brand name Magnavox uses a solid-state laser beam, rather than a stylus, to pick up the sounds and images from the discs Besides eliminating needle scratch, the laser provides the home viewer with several professional features including slow motion fast forward freeze-framing for in-depth study, and two discrete audio channels that can be jacked into a home stereo sound system

The Magnavox player will sell for $500 and the MCA discs for about $12 apiece Not all the videodiscs are movies Of the 300 already recorded half are in the areas of opera, ballet, symphonic music as well as "how-tos," sports, hobbies, educational aids, and cooking

COTTON VS. POLYESTER

The energy issue has permeated almost every facet of modern life—right down to the shirt on your back Not surprisingly the question of whether cotton or polyester is less "energy costly" to society has set the stage for a major confrontation between the manufacturers of natural and synthetic fibers

The battle of one-upmanship began when the National Cotton Council produced impressive figures showing that the energy required to produce cotton fiber is one fifth that needed to produce polyester To counter this claim, the Man Made Fiber Producers Assoc , Inc argued forcibly that if the maintenance and "replacement energy" for the cotton garment (which wears out before the synthetic) is taken into account, the synthetic garment requires only 65 percent as much energy as cotton

In an attempt to resolve this crucial question, four engineers at Yale University relinquished their more scholarly pursuits to get down to the dirty ordeal of laundering They washed, dried, and when necessary ironed cotton polyester and blends shirts while monitoring the amount of energy consumed in every cycle Emerging from the washroom 50 launderings later, the Yale team concluded that while less energy is needed to make a cotton shirt this advantage is far outweighed by energy required in maintenance In the long haul, polyester and blends shirts not only are less energy consuming but last about 50 percent longer

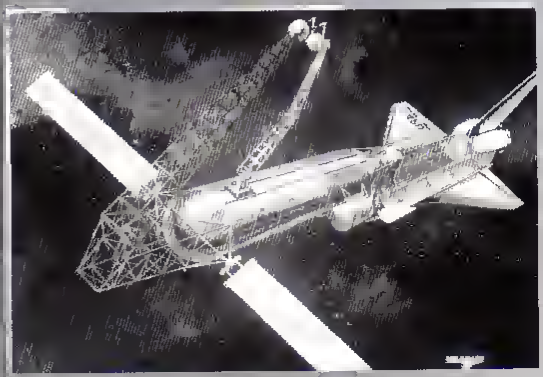
SPACE INDUSTRY

Space exploration is now big business Over 111 nations are in the race to conquer and exploit this last great frontier, and by the year 2000 "AstroBusiness should result in new sources of energy innovative products new public services, more jobs, and perhaps even space tourism for the elite

Already $1 billion in worldwide revenues has been grossed from space-related business By 2000 this figure could escalate to $20 million, according to a recent study by Rockwell International and Science Applications Inc for NASA's Marshall Space Flight Center

In the plans laid down in the NASA report, a satellite solar-power system would be built in the 1980s By 2000 these satellites would be providing solar power for factories and homes on earth as well as powering factories in space

And very shortly we may be able to talk to anyone anywhere on the globe with wireless pocket telephones that would operate via satellite Other planned satellite services are a worldwide medical-advice network and a national information service provided by the Library of Congress



Space shuttle hauls solar collectors into orbit NASA hopes to build extensive satellite solar-power system by the 1980s

According to NASA, space industrialization is also expected to improve America's balance of trade (by as much as $50 billion by the year 2010) and create as many as 1 9 million new jobs

AT THE SOUND OF THE BUZZER . . .

The sound of a buzzer may be as good as a shot of amphetamine In a Pavlovian conditioning experiment with rats, researchers et Albert Einstein College of Medicine in New York City have demonstrated that external events or signals can trigger chemical changes in the brain, mimicking the effects of psychoactive drugs

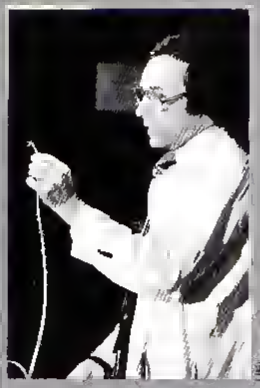
Stanley Schiff and his associate Wagner Bridger paired amphetamine injections in the rats with a buzzer over severel conditioning trials On the tenth day they injected the rats with a harmless seline solution when the buzzer sounded The result? The rats scurried frantically around their cages just as they had done on previous trials when amphetamine had been administered

Schiff went on to show that the rats' bizarre behavior had been caused by increased activity of the brain transmitter dopemine, evidently brought on by the saline injection-buzzer combination Amphetamine has the same effect as dopamine on the nervous system

These findings shed new light on the so called "placebo effect " The expectation of a drug's effect, it seems, may be sufficient in itself to bring about biochemical changes "What happens is not 'just in the mind' but in the physical brain," says Bridger "Suggestion is not just psychological but also biological "

BLOWING UP CHOLESTEROL

Heart patients whose coronary arteries are severely clogged with cholesterol or other plaquelike material must often submit to coronary bypass surgery to save their



Dr Simon Stertzer holds business end of the balloon catheter

lives and to relieve agonizing pain called angina A bypass operation costs $12 500 and requires two to three weeks of hospitalization

Now a new procedure called balloon catheterization can accomplish the same thing at one tenth the cost—and requires a hospital-recovery period of only two days

Surgeons insert a small flexible balloon-tip catheter into the clogged coronary artery The balloon is then inflated, thereby flattening the plaque against the artery wall This allows more room for the blood to flow freely and doesn't significantly stretch the artery

Thirty U S patients have been treated with the balloon catheter the majority of cases having been performed by doctors Simon Stertzer and Eugene Wallsh of Lenox Hill Hospital in New York City Results have been good, and no one has died because of the procedure

The method was developed by Swiss cardiologist Andreas Gruntzig

CLONE ZOO

To assure that people a thousand years in the future will know what a white rhinoceros looks like, cell biologist Dr T C Hsu has esteblished a 300-animal zoo right in his own laboratory

"I have everything from aardvark to zebra," boasts Hsu And they re all neatly tucked away in a small freezer on the fifth floor of the M D Anderson Hospital in Houston, Texas

Actually, it's a clone zoo, and scientist Hsu claims he can preserve the cells of various animals forever in his special liquid-nitrogen freezer, capable of maintaining a constant temperature of −240°C "At that temperature " says Hsu, "the cells are neither dead nor alive You might say they're sleeping for a while"

The plan? Should the day ever arise when the process of cell differentiation or cloning, is perfected the scientist hopes that his future colleagues will use his zoo to breed animals that have become extinct

TALKING BIRD

The Indian Hill mynah (*Gracule religiosa*) has long enjoyed a reputation as the world s best-talking bird

Now the mynah has added another feather to its cap Animal behaviorist Thomas H Turney of New Mexico Tech hes trained an Indian Hill mynah to say "hello" to photographs of people and to remain mute when presented with photographs of trees No matter what the context in which people appear—alone in crowds wearing sunglasses—the mynah seems to have no trouble recognizing them and responding "hello "

A few other birds, including the pigeon and blue jay, have been shown to recognize objects in photographs, but Turney's is the first laboratory demonstration of the ability of a bird to associate a visual concept like "person" with a learned vocalization —Barbara Ford

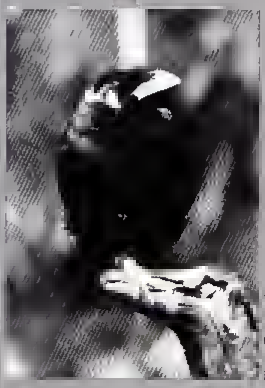


Photo Researchers

Indian Hill Mynah Says "hello" to people but snubs trees

CONTINUUM

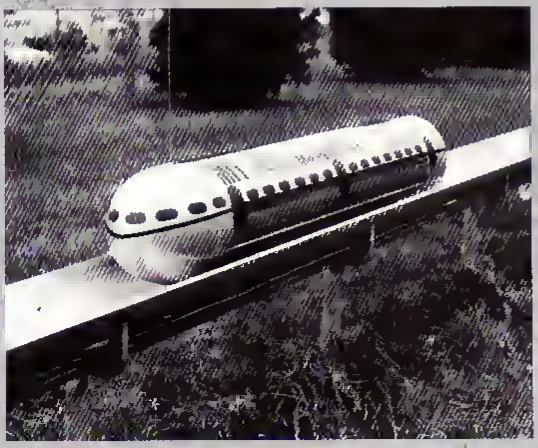
LEVITATING TRAINS

Magnetically levitated trains may become the predominant form of long-distance transportation of the future, leaving the airplane behind as an outmoded vehicle of the past. A 21-minute trip from Los Angeles to New York may sound like science fiction now, but the technology for using electromagnetic fields to levitate and propel passenger trains may be only ten years away.

Several different systems designs for magnetically levitated or maglev, trains have been explored by Ford Motor Company, the Massachusetts Institute of Technology, the Rand Corporation, and the Mitre Corporation. The best system to emerge employs powerful superconducting magnets along the bottom of the vehicle to create a repulsive force against current induced in a conducting aluminum guideway. The repulsive levitation acts against the force of gravity, raising the vehicle one foot above the guideway. A separate superconducting system achieves propulsion—the train is pulled forward by attraction to the magnetic field in the guideway ahead of it while a repulsive force pushes the vehicle from behind.

The advantage of "electromagnetic flight" over winged flight is speed. Aerodynamic drag increases with an airplane's speed, but magnetic drag reaches a peak relatively quickly and then *decreases* with speed. Once air resistance is eliminated, a cruising speed of up to 22,400 kilometers per hour is attainable.

Building underground semi-evacuated tunnels of little or no air resistance for the maglev system has already been researched by the Rand Corporation. The estimated cost for the system, including equipment and tunneling, is approximated at $30 million per kilometer. Although this price may seem prohibitively high, Rand projects that the revenue derived from long-haul domestic travel will make the underground maglev system a profitable endeavor. Indeed, economics may permit the lowering of one-way, coast-to-coast travel fare to as little as $50.



Magnetically levitated and propelled trains might someday hit speeds up to 22,400 kilometers per hour in semi-airtight tunnels.

Photo Researchers

In response to a widespread scarcity of rhesus monkeys, the Indian government banned their export on March 31, greatly decreasing the number available for scientific research. As our closest primate relatives, rhesus monkeys are indispensible experimental models in biomedicine. Their shortage threatens the continuation of many essential health programs.

"Even if the propeller had the power of propelling a vessel, it would be found altogether useless in practice, because of the power being applied in the stern. It would be absolutely impossible to make the vessel steer."

—Sir William Symonds, Surveyor of the British Navy, 1837

MAGNETIC BACTERIA

Nothing about the mud bacteria migrating across the microscope slide toward the northwest laboratory window was that unusual. It could easily have been explained as an affinity for the incoming light. Yet when microbiologist Richard Blakemore examined the phenomenon more closely, he discovered the bacteria had no interest in the window but were in fact swimming toward the earth's magnetic north pole. Blakemore, of the Woods Hole Oceanographic Institution, Massachusetts, later found he could get the microbes to change direction merely by moving a small magnet close to the slide.

Using an electron microscope, Blakemore discovered that several species of bacteria found in the sediment bottoms of fresh- and saltwater ponds contain chains of iron-rich particles. These particles, he believes, act like miniature bar magnets.

Working with biophysicist Adrianus J. Kalmijn, Blakemore found that by subjecting the creatures to a strong magnetic pulse, they could cause the strictly northbound bacteria to reverse their polarity and swim south. Though the biological use of this magnetism remains a mystery, scientists speculate that it may direct the bacteria to sediments favorable to growth.

—Kenneth Jon Rose

"The man with a new idea is a crank until that idea succeeds."

—Samuel Langhorne Clemens

He's more expensive than the $6 Million Man and he lives in Utah.

THE REAL BIONIC MAN

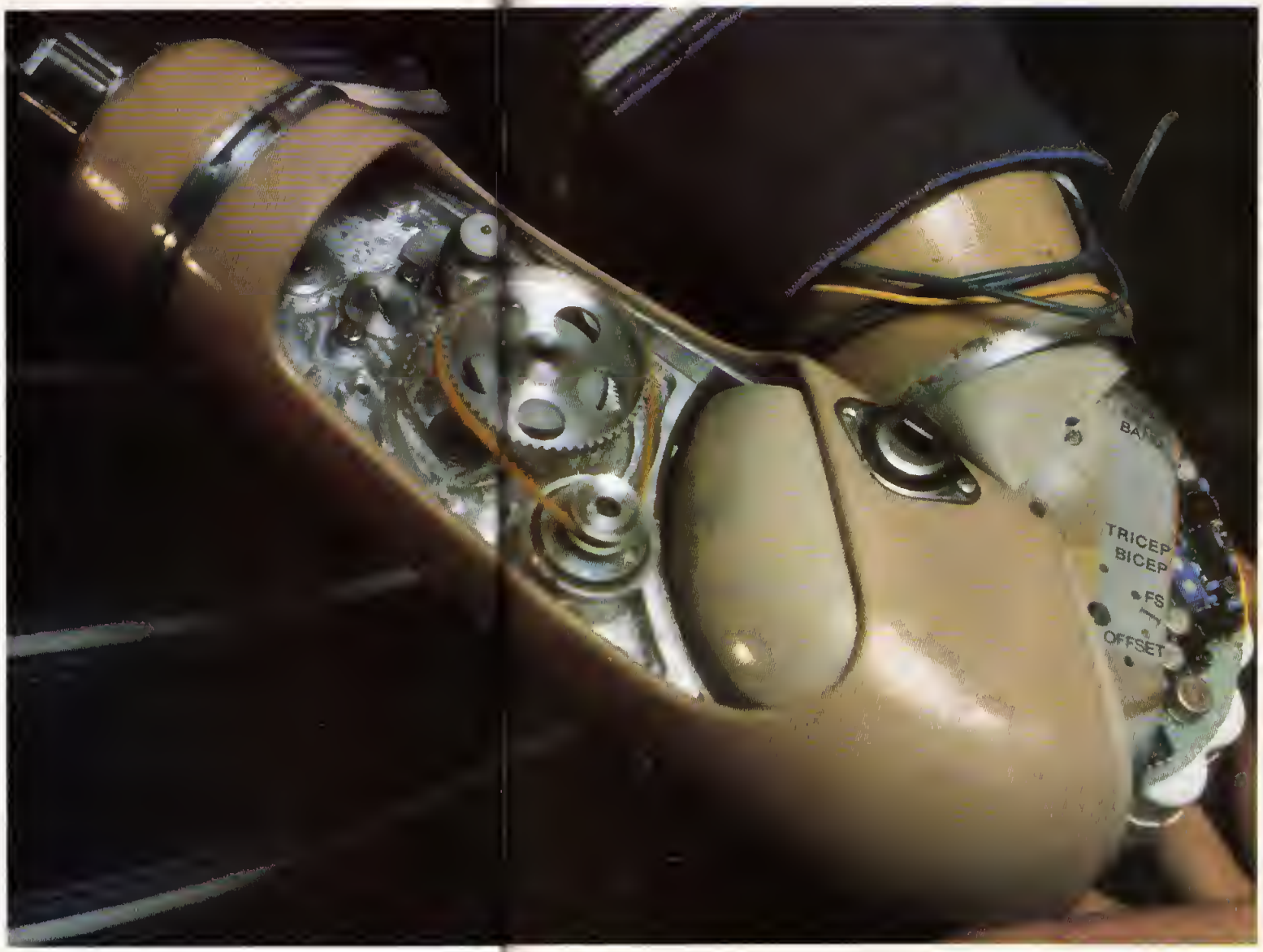
BY DICK TERESI

The rumor began in 1972. That's when Martin Caidin's SF novel *Cyborg* was published. The rumor intensified when ABC turned *Cyborg* into the popular television program *Six Million Dollar Man*. The hero of the tv series, Steve Austin, is an astronaut whose body was almost destroyed in a rocket-sled accident. But by using bits of plastic, titanium, sophisticated electronics, and a nuclear power pack, medical scientists put him back together again. Moreover, not only was old Steve restored to peak condition, he was given superhuman capabilities. He now leaps over buildings, hears conversations half a mile away, sees with zoom-lens accuracy, and resists physical assaults that would fell a water buffalo.

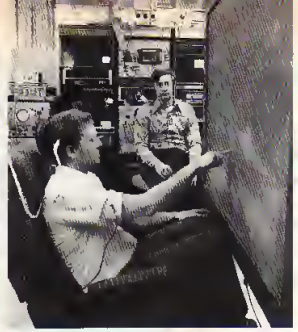
It all adds up to good fun on the tube.

But the rumor is this: Many people speculate—and it's even been reported in the press—that the basic story line of Steve Austin is true. That somewhere—perhaps in a supersecret Houston laboratory or hidden among the serpentine medical facilities of the National Institutes of Health in Bethesda, Maryland—there exists a team of scientists who are churning out Cyborgs at an assembly-line rate.

In search of the real Six Million Dollar



Photographs by Al Thelin



Right: Willem Kolff attaches ventricles of artificial heart to each other. Velcro holds them together. Opposite page: Close-up of blind subject's wiring (top left). Cables attach to graphite button, which is the outlet for an implant that runs directly into the brain. Craig, the subject, has had the implant for three years. At top right, Craig shows Michael Mladejovsky what he is "seeing" by making marks on a blackboard. Mladejovsky built the computer equipment that stimulates Craig's visual cortex. Alexander (bottom left) is one of many Utah calves that have survived long periods with air-driven plastic hearts. Dr. Kolff (bottom right) holds electric heart he hopes will someday be implanted in man.

Man. I went to Salt Lake City, home of the University of Utah, which has the most comprehensive bioengineering program in America. Utah has in fact already outclassed the Six Million Dollar Man in at least one respect—cost. This year the university will spend $8.4 million on bioengineering, the application of space-age technology to the repair and maintenance of the human body. And Utah employs more than 360 engineers, medical scientists, and technicians who work directly on what are popularly called "bionics" projects.

I talked to Stephen C. Jacobsen, director of the university's Projects and Design Lab and inventor of many outrageously futuristic devices, including a "thinking" artificial arm. He had a simple response to the claim that the government has a secret Cyborg laboratory.

"Bullshit," said Jacobsen. "If the government already has a Cyborg, well then, they're wasting a lot of money on us." He refers to the fact that most of Utah's bioengineering budget comes from federal grants and contracts.

Members of the bioengineering team at Utah agree that the future lies not in building Cyborgian robots, but in developing prostheses that mimic human body parts as closely as possible. Their research is focused on understanding how the body works and how to duplicate its physiology.

The university entered the field 14 years ago and in 1967 hired one of the pioneers of bioengineering, Willem J. Kolff, to head its artificial organs division. The Dutch-born Dr. Kolff invented the first artificial kidney during World War II. Working under near-secret conditions in the Nazi-occupied Netherlands, he saved the lives of end-stage kidney patients who, before his invention, would have been doomed. Today at Utah his mission remains unchanged.

"Our aim," says Kolff, "is to restore people." And there are few places where a better job of it is being done. Utah boasts spectacular programs in artificial vision and hearing, the most successful artificial heart project in the world, a new polymer-implant center that's developing plastic-like blood vessels, bladders, testicles, and other organs, and a whole assortment of other bioengineering marvels aimed at improving medical care. But for you Cyborg fans, let's begin with the device that's the most suggestive of science fiction—the Utah arm.

"I'm not trying to be obnoxious," said Stephen Jacobsen as he clipped an electronic sensor to my forearm, "but this is the best artificial arm ever made." The electrode on my arm, explained Jacobsen, picks up electromyographic (EMG) signals. "Every time you flex a muscle, electrical activity is produced on the surface of your skin. It's crawling all over you."

A wire led from the sensor on my forearm to a one-kilogram (2.2 pound) artificial arm, which Jacobsen held just above the elbow by its stump socket. I held my arm straight at my side with my wrist relaxed. But when I flexed my wrist and raised my hand, the artificial arm also moved upward, bending at the elbow. When I dropped my hand, the Utah arm dropped. Crudely speaking, the electrode had picked up the EMG signals on my forearm and transmitted them to a minicomputer in the arm, which in turn commanded the arm's electric motor to flex it up or down at the elbow.

Of course, the arm is meant to be used by an amputee, in which case it is fitted over the patient's stump. Electrodes would pick up the amputee's EMG signals from his limb remnant and from his shoulders, chest, and back on the affected side. Besides elbow flexion, the amputee can operate three other joint-movements: humeral rotation, wrist rotation, and hand closure.

The beauty of the Utah arm is that an armless person doesn't have to be taught how to use it. "The amputee has muscles left in his stump that don't pull on anything anymore. But they're still connected to his brain. We pick up those signals and have them control the arm," explains Jacobsen. "He doesn't have to do anything unnatural, like wink to close his hand." In effect, all the amputee must do is think and act as if he had a real arm and use his muscles as he did before amputation. The Utah arm does the rest.

Jacobsen believes in developing medical devices to the point where companies will want to pick them up and sell them to the public. And he often becomes so enthusiastic when ticking off the arm's commercial attributes that he sounds a bit like a high-class Cuisinart salesman.

"It has a nice, cosmetic exterior, a nice weight. It's quiet in operation, smooth, and doesn't pinch or cut clothing. It will go fast, slow, and lock in place. It will lift three pounds and support fifty pounds. It has a great electronic package. The batteries are easily replaceable by the amputee, even the circuits can be removed and replaced. It's repairable, maintainable, and can be sold at a reasonable price—*under* three thousand dollars."

Jacobsen's style, though, stems simply from his desire to get ideas from the lab out into society. "So many ideas," he says, "just stay locked up in universities. The public pays for the research but never receives the benefits. It's like pouring money down a hole."

The Utah arm will be ready for home use in less than a year, according to Jacobsen.

Right now it is still being tested in the Project and Design Lab. Several amputees have used the arm, but never outside the lab. Jacobsen and his staff fit a dozen or so electrodes to each subject. They then use a computer to adjust the arm's movements to the amputee's EMG signals. Each arm must be electronically tailored to its wearer.

But recently, while working out equations for the arm's control system, Jacobsen made what he calls an "awe-inspiring" discovery. He noticed the possibility of making a feedback loop in the circuitry. What you'd then have is an adapter-controller in the arm that would automatically adapt its movements to the amputee. "You'd just slap an arm on somebody," says Jacobsen, "and they'd reach an agreement about how they were going to behave."

Even though the Utah arm may be the best artificial arm in the world, Jacobsen scoffs at the better-than-human bionic concept of his work. Recently a major encyclopedia company made a film about the Project and Design Lab. Jacobsen is still reeling from the results. "Jesus! I just saw a copy of it and it's the absolute worst," he says. "The narrator turned out to be the actor who stars in *The Bionic Woman* [the tv show] and he was standing the whole time in front of this stupid panel of flashing lights that was obviously out of some tv series because the discs in the computer didn't spin right." The effect of this kind of publicity is an illusion that amputees fitted with these new devices will be bionic supermen.

Those people expecting a Cyborg-strong arm have a long wait ahead of them. The Utah arm can lift little more than one kilogram (three pounds). And while Jacobsen says a one-kilogram lift is adequate for 95 percent of all normal human arm activity, it's still a far cry from a real arm's capacity, somewhere between 23 and 45 kilograms (50–100 pounds).

To make the arm more competitive with its human counterpart, Jacobsen says four technological advances must be made. First, he needs better motors (compared to muscles, says Jacobsen, "motors are crummy"). Second, he needs a way to attach the prosthesis directly to the bone so it can support more weight. Other breakthroughs needed are a way to hook into the amputee's nerves for better control of the arm and some kind of feedback system so the wearer can tell without looking at it what his arm is doing.

But the Utah team understands the basic physiology of arm movement. And in this respect Jacobsen says the arm is designed as far as it can go. "We don't need a fancy new designer. We need new technology."

Michael G. Mladejovsky (mal-YOFF-ski)

"The Utah team won't build Cyborgian robots. "Our aim," says Kolff, "is to restore people."

has the opposite problem. Director of the Neuroprosthases Program at Utah, he's been working on developing an artificial vision system for almost a decade. He says facetiously that building a device that serves as an eye is a "mere technological problem." He could build it right now with existing electronic hardware and techniques . . . if only he knew what it was supposed to *do*.

There's the rub. No one quite yet knows what happens in the brain that allows people to see. But no one has come closer to finding out than the scientists at Utah.

William H. Dobelle started Utah's artificial vision program in 1969. Dobelle's role was to handle the physiological side—what goes on inside the visual cortex—while Mladejovsky handled the computer-hardware end of the project.

They had been inspired by a 1968 discovery in England that blind persons, as well as people who see, can perceive spots of light called phosphenes when the visual cortex at the back of the brain is stimulated with electricity. These phosphenes usually appear as bright, white dots—patients describe them as "starlight"—but sometimes they're yellow-green, red, or blue-white.

The Utah team's idea was this: if you could stimulate the cortex of a blind person in an orderly way, you could draw pictures in his mind composed of phosphenes. And, in a way, that's exactly what they've done—by using electronics and surgery.

Three years ago Dobelle and Mladejovsky found a willing subject, named Craig, who had been blinded in a gunshot accident. Craig agreed to some very scary brain surgery. The Utah team fashioned a two-inch square Teflon wafer studded with 64 electrodes. Surgeons separated hemispheres of Craig's brain to expose the visual area, placed the wafer against it, then let the two brain halves drop back into position, holding the wafer in place. A wire connected to the implant was threaded through a hole in the back of the skull, then snaked forward between the skull and scalp to a buttonlike connector that protruded (and still protrudes today) above

CONTINUED ON PAGE 138

Above: Array of artificial arms shows a history of the prosthesis. At far left is 1866 model. Electronic parts in background are amplifiers for picking up electrical muscle signals. In two photos at right top and center, Dr. Stephen Jacobsen, father of the Utah arm, shows how it responds to signals. Sensor is clipped to his left forearm. When he raises his hand, the arm rises also. Far right: Modern hand compared to 1866 hook. Near right: The tiny Superprobe blood sensor.

FICTION

THE WEARIEST RIVER

His sworn duty was to protect the hospital—which would save lives. But there were enemies within.

BY LLOYD BIGGLE, JR.
PAINTING BY GEORGE TOOKER

The sounds came from directly behind him. *Purr . . click . . swish.* Carlton Conlan Connager instinctively stepped to the side of the corridor, and the Patient Transport Vehicle hummed its way past him. The patient, who was seated HR, half reclining, looked up in sudden fright when Connagar's figure momentarily loomed over him. Then the PTV moved on, another click . . . sounded followed by a swish as it turned a corner, and it disappeared into the Hydrotherapy Center.

Connager scowled after it. He'd never heard of a hydrotherapy patient who hadn't loved the treatments, but this one had been panicky. And when Connager paused at the open door and looked in, old Mannighan, the hydrotechnician, started and peered anxiously at him until his acute myopia finally identified Connager.

Patients, employees, statt. All of them were frightened. Some of them were terrified because they'd never been frightened before.

Purr . . . click . . . swish. Connager stepped aside. Another patient, riding fully reclined, looked up at him in fright. Connager watched the humming PTV until it turned the next corner. Then he walked on, slowly.

The stockroom maneger, Ritala Melmann Danvist, looked up uneasily when he entered and then gave him a formidable frown. "What is it now?"

"Found the missing hypos?" Connager asked lightly.

"Look. No one in this hospital has used a disposable hypo for years. I'm *positive* they were marked for destruction long before I took this lousy job. They just happened to turn up missing on my first inventory so I'm stuck." She eyed him worriedly and asked, "What's there to worry about?"

Connager leaned over the counter. "Public Security thinks they vanished into the cotics trade. I disagree. Did you know that Pharmacy has lost track of a couple of liters of Tharmenol?"

She stared at him.

"Tharmenol is a powerful injectable barbiturate," he went on. "Five cc's, even if injected in a muscle, would kill a healthy human." Connager turned away. In the doorway he paused to look back. She was regarding him with an entirely different kind of worry. "Those missing hypos had five-cc syringes," he said.

He walked on toward Pharmacy, where a frenzied inventory was under way with an outside accountant on hand to tabulate prescriptions. Before he reached it, his jacket pocket beeped twice. He took the coin disc from his pocket, activated it and said wearily, "Hospital Security, Connager."

"You sound tired," the mellifluous voice announced.

"Dead," Conneger agreed absently.

The voice laughed warmly. "This is the wrong place to say that. Were you up all night?"

"I've been up the past two nights."

The voice laughed again. "The director has agreed to meet with a committee of pickets. He'd like to have you present."

"Tell Doctor Altnol I'll make the arrangements for this meeting myself. We don't want one of those youngsters smuggling a bomb into the hospital."

He switched the disc to another channel. "Connager. Emotional Therapy report, please."

A different voice announced crisply, "Traffic heavy, flow continuous, occupancy close to capacity but no problems."

Connager pocketed the disc and headed for his Security Section, wondering about that warm and vivacious and caretree voice that spoke to him several times a day from the director's office. He had never met the owner, but he suspected that she was a sour-looking, homely old shrew. Things usually worked out that way.

Purr . . . click . . . swish. Connager stepped aside and watched another frightened patient recede into the distance.

Connager met the committee of pickets at the front gate. The lines were moving more slowly than they had that morning, and all of the pickets looked tireder and hungrier and dirtier. Some of their signs—*Death with Dignity . . . We Demand the Right to Die in Privacy . . . Hospitals not Circuses . . . Natural Death Is an Affront to Humanity*—were torn and drooping.

Like the other pickets, the members of the committee were young—all of them under 20—and they looked unwashed and untidy. Connager asked for their identity tags and gravely copied their names into his notebook: Lynar Dab-375, a tall, gangly youth still afflicted with adolescent acne; Jolan Sill-264, a husky youngster whose bulging contacts hinted at a lite-

"Several of the doctors were looking at him angrily—which was, Connager reflected, another healthy emotional reaction. He said again, "The threat to this hospital's patients is an internal one."

time of vision disability; Stel Mur-973, a slender girl with a boyish figure, tousled hair, and a smudged face, but with far more poise of manner than the males. The girl and Jolan were wearing stretch suits, which two or three years before had been the adolescent tad in nonclothing. Probably they hadn't been able to afford new wardrobes since their education allowances had terminated. Lynar was clad in the dusky garb of manual employment. He, at least, had worked at something, or affected to.

The hospital's director, Marnsdorf Hardley Altnol, was waiting for them in Connager's own office. He arose when they entered and regarded the youths distastefully, as though such obviously diseased specimens were unsafe in any hospital department except the morgue. Connager performed introductions and got everyone seated.

The director leaned across Connager's desk and cleared his throat ostentatiously. "You are—ah—the committee. What can I do for you?"

He was a paunchy, intensely serious individual—a distinguished physician, an excellent administrator, and an outstanding citizen—but he belonged to the wrong generation and the wrong world. The boys regarded him belligerently. The girl, whose steady gaze had been fixed upon him from the moment they entered the room, leaned forward and spoke.

"You can let your patients die in peace and comfort and dignity."

Altnol cleared his throat again. "My dear young people. In this institution, death is not our profession. We are dedicated to life—to healing, to repairing accident-damaged bodies, to correcting genetic errors, to curing the diseased, to keeping people alive and enabling them to live happy and useful lives. Fewer than five percent of those admitted to this institution die. Our handling of those few is prescribed by law. The moment a patient becomes terminal, our responsibility ends, and we transfer him or her to the terminal wards, as the law requires. You should be picketing the legislature."

"We are," the girl said. "But of course the legislators say that they make laws in the area of medicine only on the recommendation of doctors." She paused. "There once was a physician named Hippocrates. You may have heard of him. He said, 'Wherever the art of medicine is loved, there also is the love of humanity.' If the art of medicine is loved in this hospital, as you claim, the love of humanity will force you to defy the law and its inhumane strictures on natural death."

The director managed a hurt smile. "You are asking those who devote their lives to the repair and cure of damaged and diseased bodies, you are asking them to prove that they love humanity?"

"One who loves humanity loves all of humanity," the girl said bitterly. "The healthy, the sick—and the dying. Take me to the terminal wards and demonstrate your love of humanity by ending the suffering there."

"However much we may sympathize with your objectives, we must obey the law," Altnol said.

The conversation continued, but the looming shadow of the law lay heavily across every question. Finally, without a trace of amenities, the young people got to their feet and marched out. Connager left with them and walked them past the various guard posts to the main gate. The guards there opened the gate for them, and as the other pickets surged forward to ask what had happened inside, Connager spoke curtly to the committee.

"I'd like to show you something." He turned and walked away, following the perkway outside the hospital's fence. The committee trailed after him. He could have avoided the long walk by cutting through the hospital from his office, but revealing the staff communication system to these unwashed youngsters would have left him open to scathing criticism. Connager had to go out of his way to avoid criticism. The director of anything made enemies, and a new director of hospital security made

CONTINUED ON PAGE 124

NATURAL PACKAGES

Warning: This Food Contains Chemicals That May Be Necessary For Your Survival

PHOTOS BY MICHAEL SOMOROFF


EGG
Ingredients:
Xanthophyll, carotene, mannose, galactose, ovalbumin, conalbumin, ovomucoid, lysozyme, lipovitelin, phospho-protein, livetin, cholesterol, lecithin, choline, avidin, zeaxanthine, pantothenic acid, riboflavin, thiamin, niacin, pyrioxine, folacin, cyanocobalamin, sodium chloride, iron, calcium, phosphorus, H_2O (74%)

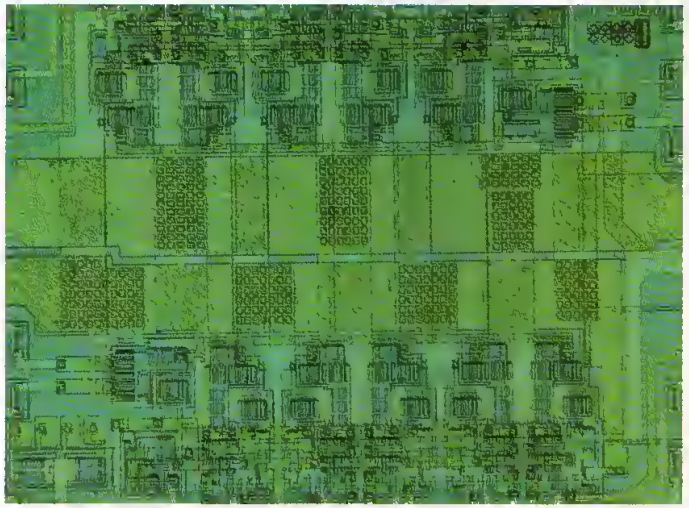

ORANGE
Ingredients:
Carotene, anthocyanins,
tangeretin, polygalacturonic
acid, sucrose, fructose,
arginine choline asparagine
3-keto-1-gulonolactone
d-limonene, decytaldehyde oc
tyl alcohol, amyl alcohol has-
pendin, 2-hydroxy-
propanatricarboxylic acid pa
allic acid, methanol formalde
hyde, tyramine, synephrine,
H2O (86%)


CANTALOUPE
Ingredients:
Fructose, sucrose, hydrolyzed
ionic acid, 2-hydroxy-
-tricarboxylic acid, ethyl
propionate, ethyl acetate,
β-carotene, riboflavin, niacin,
phosphorus, potassium, amyl-
ase, amylopectin, polygalac-
turonic acid, H2O (87%)

COMPUTER LIB

The computer revolution
has begun, so get your data ready
There's no turning back

BY TED NELSON



Suppose you met a man who didn't know what an automobile was. You'd think he was a cluck, a simpleton, someone unable to hold a sensible opinion on anything in the modern world. And it's so simple—*an automobile is a box you go places in.*

The majority of well-educated Americans, however, are clucks and simpletons when it comes to something just as basic as the automobile: the computer. Just as the automobile is a box you go places in, *the computer is a box that follows a plan.* The plan can be anything. It can tell the box to turn

PHOTOGRAPHS BY FRITZ GORO

things on and off, to file and bring back information autometicelly, to blink lights, to mix drinks, to play music—anything at all

So I've given you the word. You now know what e computer is.

• • •

They should never have been called computers.

The first machines were labeled computers because their developers felt that numerical computations would be their main function. It reminds one of the blind men in the fable, who when confronted with an elephant thought it was a wall, a tree, or a snake, depending on what parts of the animal their hands touched.

The pioneers were not wrong, just preoccupied. But the result has been that the name *computer* has frightened people ever since. It might just as well have been called the Oogabooga Box. That way at least we could get the fear out in the open and laugh at it.

In France they call all aspects of computer use *l'informatique*, the automatic handling of information. From time to time computer fans have advocated translating the French term and calling the use of computers *informatics*, an extremely appropriate term. Unfortunately, "informatics" happens to be the trademark of Informatics, Inc. here in the United States, so that pretty much squashes that.

In Sweden they call computers "dators." A computer—or a terminal between you and the computer—is a dator, meaning something that handles data. Straightforward, huh?

The celebrated scientist John Von Neumann got it right at the very beginning, but nobody listened. He called it "the all-purpose machine."

But computer is what we call it, even when it is playing music or meking pictures on a screen.

Keeps people scared. Oogabooga!

• • •

Any nitwit can understand computers.
Many do.

• • •

Many people, particularly those who call themselves "humanists," often claim that computers are oppressive, cold, impersonal, rigid, dictatorial, militaristic—the list is endless. "They're controlling our lives!" I hear. "They re taking over the world!" This is a widespread view, held fanatically by a large number of people, and it is not altogether wrong.

Computers have been used in many systems that push people around. They are frequently instruments of oppression. The Nazis, however, used railroad cars and ovens in oppressive ways, but this does not mean that railroad cars and ovens are in themselves oppressive. Computers, in fact, have provided a handy excuse for oppression. "Sorry about this, but the computer made me do it."

Consider this. Suppose someone creetes a system for handling warranty repairs. You go into the store where you bought your nice new radio that doesn't work. You have the seles slip end your registretion card stub.

"Fill this out," the clerk says. He hands you a form that asks for your name, age, sex, address, occupation, height, weight, identifying marks, where you purchased the appliance, where you first heard of the appliance, a description of your problem, and your signature.

You demand to know why you have to answer so many questions.

"Fill it out, or you don't get your radio fixed," responds the clerk. "Gotta have all that for the computer."

You filt out the torm. It takes 20 minutes. The ballpoint pen smears ink all over your hands.

"This is no good," says the clerk. "Machine can't read the carbon copy."

Quivering with rage, you fill out another form, which the clerk accepts. You get a portion ot it back that bears the first three letters of your name, several digits, and some hyphens. You hand over your redio.

"When will it be ready?" you ask.

"Six weeks, maybe seven," he answers. "Computer has to match it up with your warranty card in California."

"Never mind, just give it back," you say.

The clerk hands you your radio and confiscates the stub.

"Damn these computers," you shout and stomp out the door. For days you complain to everyone about "those damned computers never work."

But you are wrong. The system worked perfectly. They did not heve to repair your radio.

And you blamed the computer.

• • •

Suppose you were taken on a tour of a library, but you did not know how to read. You would see people moving books around, turning pages. You would think they were all doing the same thing. You would not see the romance and adventure, the science and history, moving across their minds.

Similarly, people working with computers all seem to be doing the same things—typing odd messages into the machine and scratching their heads at the results, staring at walls, scribbling strange symbols on blackboards, sometimes muttering out loud and watking into things.

But each one is doing something different. One may be studying the life and death of stars and galaxies, another arranging a dating service. One may be robbing a bank.

• • •

To understand the language of automobiles is basic. "A guy in a pickup tailgated me off the interstate." Everybody understands that.

To understand the language of books is basic. "The librarian told me the book was out for rebinding." Everybody understands that.

But how ebout this one. "The program got hung in a loop end I tried to do a restart, but the system bombed."

A few years from now, that language and the world it describes will be as familiar to us as the librarian and the tailgater are. Today, however, anyone who understands that mysterious sentence is called a "computer person."

• • •

"You'll have to talk to my nephew, he uses computers." I gnash my teeth at that statement. Just because I use wheels, must I talk to the niece who rollerskates or to the uncle who teaches driving? Luckily, in a few years there will not be any computer people. That is, people won't be set apart as computer people, any more lhan skateboarders and truckers and commuters are set apart as "wheel people."

• • •

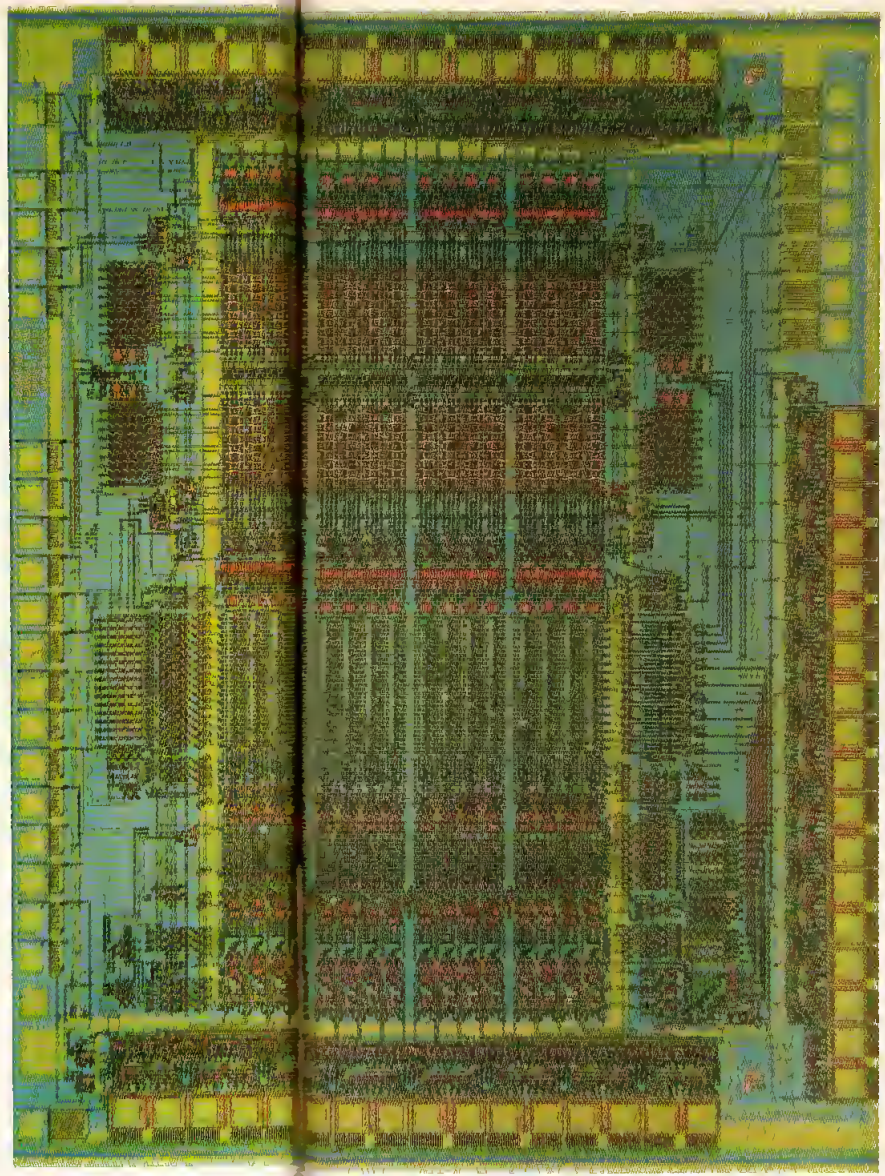
This is the magic time. It is like the Klondike, like the old Hollywood, like the birth ot air travel and radio and television. It is the new computer world. It is going to explode.

Today real computers can be purchased for as little as $600 (the TRS-80 from Radio Shack, for example), and some of these small machines are more powerful than the IBM 1401, the computer that ran American business only 15 years ago (and cost upwards of $50,000). Though only half a dozen brands are available at this writing, new electronics companies are tumbling into the personal computer field willy-nilly.

In my recent book *The Home Computer Revolution* (available for $2.00 plus postage from The Distributors, 702 So. Michigan, South Bend, IN 46618, softcover, 224 peges), I predicted that ten million small computers would be sold by the end of 1979. That prediction will probably not come true for there is not now the production capacity. But I think it will be closer to ten million than to one million.

The history ot electronics since World War II can be described in two words—smaller and cheaper. The vacuum tubes that made the first hi fi sets hum in the early 1950s were the size of a pinecone. The transistors that replaced them were first the size of a thimble, then as tiny as a BB.

Not only were transistors small—they could be grown, like little mushrooms, and sculpted and arranged in patterns while they were growing. This led to the "integrated circuit," a little cluster of transistors and other things electronic all grown to-



The "OM" circuit is an experimental microprocessor, measuring a mere one centimeter on each side, that has the capacity to store greater logic and memory functions than any previously designed chip.

gether in their intended combination. The size of a postage stamp, the integrated circuit could be designed for any electronic purpose—as an amplifier for a hi-fi, a circuit for controlling radar sweeps, or the building block of a computer.

By 1965 it became clear that the workings of an entire computer could be put on a single integrated circuit. Did people plan ahead? Did the computer industry prepare for drastic change as the price of computers fell from thousands to hundreds of dollars? Did any big companies get ready for this change?

You bet they didn't.

The breakthrough came in 1971, when an integrated circuit company, Intel Corporation, brought out the first "computer on a chip," the model 4004. This was not a full computer, with blinking lights and memory, but it was the vital part—the circuitry capable of following a program stored in whatever memory that was attached to it.

Intel also offered, to go with the 4004, components that would provide memory, outside hookup, and so on. All you had to do was buy the various parts and know exactly what you were doing.

Then came the Altair. Out of the blue, in December of 1974, there came an electrifying announcement from Albuquerque, New Mexico. A tiny company called MITS was offering a computer kit—for $420.

Two hundred orders for the Altair would allow MITS, faltering, nearly broke, to break even. Those 200 orders came the day the kit came out. Quickly there were thousands of orders, then pandemonium. This tiny firm had discovered by dumb luck what a few prophets had claimed but what nobody believed: *people want computers*.

By June of 1974 there were several companies making Altair accessories. There was also a slick magazine for computer hobbyists called *Byte* and a store in Los Angeles where you could walk in and buy a computer. By December there were more than a dozen companies making Altair add-on products. By the following summer the Los Angeles computer hobby club had 3000 members.

Today there are perhaps 50 brands of personal computers on the market, most of them kits but some, like the Apple II and Radio Shack's TRS-80, fully constructed and ready to run. The revolution has begun. Computer Lib has become a fact.

• • •

Virtually every city in the country now has its own band of computer hobbyists. The weekly meeting of personal computer enthusiasts in such cities as Boston, Los Angeles, and San Francisco may draw more than 1000 members. Curiously, Women's Lib has not joined up with Computer Lib. Membership in personal computer organizations is almost exclusively male. Women are not only welcome but encouraged to join, for most male computer hobbyists are dying to meet a woman who can talk about computers. Women should beware, however, for many computer hobbyists cannot talk about anything else. "What else is there?" is the common response.

• • •

Anyone can learn to program a computer. It is simply a matter of getting access to a computer and learning one of the languages that will direct it. You don't have to know mathematics or electronics any more than you have to know the fox-trot.

The magic age, however, seems to be 14. (The average age of people in noncredit computer courses, for example, is 14.) Today, of course, there is a simple way for a youngster to get involved with computers: probably the best way of all. *His father can buy him one.*

• • •

A curious strategy pervades the computer world from top to bottom. It is employed by the grandest bureaucrats and the most modest individuals. It is known as *lock-in*.

"Today computers can be purchased for as little as $600, and some of these small machines are more powerful than the IBM 1401, the computer that ran American business only 15 years ago."

Lock-in simply means keeping someone a prisoner of your products and services. It has been around for years—ever since Samuel Colt invented the gun you had to buy refills for. Anything that requires refills made by the manufacturer locks you in—razor, camera.

Computers and their hardware are different from manufacturer to manufacturer. This assures that after programs are written and corrected until they work perfectly, you can't change computers. Although IBM is the most notorious user of this strategy, all computer manufacturers practice lock-in whenever they can.

But lock-in is not limited to the manufacturer of computers. It also is practiced by the so-called "computer center," the department within a company, university or government where the big computers live. Initially designed to provide centralized, efficient computer service, the computer center has evolved into an internal tyranny set up to operate at its own convenience and dedicated (like any organizational entity) to its own self-preservation. The computer center, of course, always wants a better (read bigger) computer over which it has exclusive control.

Today, thanks to small computers that are cheap enough to bypass the "computer selection committee," the internal monopoly of the computer center is coming apart at the seams. According to Portia Isaacson, part owner of Houston's Micro Store, little computers have already penetrated large companies without the knowledge of the computer centers. The Trojan horse is already inside the gates. "I'll sell you a computer under any name you like," says Isaacson. "You'd be surprised at all the different things we call them on the sales slips."

Lock-in also is a strategy employed by individuals—programmers and technicians primarily. If you are the only one who understands the computer system you've created, you can't be fired. All you have to do is look more and more harried each day, keep longer and longer hours, and demand raise after raise. Said one programmer, "I always tell them that if it can't be done in COBOL (the standard business-programming language) it can't be done by computer. It saves me an awful lot of trouble." The case was well made by Robert Townsend in his best-selling book, *Up the Organization*: "Most of the computer technicians you're likely to meet or hire are complicators, not simplifiers," he said. "They're trying to make it look tough, not easy."

• • •

This is a critical time for the home or personal computer. In the very near future virtually every device or appliance costing over $50 will contain computer *chips*, but it is unlikely that we will be able to treat them as computers. Each device will be programmed to behave in a specific way when you touch its buttons, but there will be no tie-in. (Sometimes this situation is called "distributed intelligence.") For example, the automatic "trip computer," already available in Cadillac, has its own fixed repertory of behaviors as does this portable telephone-memorizer (now available for about $70) and the box you can preload with your appointments (at several hundred dollars). None of them can be together. Each one locks you in.

This is not Computer Liberation. It is just crowding us with more gadgets.

Only if the personal computer can perform a unifying function, only if it can both keep records and orchestrate our accessories, can we derive full benefit. If all we get is a lot of separate gizmos the computer revolution will fail.

Unification is not easy. It requires deep and thoughtful design. Unfortunately, so long as people buy cameras they can't understand and hi-fi sets with rows of identical knobs and switches that cannot be distinguished by touch, there will be little improvement. The computer manufacturers will build what people will buy. It is up to you. ∞

"So much for the black hole theory!"

Whether it's a volcano disaster in Hawaii or a "rogue wave" in the Atlantic, the Center will be there

THE CENTER FOR SHORT-LIVED PHENOMENA

BY TIMOTHY BAY

It has been a busy week at the Center for Short-Lived Phenomena in Cambridge, Massachusetts. Telephones ring in a ceaseless cacophony, bringing news from around the world of fast-breaking events on the environmental front.

A caller alerts the center to a volcanic

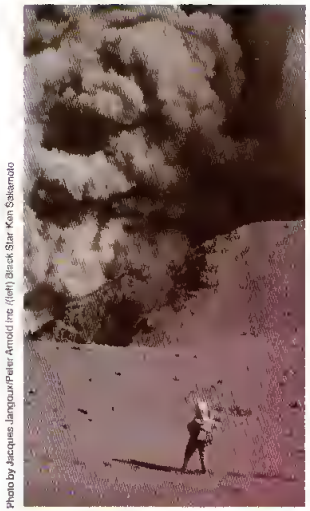


Photo by Jacques Jangoux/Peter Arnold Inc. (left); Black Star/Ken Sakamoto

Photo by John Launois/Black Star

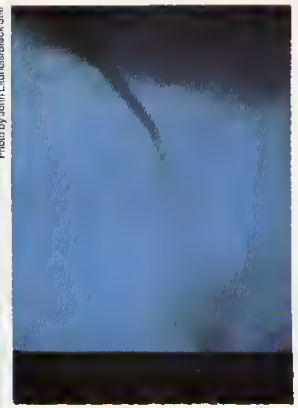


Photo by Fipp Schulke/Black Star

eruption in the Philippines, sparking a flurry of activity as staffers scramble to piece together the story. Meanwhile, someone else is trying to uncover the mystery behind a major fish kill along the Brazil-Uruguay coastline. Simultaneously, background on an oil spill off the coast of Brittany, a starfish infestation off American Samoa, and a whale stranding in Newfoundland are brought up to date.

A phenomenon in its own right, the Center for Short-Lived Phenomena (CSLP) is more than just a global news service covering the environmental beat. Its continuing analysis of a rainbow-range of both man-made and natural events provides scientists with the stuff to understand shifting forces and larger patterns in nature. Since its founding ten years ago by the Smithsonian Institution, the center has compiled dossiers on over 2500 natural events, aberrations, and man-made accidents.

Raining fish in Australia, a meteorite fall in Louisville, the eruption of a submarine volcano off the coast of Japan, a tanker disappearing off Nova Scotia, strange sonic booms along the East Coast, a fireball in the Rocky Mountains, discovery of a new species of shark in Hawaii, a dangerous leak in an Italian chemical plant—these events and others are dutifully monitored, recorded, and stored by a crack team of "aggressive" environmental reporters. Large sectors of the globe are hooked into this information resource. But the center is evolving a wider base. It is promoting a new-age awareness of man's close and life-sustaining relationship with nature.

"The center has become more than just an information clearinghouse for industry and government," declares CSLP director Richard Golob. "Today, many people—in this country and around the world—rely on it for an understanding of the pulse of the planet."

Already, the center has in a modest way moved into the streets. Above a kiosk in Harvard Square, an electronic message display spills out news from around the world. A first step, it is part of a much larger mission taking shape at the center: a campaign to raise people's environmental consciousness.

A few blocks from Harvard Square, the center is headquartered on the second floor of a renovated white frame house. A warren of rooms contain bulletin boards filled with center news, filing cabinets, a few pieces of office furniture, maps, and telephones. The staff is young and hard-working, mainly recruits from the Boston academic community. Only five staff members operate the center, but a far-flung network of some 2000 correspondents—government officers, scientists, journalists—are its eyes and ears around the world. When one of these informants phones in an event alert, the staff immediately places calls to confirm and flesh it out. Once verified, the report is edited and then reproduced for airmail delivery to subscribers around the world. Initial notifications are then followed up with reports tracing the event's life history.

A typical correspondent was the army man stationed at the North American Radar Air Defense (NORAD) base in Cold Bay, Alaska, who kept the center informed on a local volcano—when he was not monitoring radar screens. This amateur volcano watcher organized an entire network of reporters in the Aleutians. Because of its credentials, the center has access to scientists who are more willing to give it information, rather than pass it on to the media.

Over 1500 subscribers pay to be part of this hotline. The subscriber list reaches from major media, like the *Los Angeles Times* and the Associated Press, to academic and research outposts, as well as into the Fortune 500 reaches of big business. Corporate giants, like DuPont, Texaco, Exxon, subscribe to the news reports because of the up-to-date reporting of oil spills, chemical leaks, and other industrial accidents. Major oil companies make large corporate contributions to the CSLP to ensure immediate and comprehensive reporting of pollution incidents.

Scientists have tapped this resource in a variety of ways. Data compiled by the center, for instance, have helped scientists develop better, more accurate predictive models of volcano activity. Emergency relief organizations use CSLP resources to upgrade planning so they can better handle the effects of natural disasters on population centers. Major companies incorporate CSLP reports to strengthen oil spill response plans. Mobil Oil is now working with the center to evaluate the effectiveness of dispersants, chemicals that break up oil slicks. The center has also collaborated with the United Nations Environment Programme in compiling a directory of worldwide pollution monitoring programs.

Because of the CSLP's digging and journalistic footwork, a simple phenomenon may be shown to have much greater significance than a first glance would indicate. What seems like an isolated event is connected to a much larger ecological chain of life. A typical example occurred in the fall of 1976, when five million squid came ashore on the beaches of Cape Cod. Natives and scientists were baffled by the event, and the local media treated it as something of a joke. But the center did some snooping, and what they found was far from comical. The extraordinary influx, they warned, could very well be related to declining populations of cod and haddock, which prey on the squid. In turn, they suggested that the high body count washed ashore might be traceable to chemical pollutants or to a rapid temperature decline in the water.

Similarly, when sonic booms mysteriously began resounding along the East

Photo by Gerard G. Schaidle/Peter Arnold Inc.

Photo by Jim Goodwin/Photo Researchers

(Preceding pages) Kilauea volcano in Hawaii violently blows ashes sky-high in 1964 eruption witnessed by Center correspondent. Top left: Center is still mystified by 1969 deaths of thousands of shearwaters, a long-winged sea bird, off the North Carolina coast. Top center: Center issues immediate reports on major oil spills, such as this one that ravaged France's Brittany coast. Above: Hurricane Belle threw this 13.5-meter (44-foot) ketch clear out of the water and through a stone wall in its 1976 rampage through Norwalk, Connecticut. Center is interested in any severe storm erosion. Left: Wrecked car rests amid debris from Los Angeles earthquake. Center catalogues all quakes over 7.0 magnitude. Top right: Hurricane Cleo.

Photo by Bob Evans/Peter Arnold Inc

Photo by Stephen J. Krasemann/Peter Arnold Inc

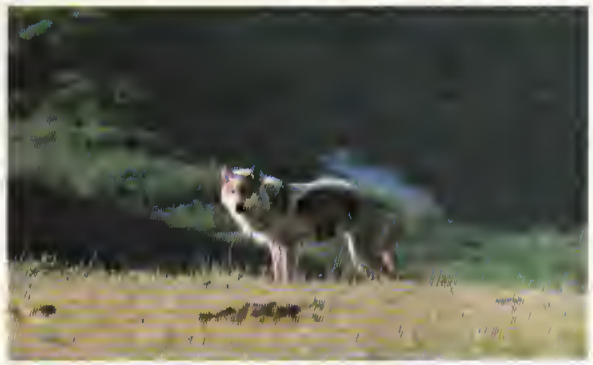


Photo by Stephen J. Krasemann/Peter Arnold Inc

Photo by Stephen J. Krasemann/Peter Arnold Inc

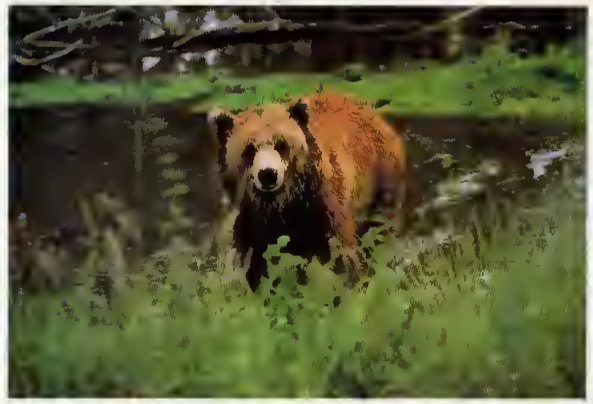


Photo by Clyde E. Smith/Peter Arnold Inc

Top left: Elephant seal sounds his mating/battle cry as he prepares to fight all comers for sexual rights to seal cows off California coast. Males often maim, even kill, each other in this sexual/social ritual. The Center is on the lookout for any event that could disturb animal mating habits. Top center: Center correspondents are also on constant alert for rare or sudden bird migrations or other animal movements. Above: Center reporters are concerned with this lone survivor of a previously populous wolf pack. The Center keeps an eye on all endangered species facing imminent extinction: bighorn ewes (right) and the grizzly bear (top right).

Coast last year. CSLP was called in on the case. During this period, the center became mission control for boom reports: a central switchboard tying together various regional reports. Working with government groups such as the U.S. Naval Research Laboratory and the Congressional Research Service, staffers rolled up their sleeves and dug in. Center director Richard Golob recalls the investigation; his account neatly illustrates how CSLP research methods pay off.

"We checked our files and talked with CSLP correspondents," Golob recalls, "only to discover that similar sonic boom phenomena had occurred in England the year before. These previous sonic booms had been tied to the arrival and departure of the SST at airports near London and Paris. Apparently, sound waves propagated by the SSTs had, due to unusual environmental conditions, bounced back and forth in the atmosphere—as if reflected in a series of mirrors. This effect increased the range of the booms from 10 to 20 miles to more than 100 miles."

The center, he continued, did some more digging only to find that these UAOs (Unidentified Audible Objects) had been occurring in Nova Scotia at roughly the same time as the booms reported off the East Coast. Speculation proliferated. Some people explained the booms as methane gas emissions, earthquake precursors, and even close encounters. But the center linked these episodes up to the earlier European boom reports, theorizing that unusual environmental conditions were again the precipitating agent.

"We felt that given their regularity during weekdays and only during certain times of each day, the booms were connected to man-made activities," Golob explains. "The booms were undoubtedly linked to SSTs or military planes breaking the sound barrier during a period of temperature inversion."

Their biggest coup came at the end of 1976 with an exclusive on the ill-fated history of the *Argo Merchant*. Within hours of her grounding off Nantucket, the center revealed that the ship had a legacy of disaster, involving some 18 previous accidents, including two previous groundings and other mishaps. A source in the tanker industry gave the center the exclusive, a scoop that was immediately picked up by papers across the country.

The *Argo Merchant* episode dramatized to the American people the danger of oil spills. But to Golob, it also emphasized how limited—fixed in a regional viewpoint—is our awareness of the problem. "All around the world, there are oil spills," he declares, "but it takes something in our backyard to alert us to the danger." He mentioned a disaster involving the *Urquiola*, a tanker that grounded in a Spanish harbor a few months before the *Argo Merchant*. "The *Urquiola* dumped close to 100 thousand tons of oil,' he noted, "but only a handful of people in this country were aware of the disaster."

The birth of a volcanic island near Iceland in 1963 precipitated the center's creation. The new island, Surtsey, proved a major scientific event, with volcanologists arriving on the scene from all over the world. Out of its creation emerged data and photographs providing valuable clues to the emergence of life on earth. The event also dramatized the need for some central agency that could function as both early-warning system and monitor for similar occurrences.

At that point, scientists had no central communications system. Too often, they learned about a significant natural event months later through scientific journals or secondhand accounts from untrained observers.

Five years after the 1963 volcanic eruption, the Center for Short-Lived Phenomena was created on a shoestring budget by the Smithsonian Institution, with a staff of two people. At that time, its mandate was to cover only natural events. During the next few years, the center built up its circuit of correspondents and developed a scientific influence far out of proportion to its size.

In 1975, the center set out on its own, breaking away from the Smithsonian and its economic subsidy. The center's focus was changing. They were incorporating man-made events—such as chemical leaks and oil spills—into their field of study. Its constituency was also beginning to grow, moving beyond the sectarian boundaries of the scientific world and into business and the general public. "The split was amicable," says Golob. "It was simply that we had outgrown our original role and were moving on to other things."

Today, the center is diversifying and learning how to imaginatively market its services. It is looking around for ways to reach a larger audience—as well as pay its bills. Says Golob: "It takes some $150,000-$200,000 per year to run the center. Money-making ideas are proliferating, as are ways to expand the center into a multimedia resource. For example, the center, in collaboration with a Boston publishing company, has begun to publish the "Oil Spill Intelligence Report," a weekly newsletter that will provide subscribers with thorough international coverage of oil spills as well as updates on cleanup technology, legislation, research conferences, and publications. Golob is also discussing the possibility of documentary films with tv and movie producers and is roughing out a possible book, which would be a compendium of odd and significant environmental events.

Beyond these merchandising projects, Golob has a far-reaching vision of the center's future. The 27-year-old director is the center's entrepreneurial motor as well as its chief tactician. Boyish, self-

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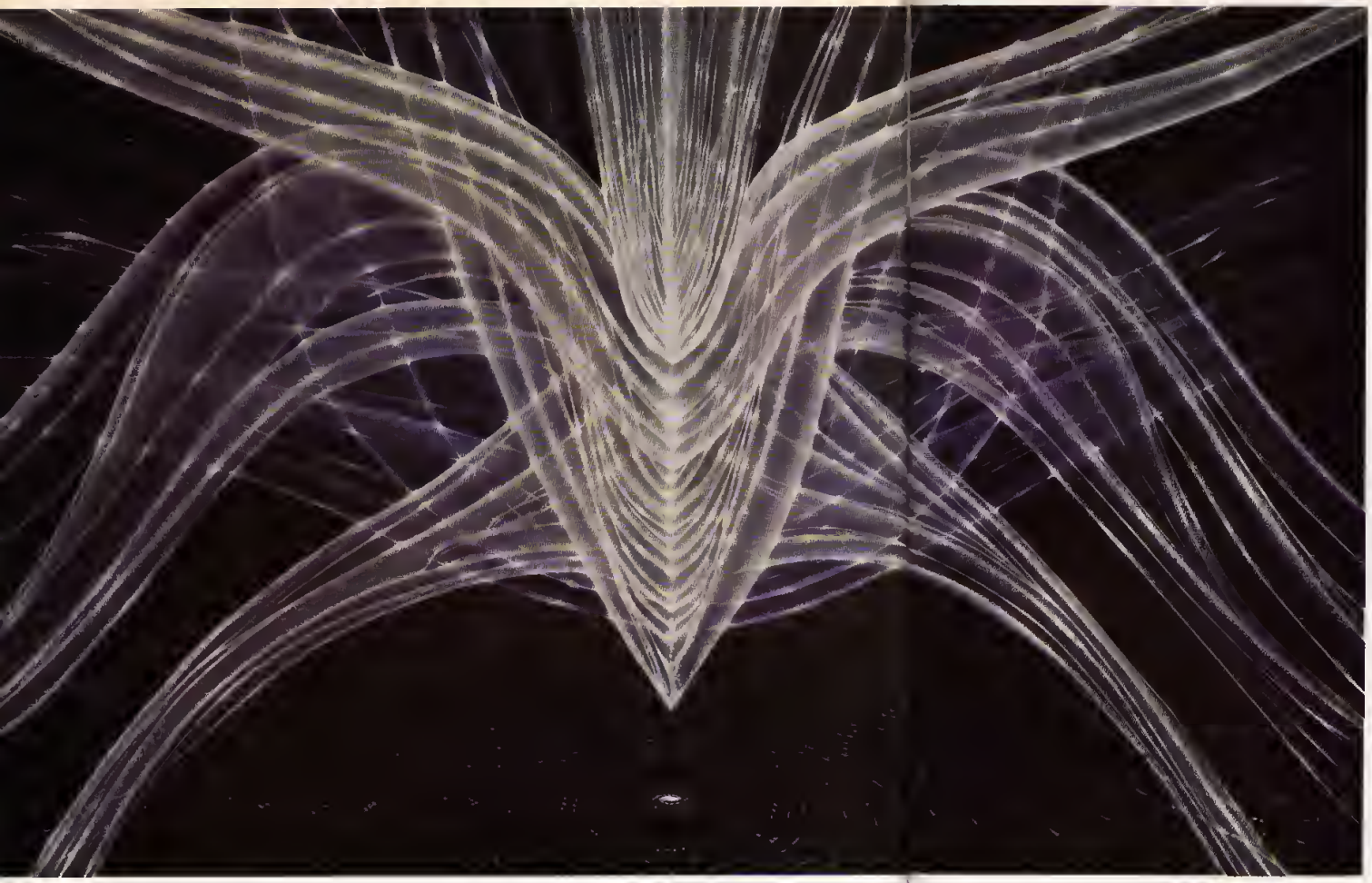


He used to search for his own kind, but after the great massacre in his fifteenth season, he hadn't had but a fleeting contact with others—a warble, a rumble, and a squeal that had come to him after endless traveling through the message-carrying waters. Loneliness. That was all any of the others spoke of.

He bellowed his foghorn bellow, feeling the water around him tremble with his giant voice. He rose, the spray of infinite bubbles tickling against his skin, exhaling with a vaporous gush of relief, sucking in precious air. For a moment, suspended above the sea, no longer rising but not yet falling, he squinted in the yellowness of the outer world, feeling the warmth of dry air on his massive head

WHALE SONG

Hunting whales was their way of life—and path to death.

BY LEIGH KENNEDY

PAINTING BY BOB VENOSA

Above, a pale-blue flatness struck against the rich blue-green of his world.

Below again, sailing downward, pulling the division between the pale and the rich in a confused whirl behind him, he cried out in a squeal that ended with a honk.

Maybe someday someone would hear if he called.

Dr. Marsha Scott leaned into the viewscreen as if pressing close would undo the separation between herself and the sea. Inside—a man-refuge of metal and plastic and nylon with gauges, dials, switches, lights, and papers clipped to the walls with strong magnets. Outside—a blue mystery that faded into an opaque universe where odd creatures darted, crept, or floated sleepily.

"Where are you, pretty one?" she called through the viewscreen, searching for a great whale shape in the foggy water. 'Come on, come on, we heard you. Don't be shy.' Encapsulated in the submarine, her soft human voice was of little use.

The cabin of the mini-sub was filled with squeals and twitters, sometimes mournful sounds, sometimes comical. The alien metal bubble of the sub was endowed with eeriness from ascending and descending scales—ocean concertos accompanied by the microphone's brooklike interpretation of the water rushing around the sub.

Barbara rose from the pilot's console to stand by Marsha and peer into the screen. "I think I see her. Look there." Barbara's keen pilot's eyes were seldom wrong, something Marsha had learned to appreciate in her. Just as Marsha trusted Barbara underwater, Barbara seemed to defer in the lab. A well-suited pair of researchers needed that kind of trust. Barbara pointed to a vague, distant movement in the upper right corner of the screen. They both watched, wondering whether it was only a cloud-shadow changing the color of the water or a thick school of fish or plankton—or the solo female whale they had traced earlier in the day, following the trail of irresistible scent they had puffed out just for her.

The whale made a sound equivalent to a human flapping his lips obscenely.

The two women laughed, though they had heard the same thing endless times. Marsha felt an uncomfortable, guilty happiness. Sometimes she felt as though she should be sad every moment of her life, considering what was happening to her whales. But she couldn't help but feel glorious joy when she was this close.

"Definitely," Barbara said coolly.

They smiled at one another, then Barbara returned to the console. Marsha watched over her shoulder to see the course change. Barbara punched in an 18-degree starboard turn. Marsha looked to her left, checking the tank gauge for the whale "perfume," as they called their solution of pheromones, though to the whales themselves it was more a matter of taste than scent. The tank was still three-quarters full, though they'd traveled far from the coast leaking a fragrant trail.

Marsha felt the change in course even before she looked back at the viewscreen. She waited to ask, knowing that it would take a distance to be able to discern whether the whale had changed course with the sub.

'Sonar?' she finally asked.

"We're being followed," Barbara said.

Marsha knew, even halfway through her talk, that the lecture rebounded off the Eskimos' emotions. They watched the film of the Japanese whaler-factory ship, not comprehending the significance of massive killing. The tape of whale songs didn't bring even the expected vague smiles of amusement. Mostly men in flannel shirts and jeans, smoking cigarettes until a blue haze lay in layers from the basketball hoops to over their shoulders and round, brown faces like a gauzy blanket, they sat on metal folding chairs in the modern gymnasium of the village school.

"The cabin of the mini-sub was filled with squeals and twitters, sometimes mournful sounds, sometimes comical... ocean concertos accompanied by the... water rushing around the sub."

Only two people seemed to show any signs of listening, an old man and a young man. The old one moved restlessly in his folding chair, looked around at other impassive faces. He seemed horrified by what she said. When she explained that there had been no recent sighting of an adult male bowhead, the old man whispered, "Gone! Gone!" to Marsha's distraction. The younger man—awkward, silent, apart—took a pen and a small notebook out of his shirt pocket every now and then and wrote briefly. The rest sat with their arms crossed or hands on their knees and simply watched her with shuttered expression, having found she would say exactly what they expected. Please, please don't kill any whales this year.

They had heard it before. For years Marsha knew about the Eskimo—she knew that the whale and the Eskimo had lived a life together for thousands of years; she knew the customs and even a few words.

"Understand," she said, sweating and too warm for the first time in three days, 'we are not asking this because we are anti-Eskimo. There will be no whales ever, ever again if you kill them. The rest of the world has finally stopped. If you will leave them alone, they have a slight chance. At my University, we've been working with a chemical to draw all the whales together at mating season. It's called a pheromone—a hormone like the ones the whales themselves make—that attracts the whales who have gotten separated from schools.'

Marsha longed for a glass of water, but no one seemed to notice her hoarseness. She explained carefully about pheromones, that most animals seemed to have these, but they were hard to make in the laboratory. Appreciate the work I've done! she wanted to shout. Understand how important you are and why! But she lectured on steadily, feeling like a beached whale, suffocating from their resistance like a whale suffocates under its own weight when out of its cool, blue world.

'Clever!' the restless old man muttered, watching her with bright eyes.

Hope. She found herself speaking to him and the note-taking young man, not even seeing the sleepy looks that now graced those other faces.

She finished. "Thank you." And they said nothing. Watched her until she collected her notes and put them into her folder. Fingers and lips trembling, head pounding, she crossed the gymnasium through the rows of folding chairs, across the slick varnished floor, into the dimly lit corridor, looking for the drinking fountain. Behind her, she heard the villagers suddenly come to life. Gulping cold water, she heard the sound of argument. She stood in the doorway and saw the old man getting up from his folding chair, glaring at the man who reached out to his arm as if to convince him to stay.

"George!" one of the other villagers said, wagging his finger at the old man. "Who killed those whales?'

"Leave me alone, dammit!" restless old George said. "Even if they did the slaughtering, they've left us the worst! The worst!"

Marsha watched them bicker for a few moments, talking about centuries of Eskimo life, how the Eskimo look at the world now—bullied by biologists and ecologists, plagued by those bug-eyed beak-faced people from the south. She felt a hand on her shoulder and saw Dr. Thiel's sympathetic eyes.

'How are you?' he asked.

"I ache," she said.

In the spring, he moved from the warm south to the cooler waters of the north; in the fall he moved southward again. He drifted naturally through his life, thinking about patterns he saw, music he heard, learning new things every season as he migrated from one place to another. He'd become fond of exploring deeper in the trenches, conditioning himself even beyond his innate ability to stay under a long

while before surfacing for a breath

He felt the changes in the water sliding around him as he dipped and glided. A trailing swirl blossomed into oily spirals, a cool taste of the north sifted through his sievelike baleen where the plankton collected in his mouth for a continuous meal, the subtle changes in sounds reverberated through the sea, all giving him a feeling of purpose.

Slowing down to enjoy a bright arrangement of ocean flora—blooming in orange and pink and pale yellow ruffles, surrounded by softly waving green tendrils—he felt almost content.

He sang.

He was going home.

When the phone rang, Marsha woke completely and not at all. She bolted out of bed without conscious thought, a reflexive response. It took her a few seconds to remember to speak. "Hello."

"Marsh, they're going on the hunt anyway," Barbara said.

She stood dumbly with the phone to her ear, bending over the lamp table, her thigh-length nightshirt not adequate protection against the news that her world was about to be destroyed.

"Marsha?"

"What?" she said breathlessly.

"What are we going to do then? Maybe we could fly up there and talk."

"I don't think so, Barb. I *did* talk."

"What about taking the sub?"

Marsha had considered that already. "We'd never get that far, that fast. Besides, the school wouldn't let us take it on such short notice." Marsha finally sat down in the rocking chair. She liked talking about possibilities, even though she knew there were none. It was comforting. Somehow it gave her the illusion that there was still hope if they talked enough.

"I'm coming over," Barbara said.

"All right."

She hung up and sat in the dark for a long while. Time, distance, time, distance.

How to make them less? Less distance. Makes more time. But what.

She stood, rigid with excitement. Then she went to her desk and flipped on the light. On the wall a detailed map of the Pacific stretched across more than a meter of wall space. She traced the lines of various colored pencils, twisting her head this way and that to read the notations. Rubbing her face sleepily, she sat down and punched in a series of numbers on her small calculator. When the doorbell rang, she was still staring up at the map. She got on a pair of jeans and trotted to the doorway. "Barbara," she began right away, "do you still know that fellow with the plane?"

Barbara brightened, aware of a less hopeless tone. "I'll renew my acquaintance tonight if need be."

"Okay." She pulled Barbara by the elbow to her map and pointed to spots along the Bering Sea and north of St. Lawrence Island. "We're going to drop some phero-

CONTINUED ON PAGE 136

TEST TUBE BABIES

The most heralded birth in 2000 years, the first test tube baby may be a breakthrough more psychological than real

BY TABITHA M. POWLEDGE

In a freezer somewhere in New York City there's a test tube whose contents may interest you. They interest me. And they certainly interest Columbia University and its affiliate, Columbia Presbyterian Hospital, because a jury told both of those estimable organizations last summer that the test tube was going to cost them fifty grand. Not bad, considering nobody even knows for sure what's in that test tube.

What's probably there is some semen from a middle-aged dentist and bits and pieces of the female reproductive apparatus, including, perhaps, one or more eggs. What's possibly there is a human zygote—a fertilized egg that had begun to divide, almost through with the first day of its nine-month journey toward the delivery room. What's definitely there is Doris and John Del Zio's hope for a test tube baby as a result of *in vitro* fertilization down the drain or, rather, down the freezer.

Unless you vacationed underneath the North Pole, you are aware that last July we were treated to the most heralded birth in 2000 years, that of Louise Brown, the first human being acknowledged to have been conceived *in vitro* (that is, in a laboratory dish). Louise was the culmination of many years of effort to overcome a particular kind of infertility in which there is blockage of the fallopian tubes, the passage that monthly guides an egg from the ovary to its final destination in the womb. If these tubes are blocked, sperm can't get to the egg to fertilize it. *In vitro* fertilization involves an attempt to bypass that blockage by operating on a woman to remove some eggs from her ovaries and fertilizing them (in a Petri dish, actually, not a test tube) with her husband's sperm, "obtained manually," as the doctors delicately put it. The resulting embryo is grown in the lab for a few days and then

ILLUSTRATION BY JEAN PAUL MERZAGORA

"In vitro fertilization has spawned concern about birth defects, the denial of human rights, and even the possibility of wombs for rent."

Implanted, via the vagina and cervix, into the woman's uterus. From that point, the pregnancy proceeds in the usual way.

Louise was born in Britain but it could have been an American first. It should have happened in New York, in the spring of 1974, or so say the Del Zios, who successfully sued the university, the hospital, and Raymond Vande Wiele, head of obstetrics and gynecology there, for bringing to a halt (by placing the test tube in the freezer) a similar attempt being made on their behalf by one of Columbia's researchers.

In his defense, Vande Wiele listed several reasons for his action. One of them was that as a member of a special committee set up by the federal government to examine the matter, he knew that there were a lot of unanswered questions about the moral and legal propriety of *in vitro* fertilization and that the government was holding off underwriting any of it (a decision tantamount to an unofficial moratorium), pending further public discussion.

A lot of people, it appears, are worried about the test tube babies: the Archdiocese of New York, Ann Landers, and the editorial board of *The New York Times*, as well as the right-to-lifers and proponents of zero population growth, feminists, anti-feminists, possibly even you. Do you fear test tube babies? Should you? Perhaps, but maybe not for the reasons they've told you. I list here several worries and a few reassurances.

Worry #1: Test tube babies might have birth defects. This is a reasonable fear on the face of it. *In vitro* fertilization certainly *sounds* scary. Recovering eggs via surgery, fertilizing them outside the body, letting them grow and develop for a few days and then implanting them in a uterus—a lot of things could go wrong in all that fiddling around. And in fact a lot of things probably do, which is why it took us so long to get to Louise Brown despite the fact that we've been doing all this with rabbits since 1890. Louise herself seems, blessedly, to be alright, though it's too early to be absolutely sure.

But lots of things go wrong, even in a

The extraordinary photography of Lennart Nilsson highlights the unseen world of the growing fetus. At only four months of age the rich complexity of the sophisticated system of blood supply can be seen extending through the arm (left) and into the face and brain (above).

pregnancy achievad in tha usual way It is estimatad that at laast 20 parcent of conventional concaptions navar make it to labor and about five percent of thosa that do suffer some kind of birth defect So Nature is not altogathar parfect aithar Furthermora, much of the animal work on *in vitro* fertilization is rather soothing on this point, animal embryos appaar to be astonishingly resistant to damage during transfer, and the damaged ones don't survive On that score, we're not likely to diffar much from mice

Worry #2 Test tube babies will suffar psychological damaga bacausa of all the publicity In other words, out of the test tuba into the goldfish bowl Remember the Dionne quintuplets? Poor Louisa, it is too bad her parents couldn't resist the media madness but how many people can resist their only chance for limelight, glamour and money? Maybe, with the precedent of the Dionnes batora them they will manage it all more sensibly And maybe if she knows she was one of the most wanted babies in human history, that will compensate Of course tha publicity problem will apply almost exclusively to Louise subsequent babias born of *in vitro* fertilization will be greeted first with a few polita handclaps, than with yawns, and then, alas, with an ear-piarcing silanca We will all be paying attantion to some difarant nine-day wonder

Worry #3 Laboratory manipulation of a fertilized human egg denies to a human baing its basic rights This is a complicated worry with a number of sub-worries a It is experimentation on a human subject, the zygote, without that subject's voluntary informed consant Since, of course, such consant can never be givan, this work will always be unethical

b Sinca a number of aggs are often fertilized but only ona salected for implant, discarding the others is a form of abortion

c Researchers who pursue *in vitro* fertilization because they are intarastad in very early human development and who have no plans to implant tha results are, when they discard those results, indulging in the wanton destruction of human life

All of thasa worries rest on the belief that human life bagins at the moment of concaption. The abortion melee has shown us that thara ara those who believe this and those who don't Such opinions are, for tha moment at least, articles of faith rather than rationality It does not, however, make much sanse to adopt the policy of protection of each fertilized agg in tha laboratory when we have made the political decision that women should have the choice to abort or not for up to two-thirds of a convantional pregnancy

But evan people who think women ought to have that freedom are sometimes troubled at tha idea of the wholasala dispatch of human embryos, no matter how laudable the purpose, because of what those embryos might have been We might, therefore, want to set limits on the kind of things a researcher can do with the products of *in vitro* fertilization and also require that those products be treated with dignity and disposad of with decorum (as is the rule with cadavers in anatomy labs) Such steps will not, of course, satisfy the absolutists on aither side, but no other compromise would either, so we might as wall try to soothe those many of us who waffle around somawhara in tha middle

Worry #4 Isn't it crazy to spend monay, tima, and brainpower solving people's infertility problams in an ovarpopulatad world? The answer is yes, it is Infertility research of all kinds (not just *in vitro* fertilization) should be a low-priority item on our national agenda That's a position I've always found good for a few angry letters to the editor, accusing me of being inhumane and unfeeling and insisting that people have a right to children of their own Do they? No matter what? That's a proposition we need to examina closaly in an era of scarce resources Infertility is a great sorrow, but it is only one of many plaguing humanity and nowhara near the most important one, aither For one thing,

CONTINUED ON PAGE 146

The fetus (left) is four months old, more than six inches long and already weighs about seven ounces. Though his eyes are closed, he is an active fellow, clutching and grasping with his hands and pushing outward against the amniotic sac that contains him in a near-weightless environment. All of his organs are now formed within his fetal body, and he is in a period of simple growth–the forming of the eyes (above, left), the veins of the legs (above, right)

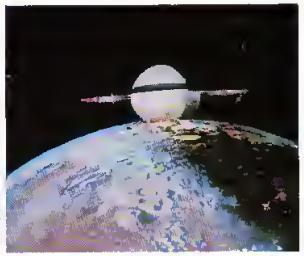
UNSEEN WORLDS

Artists have played a vital role in the exploration of space—outer and otherwise. In the 19th century, landscape painter Thomas Moran accompanied the Hayden expedition that first explored Yellowstone. Moran's heroic canvases depicted the virgin natural wonder of the region; they helped convince Congress and the U.S. public to set aside Yellowstone as our first national park.

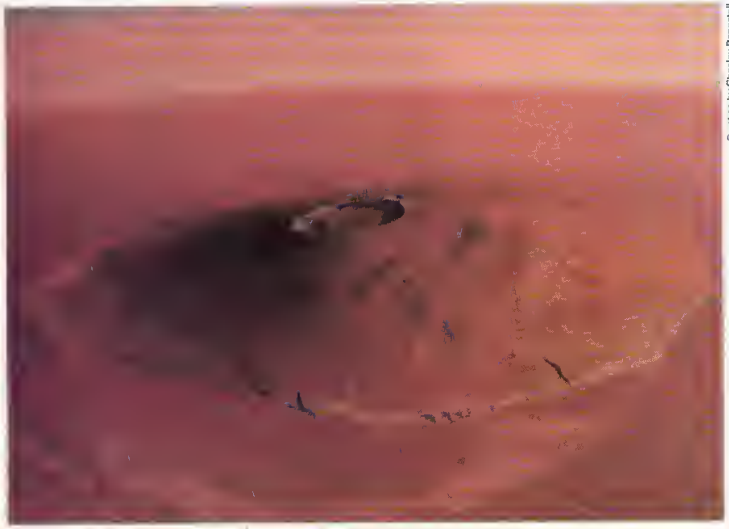
Clockwise from below: A balloon probe descends on Jupiter in Adolf Shaller's painting; Chesley Bonestell's vision of a red Martian volcano; the earth as seen from the moon by Charles Bittenger; Don Dixon's re-creation of earth's early capture of the moon, and his view of Saturn from its largest satellite.

Painting by Charles Bittenger

Painting by Don Dixon

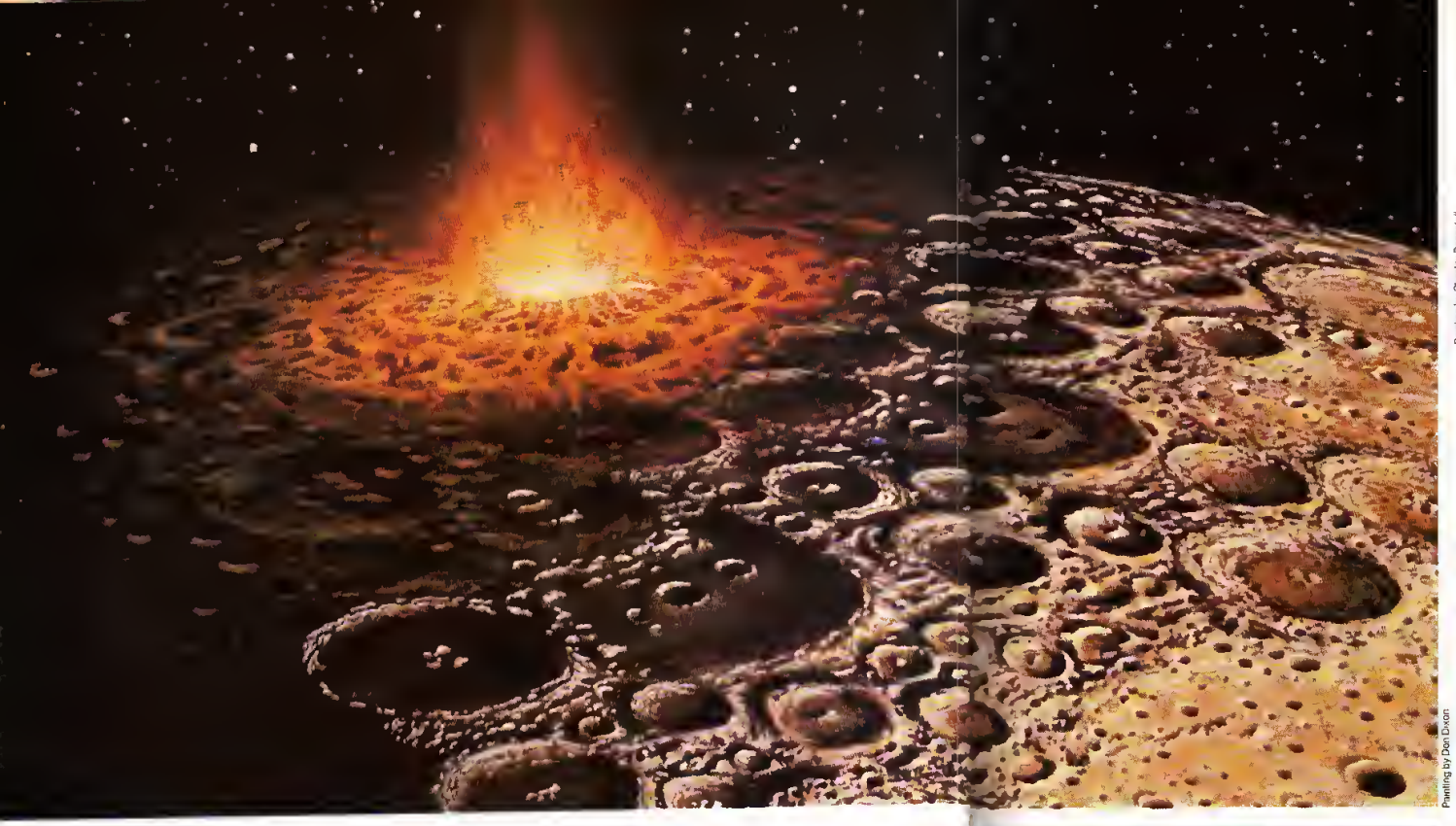


Painting by Don Dixon



Painting by Chesley Bonestell

Painting by Adolf Schaller



Painting by Don Dixon

Lava (left) erupts through a moon puncture Below Mercury's surface Bottom Saturn seen from a close moon and a 1929 vision of a space station

Painting by Chesley Bonestell

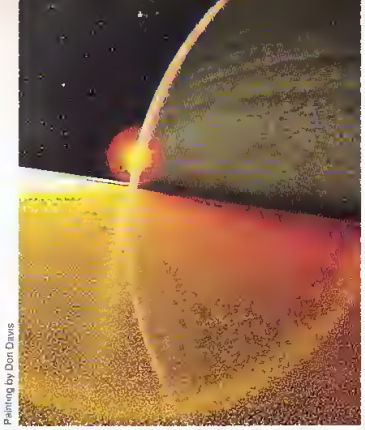
Artists have had a similar impact this century in astronomy Their task has been a difficult one to illustrate the unseeable They have taken astronomy—with its benumbing mathematics and interminable star fields—and turned it into stunning, yet accurate visions the public can understand There is little question that the taxpayers rallied behind the U S space program in part because of magazine pictorials that showed them what planets, moons comets, and the distant reaches of the galaxy might look like when we can get there in person

One of the earliest—and best—space artists was Lucien Rudaux Rudaux was both an artist and a professional astronomer, and his lunar paintings done in the 1920s and '30s bear an uncanny resemblance to *Apollo* photographs His imaging of Jupiter s cloud belts and zones (see page 90), though 40 years old, is as accurate as any picture of the planet before 1973, the year the *Pioneer* flyby brought us direct photo-

"The space artist's task has been a difficult one: to illustrate the unseeable."

Painting by Ludek Pesek

Painting by Frank R Paul



Painting by Don Davis

Painting by Chesley Bonestell

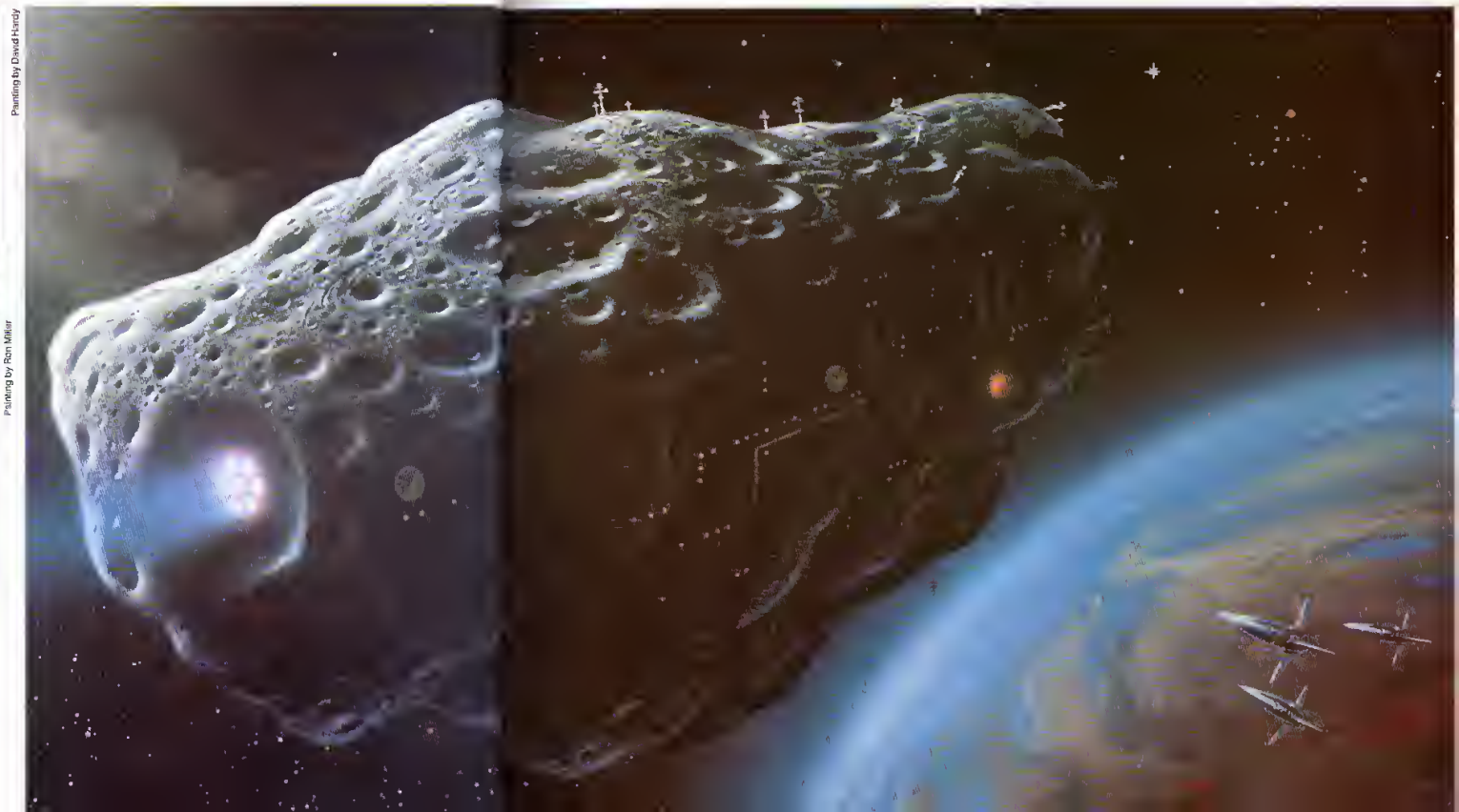
Science fiction has inspired some of our most imaginative space paintings.

graphs of Jupiter—a remarkable accomplishment for either art or science.

Some of the most imaginative astronomical art appeared in science fiction magazines of the 1920s and 30s, a good example would be Frank Paul's space station (page 85). Many Americans got their first glimpses of our universe in pulp periodicals with names like *Amazing* and *Astounding*. A breakthrough of sorts occurred in July 1939, when *National Geographic* published the paintings of Charles Bittenger, including his view of the earth as seen from the moon (page 82). Bittenger's paintings were among the very first to appear in a popular, nationally distributed—and "respectable"—magazine. To be fair to the science fiction pulps, many critics feel that some of their astronomical artwork in the 30s was far more accurate than that published by the *Geographic*.

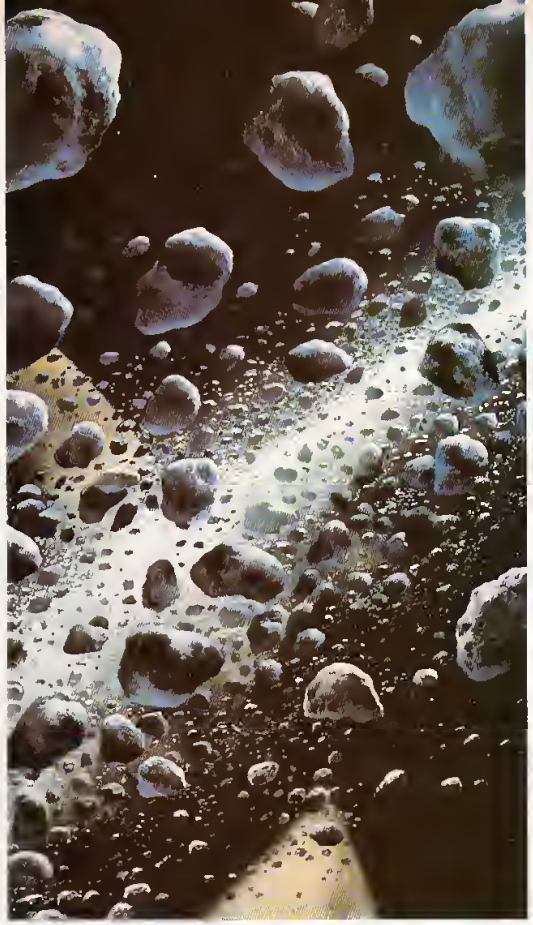
In 1957 the *Geographic* redeemed itself with the article, "How Man-made Satellites Can Affect Our Lives," accompanied by beautiful paintings of satellites in orbit—coming forth at a time when only the Soviets had a satellite in space, just a

Painting by Ron Miller

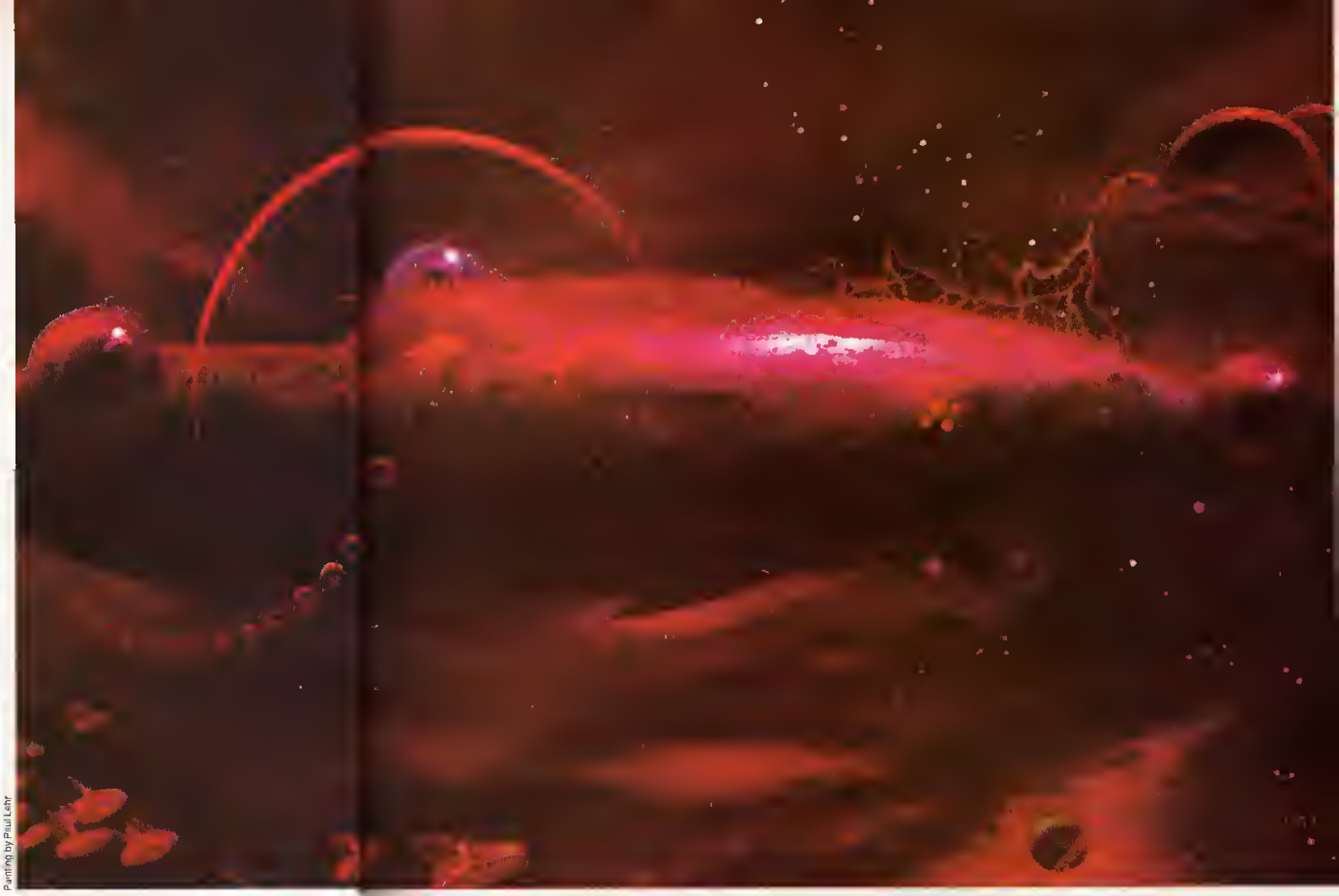


Painting by David Hardy

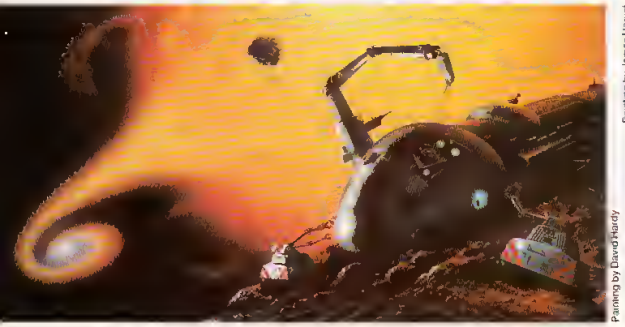
Counterclockwise from right: An asteroid hollowed out to form a "space ark". Bonestell's version of Saturn seen from a nearby moon. Don Davis's vision of what a solar eclipse would look like viewed from Saturn's ring, astronauts explore a Saturnian moon.



Painting by Ludek Pesek



Painting by Paul Lehr



Painting by David Hardy

Painting by James Hervat

single *Sputnik. National Geographic* also introduced the incredible Ludek Pesek to American readers in 1970 (see Pesek's visions of Saturn, pages 85 and 88).

But perhaps the greatest of all space artists is Chesley Bonestell. His now-classic books—with text by Wernher Von Braun—were doubtlessly influential in glamorizing the appeal of space exploration (Bonestell's work can be seen on pages 82, 85, and 86.)

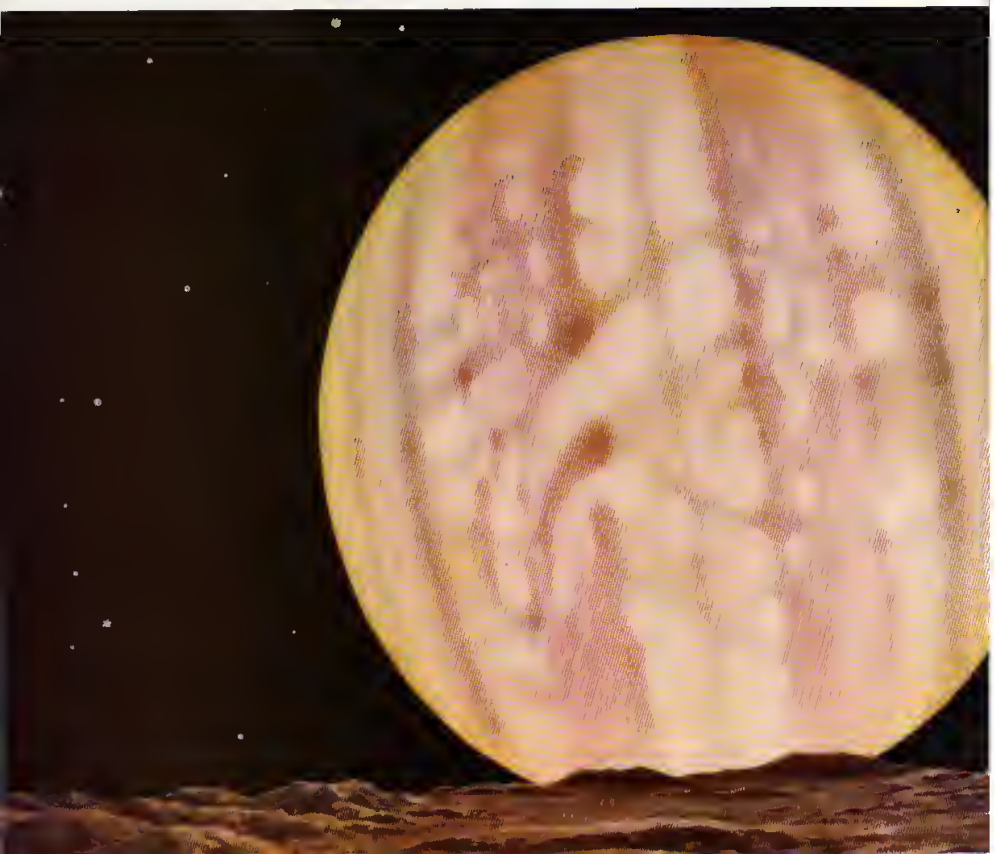
Counterclockwise from above: Paul Lehr's surrealistic spacecraft combines elements of hardware and organic forms. Ludek Pesek's conception of what it would look like inside Saturn's rings, which are composed of millions of rocks and moonlets of ice. A spacecraft makes emergency repairs on a small planetoid. James Hervat's re-creation of a Mariner 10 flyby of Mercury.

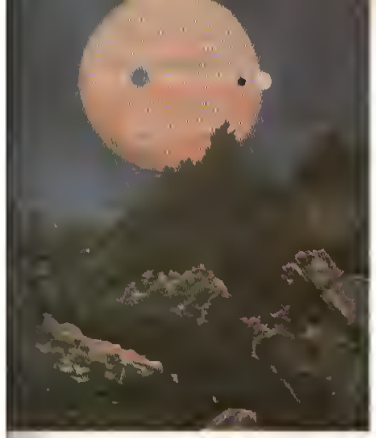
"Would we have gone to the moon had not artists first painted the way?"

"This curious marriage of fact and fantasy has opened a path to the stars."

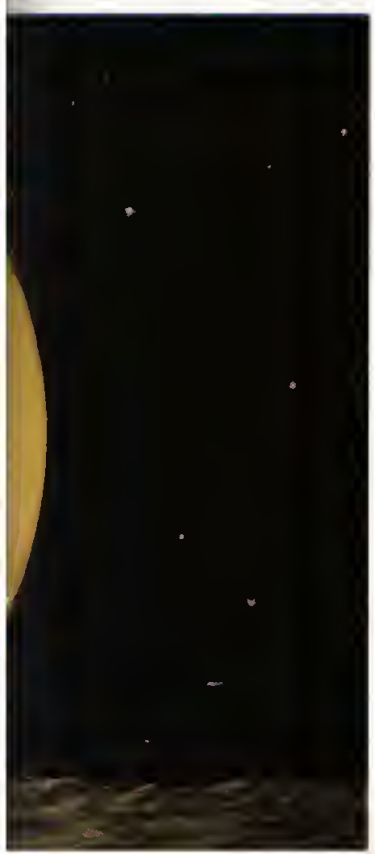
All the art reproduced here has been taken from the newly released book *Space Art: A Starlog Photo Guidebook*, compiled and written by Ron Miller, former art director with the National Air & Space Museum. Published by *Starlog* magazine, it's available in Walden and Dalton bookstores, or may be purchased directly from Space Art, Dept. 10, O'Quinn Studios, Inc., 475 Park Ave. So., New York, N.Y. 10016. The paperback edition is $7.95, the deluxe gold-stamped slipcase edition, $12.00. Include $2.00 postage and handling fee for each copy. ◻◻

Counterclockwise from below: This Lucien Rudaux painting of Jupiter, though 40 years old, is cited for its accuracy even today; a fire ball—an unusually large, bright meteor—disintegrates over the English countryside (artist unknown); a James Wyeth painting of Blockhouse 34 at Kennedy Space Center; Jupiter as seen from one of its moons, painted in 1927 (artist unknown).

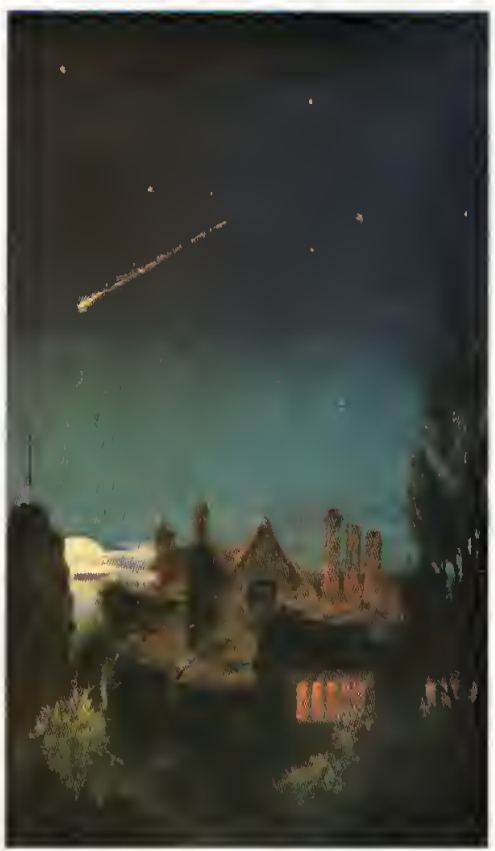




Painting by James Wyeth. Collection of Smithsonian Institute



Painting by Lucien Rudaux



Artist unknown from Splendour of the Heavens (1927)

Negative emotional states may be the critical component of all common diseases—even cancer.

LANGUAGE, EMOTION AND DISEASE

BY WALLACE ELLERBROEK, M.D.

Some years ago, when I was a little younger but just as peculiar, I was a general surgeon more interested in why people got sick than in cutting them—and equally interested in why they got well. Eventually, I decided that if I were to get any of my crazy ideas accepted, I'd have to become a psychiatrist. So I started hunting for a psychiatry residency. I was interviewed by one eminent gentleman and incidentally expressed my belief that anger and depression were important mechanisms in the induction of cancer. He sneered, not very politely, and said, "Every weekend we get at least a dozen nuts in the emergency room who have figured out what causes cancer." I asked, "What do they say?" His reply, which I treasure, was, "We ignore them . . . we have better things to do."

Better things to do? Yes, I suppose so. From his point of view we already know that cancer is caused by this, that, and the other thing. The list grows daily—just watch your newspaper.

Although I will concede that constant exposure to soot does relate to carcinoma of the scrotum among chimney sweeps in England, I have difficulty accepting the idea that everything I like is carcinogenic. I am told, in numerous scientific announcements, that maraschino cherries, barbecued meats, the water I drink, and the air I breathe are all going to lay me low. And that's not all. Eggs,

PAINTING BY ERICH BRAUER

sugar, milk, cream, butter (my wife and I probably eat several tons of these deadly items per year to the accompaniment of shrieks from our friends) are all denigrated by the utmost authorities. Leaving the worst for last, tobacco, the sin of sins, as well as coffee, the mainstays of my existence and functioning—well, they say you would be safer sitting all day playing Russian roulette with a forty-five!

This all sounds very sensible, but it nonetheless leaves me entirely dissatisfied. Some people smoke and get lung cancer, lots of people smoke and don't get lung cancer. My questions remain unanswered: why *do* people get sick? And why do some stay sick? And why do people get well, and if they don't, why not?

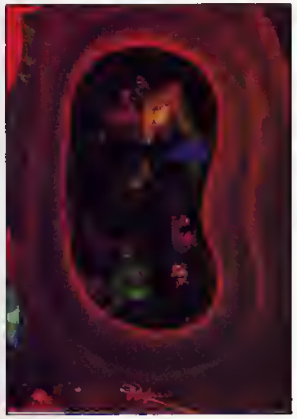
Are these impossible questions? At the moment, given the available models, it would appear so. Physicians, of course, have all the answers unless you look closely. They have names for all the known diseases—sometimes lots of names—and people do feel some relief when given a name for what is bothering them. Afflicted individuals pestilerously return to the doctor or chiropractor or, lately, to an infinite variety of gurus and complain that they feel no better.

We have doctors whose model for "diseases" are due, they say to "real" organic causes. We also have the psychosomaticists, most of whom give a fairly clear message that, basically, it is all in your head. Sandwiched in between is a new breed of patient, semi-antiestablishment, who enjoys health food a lot. This group is uncomfortable with partisans of either of the former approaches and is searching out "alternative treatment modes." In former days, people who employed such therapies were called quacks, but now they seem to be practicing holistic medicine, acupuncture, acupressure, transcendental meditation, faith healing and who knows what else. For those who want something to smear on, shoot up, or ingest, we have royal queen bee jelly, Laetrile, Krebiozen, and other varieties of rather more concrete treatments.

The really weird thing is that *all* of these work—sometimes somehow, and to variable degrees. But people still get sick. As soon as we stamp out one disease, a worse one appears. Sometimes without stamping one out, a new one starts in. It almost seems as if we *must* have disease. We have to get sick, one way or another, in spite of, and more frequently now *because of*, scientific advances.

"Iatrogenic" is an increasingly popular word for the trouble you get *after* you go to the doctor. There are even people who are hideously ill yet—to paraphrase Shakespeare—prefer to keep those ills they have than fly to medical management they know not of. Are there medical advances? Yes, of course, but if you add them all up, particularly here in scientific America, we humans should not be having high blood pressure, obesity, coronary artery disease, and on and on. I won't even mention the unconquerable head colds, sinusitis, and, in the young, ear infections, tonsilitis, acne vulgaris, and much, much more.

Yet all the same, the clues abound. Once in a great while you encounter an individual who has managed to live to an advanced age, who is not sure what doctors are for, since he or she never goes to see one, and who dies—usually while asleep—without assistance from contemporary diagnosis or scalpels. Others, it seems, are the opposite, always having something wrong somewhere. They look at you blankly when asked when they last were well. Most people are somewhere between these two extremes, having alternating periods of health and sickness over the years, the finale being some type of unsuccessful major medical ritual.



Finally, there are the so-called cancer miracles, which do actually happen, however rarely.

All this seemed clear to me in 1960 or thereabouts. I imagined that thoughts, language, and emotions had a good deal to do with illness. (For this I was considered quite disturbed by many of my associates.) The crux of the matter was that each patient, with all his or her problems, *should have exactly those problems*. The more deeply I went into that person's behavior, thinking, and lifestyle, the more sense it made. Most particularly, it seemed that unhappiness, of whatever type, was an integral part of getting sick.

I recall a charming young woman afflicted with a relatively common though obscure condition called "idiopathic cervical adenitis." This means that she had swollen glands in her neck that were tender and bothersome, no one could figure out why. She had seen dentists, throat specialists, and internists to no avail. I was treating her for something else but became interested in her neck difficulties, and we talked a good bit. She was a lonely girl, rather prudish, slightly overreligious, and very inexperienced in the ways of the world. She found most males overly aggressive in sexual matters, so never dated. Suddenly, while she was still my patient, a man in her office started to show considerable interest in her. Within a few weeks she was a changed girl—sparkling, alert, wide-eyed. And fascinating to me, the chronically swollen nodes in her neck completely disappeared. This lasted six weeks, then she found out that he was married, happily so, with a gaggle of children. Literally within a matter of days, the nodes returned, accompanied by their associated miseries and distress.

To my amazement, I was soon able to find similar factors in every patient I saw. Some cases, as the one above, were obvious. Others were extremely obscure, requiring long periods of observation. Many patients totally denied carefully concealed emotional pains, while others were completely unaware that they *were* unhappy, feeling this to be their "normal" state. I gradually learned ways to get through to them and in the process learned how devious the human mind can be.

At one point I began to realize that the puzzles of human illness were *not* insoluble. I gave occasional lectures (and was considered something of a quack), but mainly I kept working with patients and studying in all directions. I learned of Darwin's 23-year silence and so kept silent—for the most part. The exceptions were my frequent letters to the editor and book reviews, each with one or two of my own ideas tucked in: a comment on wedding-ring dermatitis, a brief discussion of the emotional feedback of shoulder posture, a hint that schizophrania might be caused by disturbed thinking (instead of being the cause of disturbed thinking), and so on.

But the climate gradually changed, and now I no longer wish to avoid open publication. So, let's state a few basic definitions and postulates and then proceed.

- There is no such thing as a fact: any verbal statement is an *opinion*, no matter how labeled. For example, any statement can be called either an opinion or a fact. If you call it an opinion, you bear in mind the possibility of error. If you call it a fact, you are neurotically expressing a belief that the statement is gold-plated, never to be questioned, and, more important, you are turning off your thinking machine as to that item.
- Objective knowledge is a myth: all "knowledge," being based on biases in "perception" and "cognition," is subjective and emotionally determined.
- There are only two emotions, like and dislike: all others are compounds of one of these plus a personally formulated comment about "reality" (e.g., "lonely" = I am all alone now + I do not like being alone).
- Anger and depression are *not* separate emotions. Anger is: "Reality, as I seem to perceive it, does not match my fantasy of how it ought to be, but I think there is something I can do about it." Depression is the same, except: "but there is nothing I can do about it."
- (This one is critical.) Negative emotions are associated with unnecessary disturbances of bodily mechanisms, proportional to the duration and intensity of the negative emotional state. Such reactions are *not* limited to a particular organ. All bodily organs and cells express their response to such brain states in various ways. If you are angry or depressed about your job, your stomach acids will either go up or down, your blood pressure will go up or down, your glands will increase or decrease their functioning, etc.

Consider the concept of "stress." There are, from my point of view, two reactions to stress. If it makes you miserable, your body will have all kinds of deleterious reactions. But if the stress is enjoyable—pursuing a not-too-willing member of the opposite sex, for example—the stress will make both you and your body function better than ever, up to the limits Mother Nature herself has installed.

Is there, then, a significant possibility that anger and depression, rather than being normal and necessary concomitants of human existence, are the long-sought variable factors in the development of *all* human diseases, both "mental" and "physical"?

This idea, bizarre as it sounds, has been for me of enormous clinical utility, and I do believe it has enormous potential for the welfare of everyone. It means that you can do something to try to avoid getting sick. It also means that if you are sick, there is something you can do to promote your recovery. And, of particular interest to the medical profession, it eliminates the idea that there are "untreatable" diseases and affords new approaches to the major human scourges—cancer, coronary artery disease, and hypertension, to name but a few.

This entire subject is, of course, incredibly complex. If my ideas seem simplistic, they are not—I have seen them work when all else failed. But before going on, I would like to insert a bit of personal history. In medical school, where I was able to listen to what I was told—and to repeat it back in test situations—they told me, "Measles is caused by a virus, and that's a fact." In my head I recorded, "*They say* measles is caused by a virus, and that is an opinion." Some of their "facts" seemed potentially useful, so I decided to hang on to all of them in case they came in handy. Some did, a lot didn't. So I became a doctor and later a surgeon and later a psychiatrist, but always with a head full of questions.

I became extensively concerned with the state of mind of my patients, both before and after surgery. At the same time, I became deliberately introspective, trying to look into my own head to see what was going on and how it worked. The net result of all this was an enormously changed state of mind on my part concerning the nature of my patients and their illnesses and how to care for them. I found that scientific medicine alone was not enough, and that my intense emotional involvement with the patient was part of the treatment. Further, I found that *anything* I did to make the patient *feel* better helped him to get better.

I continued to practice "good" medicine by eliminating treatments or medications that in some way made the patient feel worse. I also added anything that had a definite "positive placebo" effect. Critical to all this was my belief that I *could* help the patient, no matter what the diagnosis. Equally critical was my ability to make the patient feel the same thing. The results? My patients did better, recovered sooner, and had fewer complications. Even people hopelessly ill or dying showed definite improvement in the quality of their remaining existence.

Now let's start over and try to answer a few of those impossibly difficult questions.

Why do people get sick? It is *not* due to "physical" or "mental" factors but to the *sum* of all factors: physical, mental, emotional, and environmental, past and present. Careful observation, however, suggests that negative emotional states of some type are almost always present and contributory. Further, it is my opinion that what actually happens to people is not as important in producing illness as what they *think* happened is. In other words, if something bad happens, you don't *have* to get sick if you can avoid getting miserable about the situation.

Why do people get what *they get when they get it?* This is the problem of psychosomatic specificity (e.g., what all the people with certain diseases have in common). If you consider *everything* that has happened to an individual since conception (or before), everything others have said to him or her, every thought he or she has ever had, plus everything that has been happening in the universe during the corresponding time, it becomes obvious that each person should, at any instant in time, have exactly what he or she does have. And when you look closely, you do discover that people with similar diseases have similar patterns, most particularly in their thinking.

The American Cancer Society provided me with an excellent example of the disadvantages of "normal" thinking. In an ad, underneath a series of photographs showing a little boy and girl holding hands, the caption read: "Little children shouldn't get leukemia." According to me, that message has a number of less than desirable effects: it makes you angry or depressed, and more seriously it does not lead to open thinking. Try this instead: "Since certain children do get leukemia, if we understood all the factors, it would become obvious that those children *should* have gotten leukemia."

This phrase opens your mind to an infinity of questions, a few of which just might be important in seeing what the processes actually are. The problem is, of course, in the word "should." In the first case, it means "it would be nicer if," but it is expressed in a psychotic manner, e.g. *contrary to reality*. In the second case, it means "it is appropriate that" and is more in accord with so-called reality as we perceive it.

Does this mean that all diseases are mental? No. I say that mind processes (which means the functioning of the total brain in the body) are indeed part of, but only part of, getting sick or recovering.

Then how we think does contribute to getting sick or well? Exactly! And this brings up the other problem, equally complex, of just how our language affects our perceptions and behaviors. I will only indicate here that: (a) language is full of traps, (b) there is no single *right* word to apply to anything or any process, and (c) each word you use as a label for something makes you see it in an entirely different way. Say "I am free" and mean it. Say "I am a slave" and mean it. Then alternate—and watch your feelings.

Having arrived at that point, perhaps we can now start talking about the diseases so prevalent in our day, and what, perhaps, each of us can do to avoid getting sick, or if sick, what we can do to restore ourselves to health.

Obviously we cannot discuss here all the major diseases so I picked one that is now practically epidemic and truly a major public health problem: high blood pressure. It wrecks hearts, kidneys, and other things and leads to one of the most tragic of human conditions, a stroke.

CONTINUED ON PAGE 120

"Our moral responsibility is not to stop the future, but to shape it . . . to channel our destiny in humane directions and to try to ease the trauma of transition."

INTERVIEW

ALVIN TOFFLER

What date pops into your mind when you hear the word "future"? 2001, perhaps . . . or 1984?

Probably no nonfiction writer has done as much as Alvin Toffler to persuade us all that the best answer is 1978. Right now. Right under our feet. His hugely successful (six million copies) *Future Shock*, published in 1970, made Toffler one of the world's best-known futurists. He has been both observer and shaper of the future we are living in. As author of such books as *The Eco-spasm Report* and the forthcoming *The Third Wave*, as a consultant and advisor to many foundations and corporations, and as a lecturer whose engagements, combined with his own continuing research and interviews, keep him on the go.

Not surprisingly for a man with that kind of schedule, Toffler appreciates the speed of the Anglo-French Concorde, moreover, as a licensed multiengine pilot himself, he admires the supersonic airliner's "technological poetry." But he applauds the American decision to halt development of our own SST and says, "I think the future will show [the Concorde] wasn't a sensible expenditure . . . and even if it were, I'm sympathetic to the people here who were trying to control their technological environment."

In recent years Toffler has argued that if the emerging postindustrial world is to escape both totalitarianism and anarchy, we must create a democracy that is not only participatory but *anticipatory*.

"We are creating a new society," he says. "Not a changed society, not an extended, larger-than-life version of our present society, but a new society. Unless we understand this, we will destroy ourselves in trying to cope with tomorrow."

Toffler has just finished a half century of his own personal future. Raised in New York, he graduated from New York University, spent several years knocking around as a blue-collar worker and truck driver before turning to journalism. In the late 1950s he went to Washington as White House correspondent for a Pennsylvania daily, then joined *Fortune* magazine as an associate editor. Later

he wrote for many popular magazines while contributing to such scholarly journals as *Technology and Culture* and the *Annals of the Academy of Political and Social Science*. As a Visiting Professor at Cornell, he taught a course employing simulation methods to analyze technology and values. The words 'future shock,' now almost cliché, first appeared in an article he wrote in 1965. The concept itself—that the accelerating demands of change can prove too much for us and our social mechanisms to withstand—led him through five years of interviews, study, and reflection on the ways in which we can—and can't—keep our balance. The result was *Future Shock*, which reached far more people than had 20 years of "think tank" prognostications. *Future Shock* also won Toffler the coveted Prix de Meilleur Livre Etranger, the McKinsey Book Award for "distinguished contribution to management literature," and half a dozen honorary degrees in law and science.

A Connecticut home is the base of operations for Toffler and Heidi, his wife for 28 years. She shares in the research, edits his writing, and in 1975 helped him organize a committee of futurists who were instrumental in getting the members of House and Senate to set up a 'futures caucus' on Capitol Hill—the Congressional Clearinghouse on the Future. "The future must be neither ignored nor captured by an elite," Toffler urged at that time. Since then, the spread of popular concern over technological developments from nuclear power to genetic manipulation has confirmed Toffler's belief that our social, political, and economic adaptability may all reach their limits—unless we recognize just how much of the future is not far off and speculative but quite literally here today.

The following interview was conducted by *OMNI* editor and publisher, Bob Guccione.

Omni: One of the most striking developments since *Future Shock* appeared is a much wider and deeper questioning of science and technology—not just concern about, say, the consequences of automation, but concern about all the values and goals of "progress." What do you make of this concern?

Toffler: When I was a child I saw the movie *Pasteur*. I can remember seeing many movies about Edison, Ehrlich, Alexander Graham Bell, and other great scientists, doctors, or technologists. They were always heroes. And they were *my* heroes.

By the late 1950s and early '60s, we began to get more Frankenstein images—images of scientists and engineers not as saviors, but as angels of doom. *Dr. Strangelove* appeared on the scene. Sinister figures. Today I know perfectly sweet, highly intelligent people who are so turned off by science and technology, so angry at what they regard as the arrogance and dogmatism of the men in white coats, that they would gladly lynch a few before breakfast.

This drastic change in public attitude reflects something far deeper happening today—a fundamental idea-quake, an upheaval in our whole view of reality. This is a change so deep it has no precedent in the past several hundred years. As a result, both science and technology—which until now have triggered so many revolutions—are themselves about to be revolutionized.

The industrial age began, one might say, with Newton and Descartes, the founding fathers of modern science. Newton told us that the entire universe was nothing more than a machine—a clock. Descartes told us we could eventually understand that clock if we took it apart, component by component, and studied the behavior of the pieces. What we have lived in during the past 300 years—until Einstein and the physicists began to challenge the mechanistic view—was not a scientific age, but a *scientistic* age.

We raised the scientist to the status of priest. We took from science not its emphasis on tentativity, on experiment, on skepticism, on imagination and daring hypothesis, but its mechanistic, tinker-toy notions of reality. We sought not tentative findings, which the next round of exploration could disconfirm, but 'scientific laws.' We reduced causality to a simple-minded search for a single cause. We viewed a fact not as a temporary metaphorical explanation that might prove useful, but as a fixed, static, single-sided phenomenon. We looked at things one way, instead of through multiple lenses.

Today all of this is under fire—not merely by antiscientific irrationalists and mystics, but by scientists themselves. They are breaking out of the old scientistic modes of thought and searching beyond established boundaries for new metaphors, new combinations of insight from both West and East. They are beginning to see science itself not as some relentless process, driven by its own mysterious inner imperatives, but as a social and cultural process *we* have created and that *we*, hopefully, can still shape.

I think that out of the raging war between 'establishment science' and its critics—both inside and outside the science community—will come a new, far more flexible, modest, useful science of the future. This revolution in science will be part of a revolution in society as a whole. We are moving into a new civilization.

Omni: A new civilization?

Toffler: Exactly.

Omni: What do you mean?

Toffler: I mean that for 300 years we've been living in an industrial civilization. This period of human history is now over. We're moving swiftly out of—and beyond—industrialism toward a new phase that will be technological but no longer industrial.

Omni: Aren't technological and industrial the same? We've always used these words almost interchangeably.

Toffler: No. The industrial age was based on a certain style of technology, on technologies representing a certain stage of development. Newtonian and Cartesian ideas were developed, elaborated, and applied to more and more fields during the period of early industrial development. And the two lines of development wrapped themselves together like a double helix. On one side, Scientism, on the other, Brute Force technology.

Omni: Why "Brute Force"?

Toffler: Because industrial civilization, during its 300-year-long dominance of the planet, produced machines that were energy-hungry, machines that were ravenous and wasteful of raw materials, machines that were huge, machines that polluted heavily. Machines that were capital intensive.

This primitive, battering-ram kind of technology characterized the Industrial age and made mass production possible. It gave rise to industries such as the textile, steel, auto, rubber, and rail and paid off in vastly improving the standard of life for hundreds of millions of human beings. It also raped and robbed others, but that is another part of the story. The fact is, industrialism increased the life span and solved the problem of hunger for a sizable chunk of the human race.

But at the same time, the Newtonian-Cartesian habit of looking at things through only a single lens meant we seldom stopped to think about side effects. A good friend of mine, Dr. Donald F. Klein, who is one of the world's top drug experts, is often asked whether this or that drug has a side effect. He shrugs and says, "No side effects, no central effect." You can't have one without the other.

But that's not how we've looked at technology historically. We've looked at its central effect—its ability to deliver a buck or a military bang—and said, "Aren't we smart?" We forgot to look at the side effects. Or we didn't want to look at them.

Omni: How do you feel about the people who say it's time to stop technology?

Toffler: I can understand their anger, frustration, and fear. But I think the idea of "stopping technology" is both futile and immoral. I think there's a better way to achieve what most of these people want, anyway.

What we're seeing are increasing attacks on technology, not from Luddites, but from thoughtful people. They present a very powerful case, pointing out the atrocities and dangers that technology has trailed in its wake until now.

Of course, some critics are merely technophobes. They'd like the whole world to go back to some pretechnological age. They forget how life was for most human beings in those times. How short, brutal, and stultifying it was. How viciously anti-

CONTINUED ON PAGE 132

FICTION

For the competition, he had carved a beautiful set— breathing life into every piece.

THE CHESSMEN

BY WILLIAM G. SHEPHERD

Tomov was most innocent of all. It was this, perhaps, that caused the real confusion, challenged for a moment the course of history, and led eventually to Tomov's death. But Tomov, dead or alive and whatever part he played, is not an important element in this tale, being, as Tomov was, mere flesh and blood.

Our heroes are wood. Exquisitely carved, painted with infinite care, each one a child born through agonies of thought, months of uncertainty, a change here, a new idea there, but wood. Tomov made them.

After the long hours at the dyeing vats of the woolen mill at Rybinskh, it was joy to hurry home to the bench beside the sink, take his little box of tools from the cupboard, and live the evenings with the smooth, warm wood. It was worth the year it took, especially if one had but a small chance of winning the contest and of being rewarded with the trip to Moscow, visits to the shrines, the handshakes of the mighty ones, and —surely—the extra ration coupons. One might even see Comrade Stalin, or find a better job waiting at the mill when one returned.

So Tomov studied, first. He went to the shop of books and page by page looked through a hundred, or a thousand. Even those on back shelves, books so suspect they were like a ticking bomb if one dared have such in one's home, books of which private possession could bring, on any night, the silent thunder of disapproval, even those Tomov turned page by page. And on those pages were the things he sought. A queen, dressed in such flagrant riches it was enough to sicken Tomov, a queen whose very gown told of her faithlessness, her carnal loves. A churchman, pompous, fat, as lecherous as the queen. A king—ah!, these were what Tomov was after. No need to labor his dye-stained fingers with making sketches. Tomov would remember until each vicious line was shaped in the solid oak.

Then the carving. Tomov grew as each completed piece was set aside and a new one begun. The little, easier ones Tomov made first, the eight

PAINTING BY RENE MAGRITTE

chain-laden slaves, the eight strong, sickle-swinging comrades like he'd seen on the collective farms. These he made first so his hands could gain in skill for the master pieces. Next were the two castles, showing by their tumbling towers the decadence they represented. Almost with a shudder Tomov turned from them to shape the perfect tiny replicas of the new apartment house just built in Rybinskh for the faithful of the People's Republic. Then the soldiers. They were easy to think out, to plan, but hard to carve. The effeminate, weak, dull ones were the worst, but even the two broad Russian generals angered Tomov as he carved them, by bringing back to his mouth the taste of mud and snow, by causing the half-healed wound in his hip to ache, by arousing the shame a soldier of the Red Army must feel at remembering his fear. The two fat bishops brought some of the same trouble, for Tomov as a child had held his mother's hand and walked the long mosaic aisle to kiss a ring worn by a kind and gentle man. What one read and heard helped Tomov form the beady eyes, the obese jowls, but the sweat was heavy on his forehead before he felt quite sure his knife had cut the smile from the lips of both. With a sigh of relief he set the pieces with the others and began the commissars. These, when done, left him the task that brought the greatest pleasure. There was nothing the least bit personal, nothing to disturb Tomov in creating the wanton queen. Only ideas well learned went into finishing up the ermined frame and gold-crowned skull for the Capitalist king. And ideals precious to every Russian gave joy to shaping the healthy Peasant boy and girl in regal proportions.

With only one month to work before the contest deadline, Tomov spent every evening turning the carefully stolen bits of powdered dye to paint and bringing final life to every piece. There was not even time to ask Stolovkin to drop in and play a game before the set had to be bundled up neatly and sent off to the Culture Office in Moscow. Tomov regretted that, especially later. If only Stolovkin and he had tried but one game. It might have made Tomov pause, perhaps not send his proud entry to the contest at all. But there was no time.

Tomov shook off another regret. The set would not be returned to him, no one would have seen his handiwork completed. No one except the beggar who had knocked on Tomov's door and, while he waited for a bit of bread, had turned a bishop in his hand and certainly admired the work. The gesture the beggar made as he replaced the piece was odd, thought Tomov. It reminded him of the sign the priest used to make in blessing, back when there had been a priest in Rybinskh. Well the beggar, at least, had seen and liked his chessmen. That was something.

Through the processes of bureaucracies, the decisions would be delayed for some months, the winners unknown. This should have given Tomov a reprieve, yet in the period of deliberation danger threatened almost at once.

Dosiev, second in command at the Culture Office in Moscow, was struck immediately by the skill, the care, the unusual colors that had gone into entry K2726. He placed the box with the others, between the painting of the Leningrad boy and the bridge made of sticks and twigs, with half an idea in his mind. If Andreievich happened in at the right time, they might return to the office in the evening and play the interesting set. Andreievich was a fine partner for chess, relatively easy to beat yet capable on occasion of creating a difficult situation on the board. It made it pleasant, thought Dosiev, to be challenged and at the same time to know one could pretty surely win. He chuckled as it occurred to him to let Andreievich see what he could do with the king and queen while he, Dosiev—the better player—moved relentlessly on to the inevitable checkmate by the People's men. It would be a moral victory, as well as a personal one.

The evening came, and with it Andreievich. After expressing his pleasure at the workmanship of the pieces and demurring a bit over representing the enemy, Andreievich consented to play the Capitalist set. That he won was of little concern. He had bettered Dosiev once or twice before in the 20-odd times they had played. Besides, looking back, Dosiev remembered he had been rather sleepy that evening. But, somehow or other, Dosiev felt compelled to play again with Andreievich on the same basis with these chessmen.

At the second meeting in the office, Andreievich argued for his right to play the Peasants. Dosiev prevailed upon him to repeat their earlier sides, pointing out that his winning would balance the score not only between Andreievich and himself but between the sets as well. Not to Andreievich but to himself Dosiev admitted he was feeling a little tension about it. This tension, Dosiev reasoned afterwards, was no doubt the cause for Andreievich's winning again.

The third meeting Dosiev handled differently. He smuggled the box of pieces home so they might play in the morning on the holiday. No use letting end-of-day drowsiness or fatigue cause him to play poorly. Also, Dosiev went to bed early and had a full night's sleep. This time there was no trouble with Andreievich about the men. Having won twice with the gaily gruesome royalty, Andreievich was quite happy to stay with them. In fact, as he placed the chained-slave pawns, the fat bishops, the crumbling castles, the weakling knights, the wanton queen, and the skeleton king, Andreievich noticed a feeling of confidence new to him facing Dosiev across a chess board. A third time Andreievich won. Handily, too, with many pieces left and with Dosiev wiped out and helpless. Looking at Dosiev, however, Andreievich decided not to laugh aloud as

he felt like doing. Instead he said good day and left.

The following morning, wretched from a night disturbed by many shapeless feelings of anxiety, Dosiev decided to return the chessmen to the office and forget the whole affair. He would not be obliged to participate in the judging. His job was simply to arrange the entries, excluding the impossible works, so that Comrade Donovich and the man from the Kremlin Culture Office could select the winners. For a moment he considered throwing out the chessmen along with the poorer sketches, the too-crude sculpture, and other futile offerings. But no, he was making too much of nothing at all.

On the street Dosiev passed Andreievich. Did his friend walk more erect, his head higher, his chest out? Ridiculous, Dosiev told himself. Even Andreievich's wide grin with his "Good morning!" aroused only a little resentment in Dosiev. But it was a new thing, that grin. The same evening, when Dosiev saw Andreievich looking through the shelves in the back of the shop of books, Dosiev came to a decision. He would somehow place the matter before Comrade Donovich. Tomorrow.

Comrade Donovich was first impatient, then supercilious, then plainly displeased.

"Fool! Because your friend improved and you grew careless at chess, you toss in bed and bother me over the shape of pieces of wood? Fagh! Bring me these chessmen. Let me see these midget monuments that shake you in your boots!"

Although Donovich was without artistic background in any field except that of devising methods for eliciting greater efforts from inmates at a northern camp, he did in a sense justify his appointment as Director of the Moscow Culture Office in his reaction to Tomov's chessmen.

"Aha! Interesting!"

"Nice color. Nice knife work. Clever imagination, Dosiev! I am glad you show me these pieces. I take them home with me and still your fears. Yes, I like these. This fat fellow here, this cleric, looks almost alive. But you are an old woman, Dosiev. Tomorrow I tell you to stop seeing bogeymen in pieces of a tree."

The following morning a pale Comrade Donovich walked worriedly into his office, mumbling to himself. He telephoned his colleague in the Kremlin Culture Office to make an early appointment. He was told to come at once if he was so upset.

Krakov listened closely till Donovich had finished babbling and pacing. When Donovich collapsed into a chair, Krakov reviewed:

"Your wife, you say?—Three games, four games? Each time she with the—what did you call it?—with the 'corrupt' set? Then your son, who had never played before and had to be taught the moves? He also won? I do not wonder, Comrade, that you are pale if you sat up all night playing chess—and teaching it to a child! But this foolishness about evil powers, plots, magic—surely you jest! But no, I see that you do not jest. Have you been well, Comrade?'

Upon Donovich's protests that he had felt perfectly well until the previous evening, Krakov determined he should make some gesture to relieve the man.

"You brought the box? Good. I do not play the game, but leave the box with me. I have friends who play. Some, I believe, who play extremely well."

It was nearly a week later that Donovich was summoned to Krakov's office. The Director of the Moscow Culture Office, his man Dosiev tagging along, entered to face Krakov and two unsmiling members of the Politburo itself standing behind the desk.

"Donovich!"

"Comrade Krakov."

"These chessmen!"

"Comrade? You have tried them?"

"Donovich, this box is identified only as entry K2726 in our contest. What is the name of the man or woman who made them? The address?"

"Yes, yes. Dosiev, here, has it. Stop shaking, man, and give me the card with the name. Here you are. Comrades. One Alexovich Tomov, Woolen Mill, Rybinskh. You—confirmed my feelings?"

"Tomov Alexovich, Woolen Mill, Rybinskh. Comrade Donovich, this chess set has been played in exactly sixty-seven engagements. Five of the best players in Moscow have used these pieces, varying possession of the People's men and the enemy men."

"And the results, Comrade Krakov?"

"As you know, Comrade."

"The reason, Comrade, have you learned that?"

"We have! Or we have strong suspicions. Each player who used the proletarian pieces experienced a drowsiness as he played. There is evidence that these pieces are treated in some way, probably in the paint or dye, to produce this effect in the handling of the pieces. Very probably these chessmen are the agency of an imperialist design to create uncertainty and fear in our glorious People's Republic."

"We shall see this Tomov traitor, if there is such a one. He will be brought from Rybinskh. Meanwhile, Petroev will come from Stalingrad. Petroev, who has mastered the ablest of the foreigners in the tournaments in London and Paris, will try your chessmen. So superior is his skill, no drowsiness, however maliciously induced, will defeat him. He will win with the peasant pieces."

Back in Rybinskh, Tomov was not too surprised to learn he would go to Moscow. He was surprised, though, that the message should be brought by two members of the secret police and that he must leave at once, that same night. His wonder at this fact took away much of the pleasure he felt at winning the contest. (He was sure he had won, or else why the trip to Mos-

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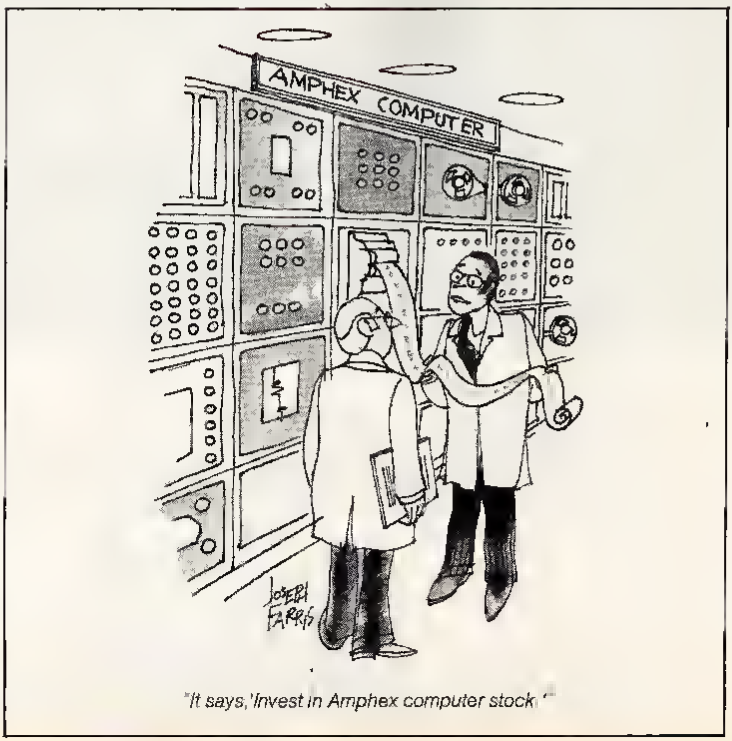

"It says, 'Invest in Amphex computer stock.'"

COMMUNICATING WITH DOLPHINS

Humanlike qualities of the dolphin brain suggest a potential for mammalian dialogue that could transform our views of all living species and the planet we share

BY JOHN LILLY

In the sea many mammalian brains have evolved to sizes equal to and larger than the critical size for language as we know it. These brains are restricted to cetaceans: the porpoises, dolphins, and the whales. No other sea mammals—otters, seals, sea lions—have brains above the critical threshold.

Paleontological evidence suggests that the cetacea evolved the critical brain size for language 15 to 30 million years ago, something on the order of ten to 20 times longer ago than man with his present brain size appeared on this planet. In their aquatic evolution cetacea developed brains up to six times larger than ours.

Several species of cetaceans have been studied from the standpoint of the acoustic spectrum they use for communication and for their echo recognition and ranging systems. The most intensively studied species is *Tursiops truncatus*, the bottle-nosed dolphin of the Atlantic. The frequency spectrum in this species runs from a few hundred Hz to 165,000 Hz, with a minimum threshold for detection in the region from 30,000 Hz to 100,000 Hz. Smaller dolphins use higher frequencies, and the larger dolphins use somewhat lower frequencies than humans.

There is sufficient overlap between the acoustic output of the human voice and the hearing curves of the dolphins, so that exchanges can take place between humans and dolphins in the sonic sphere.

Dolphins in close proximity to man can voluntarily raise their blowholes into the air and make sounds in the presence of humans. This takes place only when the dolphins are placed in close proximity to humans who will speak to them or who are talking to other humans speaking loudly enough for the dolphins to hear (tapes demonstrating such exchanges are available).

Robert W. Hernandez/Photo Researchers

Experiments using solitary dolphins in separate tanks connected by a "dolphin telephone" of a high-frequency pass band show that dolphins can carry on sonic communication by using such a link. Moreover, it has been demonstrated that dolphins use sonic communication to modify one another's behavior.

The capacity of dolphins to use echoes for recognition of objects has been studied extensively. Such studies lead to the conclusion that the postulated language of dolphins, "delphinese," is possible because of the ability of the dolphin to construct "acoustic pictures," which are the basic elements of their language. Human languages are primarily based upon visual and manual images computed in an entirely different way than the elements of the cetacean languages.

Language, as we know it, results from an agreement among individuals about the meaning of signals. Any two individuals must agree upon the kinds of signals they are going to use, the rules for their manipulation, and their interpretation.

Humans communicate in the immediate present through facial expressions, gestures of the body, physical contact, and the production of sounds in the mouth, throat, and larynx. Principal receptors of the body gestures and facial expressions in the receiving human are the eyes, one sees facial expressions and gestures. Another route is physical contact in which tactile sense, pressure receptors, and so forth are used to receive the muscular motions exerted by the transmitter.

Cetacea communicate in similar ways, producing sounds, receiving them with their ears, interpreting those sounds, and constructing mental images, maps, and ideas. They also watch one another's motions in the water and exchange physical contact.

Air-containing cavities within their bodies enable cetacea to emit most of their sound above water if there is an open passageway to the atmosphere, or they can emit most of their sound into water if cavities are closed and immersed in water. Human speech depends upon such cavities being "open," coupled to the atmosphere through the mouth and the nose. In cetacea, during sound production the cavities are closed within the body, and the sonic energy is emitted into the water.

Under water a cetacean can communicate over astonishing distances, along the order of ten kilometers for the bottle-nosed dolphin and up to eight hundred kilometers for the finback whale. This long-distance transmission is due to the increased efficiency of sound waves in the dense medium of water. (The maximum transmission in the atmosphere of information contained in the human voice is limited to two to three kilometers under quiet conditions.)

Because the air cavities dolphins use for the production of sound are totally enclosed inside the body, they are closely coupled to body tissues, which, in turn, are closely coupled to the water of the sea. In general, dolphins have three sonic/ultrasonic emitters: two of these are just below the blowhole, and the third is in the larynx. There are two plugs, a right plug and a left plug, that close the blowhole. As the blowhole opens, these plugs are pulled forward. If one continues to watch the blowhole region while it is closed, and the dolphin starts to make sounds (either pulses or whistles) under water, one can see movements of the plugs closing the blowhole. When the dolphin uses his right sonic emitter, one sees that side twitching, when he uses the left sonic emitter, one sees movements on the left.

High speed x-ray movies taken of this region show that the sounds produced are formed by the tongue coming up against the membrane edge, forming a slit for the air. This slit is then analogous to our vocal chords and their impedance across our airway.

"Dolphins, whales, and porpoises have demonstrated a capacity to survive far longer than humans. According to paleontological evidence, some ocean mammals have had brains equal to ours for at least 30 million years."

The dolphin has two right-side air sacs, two sacs on the left, and a tongue and a membrane on each side, totally independently controllable; he has two separately controllable sound sources whose frequencies, amplitudes, and click rates can be varied independently. He fills the upper sac, contracts the walls of the upper sac, and blows air through the slit between the tongue and the membrane edge into the lower sac. He can then contract the lower sac and blow the air back through the slit into the upper sac. As the sacs change size, their resonant qualities change so that the resonant click or whistle coming out of the sacs through the tissues into the water varies in frequency depending upon the size of the sac at that particular instant.

When the membrane edge is tight and the tongue presses against it, the membrane vibrates at very high frequencies, forming pulses so close together that they are heard as a continuous whistle. With a more lax membrane and lower air pressures, individual pulses of sound are released from one sac to the other. Frequency analysis of such pulses and whistles shows that they vary as the size of the coupled sacs varies.

With this rather complex apparatus a dolphin can click at a given rate on one side, at another rate on the other side, or he can whistle over one frequency range on one side and another frequency range on the other. Or he can click on one side and whistle on the other side.

The sounds are transmitted through the flesh surrounding the sacs—out into the water, most loudly upward and forward, but with fairly sizable amplitudes in all directions around the body of the dolphin. The sounds emitted by these two sonic emitters are of a lower frequency region than those emitted by the third sonic emitter in the larynx.

These sonic pulses can be controlled in their rate from one per minute up to 1000 per second. As an object approaches, the dolphin's pulsing rate goes up. If one holds a hydrophone in front of a dolphin and swings it back and forth to and from the dolphin, one can hear the pulsing rate climb as the hydrophone approaches and fall as the hydrophone moves away from the dolphin.

This is the output side of their so-called sonic navigation and ranging system. These short pulses go out through the water, are reflected by objects of interest, and come back to the ears of the dolphin under water. While the dolphin is using this sonar system, one sees him moving his head horizontally, scanning the object with a tight beam. Using sonar the dolphin has been shown to discriminate objects hidden from his eyes with exquisite fineness. At a distance of 16 meters he can distinguish an aluminum disk two centimeters thick from a copper disk of the same dimensions against a concrete wall under water.

The anatomy of the dolphin's ears shows that the equivalent of the human ear exists inside its head. The two bones containing the cochlea in the dolphin are as hard as glass. The cavities in these bones contain air. There are also cavities surrounding the bones, containing blood, fat, and a foam.

Using air cavities, we constructed a

Photo by Russ Kinne/Photo Researchers

Photo by Karen Lucas/Photo Researchers

Photo by Russ Kinne/Photo Researchers

Bottle-nosed dolphins communicate with each other by means of three sonic-ultrasonic emitters, two of which can be linked into a kind of stereo sound. The third emitter is used for sonar detection. Dolphins' acoustic range is about ten times that of humans' at both sending and receiving ends. This indicates a communications capability that is highly sophisticated. Computer technology enables scientists to transform "delphinese" into human language and vice versa. Lilly theorizes that because dolphins create sounds above water that resemble human speech, they are interested in communicating with people.

model of the dolphin s ears When this was placed on the ears of humans we found humans could localize sounds under water Extensive studies of both the human and dolphin thresholds for hearing at various frequencies show that the bottlenosed dolphin detects and uses signals of approximately four and one half to ten times the frequencies that humans normally use

Dolphins can hear the frequencies of human speech in the lower end of their detection spectrum They also produce sounds in this region However they do this only in the presence of humans who speak above water We discovered that dolphins will try to mimic and improve their copies of human speech in the presence of humans who speak to them loudly The dolphin s ability to use his communicative sound in man s presence is not unexpected when his large brain is compared with that of the human

Through modern computer technology, it is possible to devise electronic machines that can translate both for the human and for the cetacean One way involves making use of the fact that dolphins have been found to be interested in communicating with humans i e they are ready with the necessary agreement to work on the problems They go to inordinate lengths to create sounds above water that resemble those of human speech Using the narrow band of overlap between human sonic communication and dolphin sonic communication dolphins do adaptive programming in attempts to establish this communication Dedicated humans faced with dedicated dolphins can depend upon agreements for adaptive programming on each side Both species are sufficiently adaptable to modify and form new replies and new demands extremely rapidly

Dolphins understand demands and queries With real-time methods involving no delay between a query and a response, each side learns very rapidly the limitations and the possibilities expressed by the other side Thus this method of dolphin/human communication calls for changing the frequencies of the human voice accurately into the frequency domain of the dolphin s and conversely the transformation of the frequencies of the dolphin s voice down into the range of the human s A doorway must be opened between the human sonic box and the dolphin s sonic box

In the current research and development program of the Human/Dolphin Foundation a computer has been purchased to carry out the initial investigation of sonic communication between man and dolphin The program is called the JANUS project and the apparatus is also called JANUS for Joint-Analog-Numerical-Understanding-System JANUS has a dolphin face for the dolphin end of the system and a human face for the human end of the system The brain of JANUS is a computer with two sets of input and output for man and the dolphin Sonic input to the dolphin is designed to be in the region of parameters most easily detected and discriminated by the dolphin This is the region of maximum frequency discrimination and of the lowest threshold for detection of sounds running from approximately 3000 Hz (cycles per second) to 80 000 Hz (cycles per second)

On the human side the standard communicative frequencies from 300–3000 Hz (cycles per second) will be used In addition, the human end uses the standard computer keyboard and video display units as well as printers and other convenient devices (Eventually visual feedback to the dolphins will be incorporated with a cathode-ray tv underwater screen or its equivalent The dolphin's visual input has been shown to be quite capable of analyzing visual symbols, so both the sonic and the visual can be interconnected in the dolphin communication experiments)

This route takes advantage of adaptive programming on each side by means of special "vocoders " Making such vocoders is a straightforward technical design problem that can be solved given the proper financial support and properly trained engineers

In the proposed "interspecies vocoder" the human speech specfrum is divided into a number of independent frequency channels by means of filters (or their equivalent) computed by a microprocessor On one side of the vocoder each of the human sonic bands is analyzed by analog methods in real time and is multiplied by a factor of 4 5 to 10 into the dolphin's frequency band On the other side of the vocoder the machine does the inverse by analyzing each of the dolphin's frequency bands which are analogically computed to the frequency band of humans

Such a device allows a human to speak to a dolphin under water The human could remain above water and the dolphin remain under water a dolphin would speak back to the human in his natural underwater mode Each side would use its appropriate frequency bands and the electronic device would translate one into the other The air/water interface is thus broken—opening a door The frequency barrier is also broken Each individual involved is thus able to operate in the familiar regions of its existence

The number of bands required for understandable human speech of high quality using a vocoder, has been found to be 30 These devices are based upon the number of critical frequency bands involved in human speech and hearing Dr C Scott Johnson has shown that the number of critical hearing bands for the dolphin is about twice that of the human i e the dolphin will require about 60 such bands

Dr W A Munson devised the first vocoder for dolphin/human communication Dolphins expressed great interest in the

use of this device but the number of bands (ten)did not match either the human critical number nor the dolphin critical number The vocoder method has the advantage of operating in real time I e , the dolphin and human can interact and correct one another rapidly It is a relatively inexpensive method—the present estimations (1976) are that $100,000 would be sufficient for the design and the construction of the interspecies vocoder

Another method involves the use of modern high speed minicomputers and microprocessors Recent breakthroughs with microprocessors that do the fast Fourier transform can simulate the above vocoder method. With this technique the analog vocoder is simulated by digital hardware This approach has several advantages over the analog vocoder For example one would be able to shift the critical bands both the number and position in the two frequency spectra The advantages of the flexibility of the software, I e , the programming and its changes, would be sizable over the wired-in, fixed vocoder model The cost of this approach is estimated to be $300,000

A third approach, which is farther in the future, would involve additional transformations of what the dolphin sees with his sonar to human video and vice versa, by means of a high-speed minicomputer

In this configuration one visualizes an underwater artificial sonar system that scans the underwater environment in a way that mimics the dolphin's An ultrasonic transmitter emits pulses similar to those used by dolphins, picks up the echoes by means of an array of hydrophones and transfers them to the minicomputer for computation The computation in the microcompufer would be so designed that it would generate a three-dimensional felevision display in color for use by the humans A human operator could thus see with his eyes under water the way the dolphin sees under water with his ears

Such systems open operational doorways between the species Since each of the systems functions in real time we are depending upon the adaptability of both the human and the dolphin to solve the problem of constructing a suitable interspecies language somewhere between delphinese and the human languages The construction/use of this new interspecies language will probably take a fairly long time of dedicated daily use, at the least several months at the most, many years

Such technical proposals are now feasible All that is required is sufficient time, energy, money, and interest on the part of the human species to carry them out The only barrier in our way is our belief-disbelief systems about the intelligence and language capabilities of cetaceans I feel very strongly that the reward to the human species of such a program will be very great—beyond anything that I or any-

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"In my zeal to demonstrate psychic phenomena, I committed the one unpardonable sin in science."

FICTION

The experiment looked so easy, except for one factor.

CONTROLLED EXPERIMENT

BY RICK CONLEY

Standing alone on the podium, in the glare of the camera lights, the old man spoke wearily.

"I have called this press conference to announce my resignation from the American Psionic Institute."

The audience of scientists and reporters buzzed excitedly.

"As cofounder of this organization, I am reluctant to leave it, but my continued presence here can only cast a cloud of doubt over honest men's work. For recently, in my zeal to demonstrate the existence of psychic phenomena, I committed the one unpardonable sin in science. I deliberately manipulated an experiment to yield the desired results.

"A few weeks ago, I implanted in the brains of rats electrodes that, when energized by a random-number generator, produce highly pleasurable sensations in the animals. My objective: to see if the rats could through telekinesis—mind over matter—influence the generator to give more than the expected, chance number of stimulations.

"I reported almost immediate success—clear evidence of psychic ability! But then . . . then some of my colleagues, puzzled by the excessive attention I was paying to my apparatus, watched, concealed, as I manipulated the equipment to deliver additional stimulations to the rats."

The old man sighed.

"Why did I cheat? I don't know. In fact, until my colleagues confronted me with the evidence, I was barely aware of my actions.

"Perhaps after a lifetime of honest research with, at best, ambiguous results to show for it, I subconsciously decided to help the experiment along just a little, in order to encourage my colleagues and to impress the skeptics.

"In any case, I'm sorry for the embarrassment I've caused the Institute. And now I shall entrust my work to abler, more trustworthy men. In particular, I'm gratified that Dr. John Cole has promised to continue my research with the random stimulator.

"Good luck, John. I know you won't lose control as I did."

Alone in the laboratory, strapped down in a cage, the rats squealed in ecstasy as the machine directed repeated stimulations through the electrodes implanted in their brains.

More! the rats' minds shouted. More! More!

But the machine ignored their demands, it continued to grant the creatures brief moments in paradise according to its own mechanical caprice.

Then the rats tensed. The men! The man was coming!

Seconds later, Dr. Cole unlocked the door to the laboratory and entered. Walking over to the experimental apparatus, he inspected the electronic counter hopefully. He was disappointed to see that in the past hour the rats had received no stimulations beyond chance expectation. Good thing he was on board.

Peering into the cage at the tiny creatures, he sighed. "Do something, you deadbeats! Do something!"

At that moment, the rats concentrated mightily. From their minds, at the speed of thought, sprang tendrils of mental energy. Reaching deep into the recesses of Cole's mind, the tendrils touched, probed, twisted.

More! the rats' minds shouted. More! More!

Unconsciously, Cole turned a dial on the random-number generator. The stimulations were no longer random, they came faster and faster.

Even in their heightened ecstasy the rats sensed that this man was not the same one they had . . . touched . . . earlier. But still, he was a man, not a machine, and could be manipulated.

They squealed in delight.

They were in control again. ∞

ILLUSTRATION BY MARSHALL ARISMAN

LIFETIDES

In this excerpt from his new book, Britain's celebrated biologist points to the collective unconscious as the basis for paranormal phenomena.

BY LYALL WATSON

The stuff of parapsychology, supernature, and the occult is partly flotsam, thrown up to the surface of life by currents and eddies in the Lifetide, and partly jetsam, abandoned to the tide by ever more complex organisms intent on lightening their collective loads. Some of what is in the tide is useful and significant, and some is bound to be senseless and absurd. And in all our dealings with any of this salvage, it would be well to bear in mind Jung's observation that "the best, just because it is the best, holds the seed of evil, and there is nothing so bad but good can come of it." The world, by and large, is what we make of it.

As a biologist, aware of the breadth and extent of life, and conscious of many of its persistent mysteries, I am grateful for any scraps of understanding. I believe that recent advances in astrophysics at one end of the scale, and molecular biology and genetics at the other, put us now

in a position to make reasoned judgments about the general process of evolution that has led to our present strange, subdivided state.

I suggest that what we have in the field of paranormal phenomena are vivid and sometimes meaningful indicators of the true state of our psyche. The different physical realities of raps on tables, bent keys, flying saucers, and wandering yetis are in themselves purely incidental symbols, which may sometimes coincide in disturbing ways, but which bear no recognizable causal relationship to one another. We must not expect scattered occurrences, stray scraps of information, to carry any information of consequence. Each on its own says very little, and any attempt to wring an answer from isolated experience, or to massage meaning out of laboratory statistics, is doomed to failure.

I believe there may be an almost basic cosmic rhythm, which probably underlies all coincidence, chance, seriality and synchronicity. I believe we will eventually succeed in laying this ghost in our machine and give it all the physical properties and parameters necessary for its establishment as a recognized force of nature. When this is accomplished, I feel certain that it will be the source of much that we now regard as supernatural.

• • •

There are human vampires. Not only in Transylvanian nightmares, but in the person of everyone of woman born.

For the first nine months of our lives, we exist in what one textbook defines as a "parabiotic union between two different organisms in which not only is there intimate commingling of tissue cells of dissimilar genetic makeup, but also a chronic, covert exchange of blood." A rather long-winded way of saying "pregnancy," but one which effectively stresses the strange nature of the mother-fetus relationship. By all standards, the embryo is a foreign substance and ought to be rejected by the mother's immune system. She is, after all, a vertebrate with a fully functional antibody mechanism that is specifically designed to discriminate "me" from "not-me." But, in some still mysterious way, nature successfully violates all the laws of transplantation, holding them in astonishing abeyance for the 270-odd days we all spend as parasites in the bodies of our maternal host.

Jan Ehrenwald of the Roosevelt Hospital in New York calls pregnancy "the cradle of ESP." He suggests that the intimate physiological association of mother and fetus might extend into psychological areas, allowing their egos to merge in a way that bridges the usual gap between individuals.

It could be significant that the uterine conditions are almost perfect for hypnotic induction. Temperature and light are virtually constant; the fetus floats at ease in the amniotic fluid; free to drift as it will; and the loudest sound around is the regular, metronomic thud of the maternal heart. Dissociation is almost inevitable and, if the little

Photograph on preceding page by Jay Maisel

we have learned about conditions conducive to unusual perception is true, telepathy is more likely to occur in this situation than at any other time in life.

There is almost no limit to the fertility of this symbiotic theory. Right away it begins to make sense of the childlike and irrational qualities of so many paranormal phenomena. Most mediumistic communications are repetitive and seem often to be almost simpleminded. Psychoanalytically they would be classed as regressive, which is exactly what can be expected if we are dealing with something that has its roots in infancy. It explains why so many so-called extrasensory perceptions are of a preconceptual, preverbal nature, and therefore almost impossible to describe. It certainly accounts for the fact that spontaneous adult telepathic experiences occur most often between mothers and young children. And it becomes easier with the help of this model, to understand why all psychic experience is much more common in

"Pregnancy may be the "cradle of ESP," an intimate physical association of mother and fetus that could extend into psychological areas, merging their egos in a way that bridges the usual gap between individuals."

young children, who have not yet reached the stage of sharply delineating their own ego boundaries.

If a growing child, by progressively defining the edges of his own ego, smothers the possibility of telepathic communication then it is also possible that those individuals who fail to establish independent egos may remain vulnerable to continued telepathic intrusions. Most auditory hallucinations are sensed as coming from multiple voices, and when they say anything intelligible, the comments are usually anonymous and expressed in the second or third person. They are always sensed as separate from the self and out of the listener's control. There certainly is an embarrassing similarity between the paranoid schizophrenic's delusions of persecution, his conviction that others can influence his thoughts from a distance, and the theories of those, like myself, who believe it is possible for there to be contact between minds without any normal physical agency. Perhaps schizophrenics really do hear voices. They are definitely selectively attuned to subliminal, repressed hostility in other people, but maybe there is more to it than that. There may be such a thing as psi pollution for those with imperfect ego defenses.

Every culture has at some time devised a way of circumventing the cerebral censor and communicating directly with the unconscious, usually by pretending that the information is coming from somewhere else, most often through some kind of scapegoat. In Tanzania, the Safwa blame a special chair, which stands still or shakes in response to questions from a sitter. The Nyoro people of Uganda use a length of wood, something like a spear shaft, called a *segeto*. This is moistened, usually with the blood of a freshly slaughtered goat (the unconscious thrives on that sort of vivid imagery), and the questioner grasps the shaft with his finger and thumb, running them up and down. The point where they stick indicates the oracle's answer. Among the Zande of the Upper Nile, the preferred technique is the *iwa*, or rubbing board, which is maneuvered over the flat surface of a special table, answering questions according to whether it slides or sticks.

In Europe and the United States in the mid-19th century, turning tables was practically epidemic. Spirits were soon held to be responsible and codes were devised to communicate with them. Then, as interest in table tipping waned, the planchette came into its own. This was a miniature table, just 15 centimeters long and shaped like a heart on wheels, with a pencil fastened to it so that answers could be written down directly. And in 1892, a cabinetmaker in Baltimore patented a lettered board incorporating a small planchettelike indicator, under a process identified by the combined French and German affirmatives as *oui ja*. He made a fortune.

Given these freedoms to express itself anonymously, the unconscious fairly babbles away. In St. Louis in 1913, one particular ouija board began an extraordinary monologue that only ended twenty-five years and 4 000 000 words later when its operator, a housewife called Pearl Curran, died. Proverbs, poems, and stories poured out of the board in biweekly sessions, picking up the thread each time just where the last effort ended, as though there had been no interruption. Each of the communications was signed with the name of Patience Worth, who was, by the ouija board's own admission, beginning her literary career almost three centuries after her death at the hands of hostile Indians, soon after arriving in the New World from her home in England. The content is slightly cloying, in the style that *Reader's Digest* likes to describe as "inspirational," but it is extraordinarily consistent.

There is no evidence that a Patience Worth ever existed, and suspicion must fall heavily on Pearl Curran, who found, after some years, that she was able to call out the words faster than the board could spell them. Later she graduated to transcribing directly onto a typewriter, finishing one novel set in medieval England in just 35 hours. But the psychic researcher Walter

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WHERE THE ATOM SPLITS

EXPLORATIONS

By Stuart Diamond

We are standing inside the turbine building at the Millstone nuclear reactor, on the Connecticut shore of Long Island Sound. The room is enormous, the noise is deafening, the temperature is more than 100 degrees Fahrenheit. We are surrounded by a mass of equipment almost grotesque in size—pipes four feet across, pumps 15 feet high, bolts the size of fists, and horizontal, oblong heating units that are 50 feet long and look like large iron lungs. Steam, water, air, hydrogen, and oil are careening through the pipes. Above, a turbine whines. It sounds like a jet plane. Off to one side, a sign on a locked door says: 'Radiation area—do not enter unless authorized.' Another door says "Danger—high voltage."

The scene is part of a tour, open to the public, of the Millstone reactor complex, which supplies power to 1.5 million people in Connecticut. It is similar to tours at many of the 71 commercial nuclear power plants licensed to operate in this country.

Just seeing a reactor complex from the outside can be a jarring experience. At Indian Point, New York, about 30 miles north of New York City, you drive along a tree-lined country road, and suddenly, three large concrete domes emerge in a clearing along the Hudson River. You hear the whirr of machinery and see steam rising. At other locations, the reactor is covered by a steel or concrete building so that the complex looks like large, windowless warehouses or building blocks for giant children.

Security is tight at nuclear reactors today, largely because of new federal regulations enacted this past January after studies had concluded security was too lax in regard to potential sabotage. Now, time-consuming searches and identification procedures are required for tourists. This has led a number of utilities to cancel reactor tours altogether. "It just became too much aggravation," said an official at one utility.

Many power companies have taken another tack, providing tours of just nonradioactive parts of the reactor complex, such as the turbine building and the control room. For most utility officials think the new regulations will make the public more wary of reactors. If you can't see it, the theory goes, you're more likely to be afraid of it. The more limited tour gives you a sense of a nuclear reactor complex, the experience is still worthwhile.

You enter the reactor complex through a security building staffed with armed, uniformed guards. As in an airport, you walk through a metal detector. The guards then run a "sniffer" around your body. It looks like a hand-held electric egg-beater and emits a siren if it detects anything that could be a component of an explosive. Musk oil, residual cleaning fluid on clothes, gasoline fumes on the clothes of fuel truck drivers, and even deodorant have been known to set off the sniffer. After the search, you put on your hard hat and step into the reactor complex.

Around the reactor complex, you see the trappings of the security network: fences topped with barbed wire and, in some cases, equipped with alarms that go off when you touch the barrier, building-top tv cameras that continuously survey the site, antennas that link the buildings by radio. Guards continually patrol.

A number of structures are scattered over the site, which is usually a few hundred acres. The reactor building houses the reactor and fuel-handling equipment; a turbine building contains the turbine-generator, condenser, most of the piping, the control room, and administrative offices; a radioactive waste building contains highly radioactive spent fuel and the not-so-radioactive clothing, rags, and other material contaminated in the normal course of operation. There are also warehouses for equipment and machinery, a pump building that draws in and expels cooling water from the nearby natural source, perhaps a cooling tower, tanks for emergency cooling water, hydrogen to cool the generator, and oil to lubricate

The 1.13 billion watt Trojan nuclear power plant, near the Columbia River at Rainier, Oregon

generator and turbine bearings, a transformer yard, radiation monitors, a tall stack to emit gases with trace amounts of radiation, a large steel frame to support a crane, and high-tension wires leaving the site.

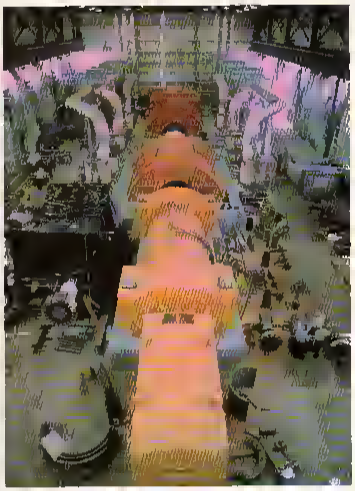
The electricity in the high-tension wires emits a continuous popping noise that is most pronounced when the air is damp. When the weather is particularly dry, the electricity can make the hair on your back stand on end as you walk under the wires.

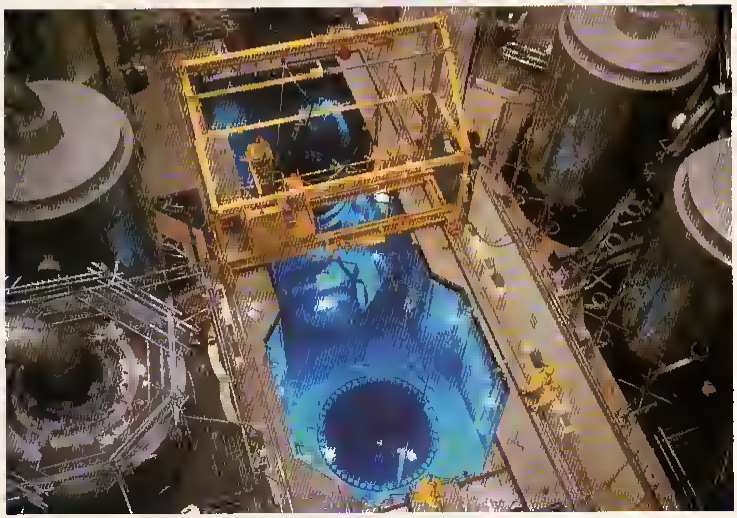
On most tours, you first are taken to the control room, where you observe operators from a glassed-in gallery. The well-lighted room has about 13 meters of light-green metal instrument panels with hundreds of levers, dials, and lights. Red lights indicate that equipment is on or valves are open. Green lights indicate the opposite.

The panel is usually in the shape of an L and lines two walls. Against a wall near the center of the panel is a lighted board that shows the location of fuel rods and control rods in the core. The lights are red and yellow, the board looks like a game of Chinese checkers. Rods are coded so they can be quickly located when there is trouble.

Above the instrument panel are hundreds of small white plastic squares, and each lists a particular reactor component or system. When something is wrong, a square will flash white or red, depending on the severity, and a loud buzz sounds. "RCP1" means reactor coolant pump 1. "East pent rm inside El 38-5" means the inside door to a penetration room—between the reactor building and an auxiliary structure—has been opened recently. It is 38.5 feet (12.5 meters) above sea level. These indicators together are called the "enunciator system" and are divided among the various reactor processes, such as turbine, feedwater, auxiliary, radiation monitoring, and reactor control.

The safety system is designed to automatically shut down the reactor any time there is a more than routine problem in operation. A pump failure, low steam level, too much water in the moisture remover, high pressure, low pressure, and dozens of other occurrences will automatically shove the control rods into the fuel core. It takes 12 to 24 hours to bring the reactor up again and costs an estimated $300,000 per day—in time and in the oil or gas that must be used instead for power. In some cases, an operator has 5 to 8 seconds to spot the failure and perhaps correct it manually before the automatic shutdown. All such shutdowns must be reported, along with a lengthy explanation, to the U.S. Nuclear Regulatory Commission.





Photos by Jeffrey Becker

The turbine and generator of the Trojan complex (above). Heart of the nuclear reactor (below).

As one walks down the hallways, doors to various other sections of the plant proclaim "radiation control area." Guards man the openings, or the doors are locked. Peering inside, it is impossible to distinguish these areas from the nonradiation areas. They all have that clean, stark, concrete look with snaking wires or heavy machinery evident. Workers who enter these areas often have to wear protective clothing that is discarded when they leave.

Throughout many plants are yellow signs proclaiming "evacuation route," with black arrows indicating direction. Occasionally, 220-liter drums with contaminated low-level radioactive waste sit in a prescribed location in the shadow of a building.

In many plants, different pieces of machinery are painted different colors for aesthetics and for easy identification. In the Connecticut Yankee reactor in Haddam Neck, equipment is painted gray, blue, and green. The floor is red, the stairs are yellow, the turbine and generator are light blue, and the railings are cream-colored. The area is quite neat, and if you ignore the noise, it almost seems like a showroom for industrial machinery.

The massiveness of the equipment is the most striking. Next to the turbine/generator at the Millstone complex is a typical highway trailer used for shipping goods. It looks like a toy model by comparison. Nearby, a fire extinguisher 1.5 meters high and 1.7 meters long has tires as large as those on some compact cars. One marvels at the fact that this is the culmination of a hundred years of engineering in electricity generation.

As you leave the reactor complex, you go back through the security building and step into a device similar to the metal detector you walked through on the way in. This device, however, scans your body to see if you accidently received any radiation in the plant. You stand there for a few seconds, until the scan is completed. Everyone contains radioactive potassium in their bodies, just as radiation is present in rocks, in watch dials, and in sunlight. If the device finds you don't have more than the amount you usually carry around, a green light flashes.

The current move away from tours of reactor plants has spawned "energy education centers" at nuclear reactors. Located outside the security fence, these centers are filled with displays of reactors and with models of various types of power generation and energy conservation. Films are often shown, and various exhibits invite visitor participation or play. The centers are particularly attractive to children, some attract 50,000 school students per year.

Most of the centers have graphic and colorful wall displays with moving lights that show how a reactor works. The various cooling fluids, components, and systems are in different colors, making the concepts clear even to junior high school children. The differences and similarities between nuclear and fossil plants are portrayed.

There are usually machines that pose questions about energy. You press a button for the answer. Some have Geiger counters that click when a weak radiation source is placed near them. A few centers have windmills and solar collectors.

WHAT'S AVAILABLE

The major problem with exhibition centers is that they really do not give a visitor the same feeling one would get from a reactor tour. Also, some of the exhibits are rather hokey: mechanical arms that challenge you to put fake fuel pellets in little slots—a sort of scientific penny arcade. Also, the darker side of nuclear reactors—potential safety problems and nuclear wastes—is not really dealt with.

Perhaps the most open reactor in the country is the Trojan plant on the Columbia River near Rainier, Oregon. A domed reactor with a 160-meter tall cooling tower and a spacious energy education center attracts 150,000 visitors each year. An electric bus shuttles visitors around the complex. Tour guides take visitors through the turbine building and other nonradioactive areas. Unlike most other reactor sites that receive visitors, no advance reservations or special arrangements are needed for tours. Usually, however, you should call in advance to find the hours and the arrangements necessary for tours. There is no admission charge, and the centers hand out a variety of brochures.

Almost all plants allow the public on at least some part of the property, even if it is only a waterfront park. In Plymouth, Massachusetts, for example, you can't tour the reactor, but you can picnic on Cape Cod Bay, watch the fishing trawlers on one side, and get a look at Boston Edison's giant, square concrete reactor complex on the other.

One of the best tours around used to be that of the Dresden 1 nuclear reactor about 50 miles from Chicago. The domed reactor was the first privately owned commercial nuclear plant in the country. It started operating in 1961. Until the new federal regulations necessitated canceling the tour, officials of Commonwealth Edison used to take visitors on the floor of the reactor building above the reactor vessel. You wore a dosimeter to measure any radiation you received. You heard a Geiger counter clicking at the entrance.

On one side of the room you could see a spent fuel pool, a brilliant-blue pool of water that contained the highly radioactive spent fuel elements. The water gets its spectacular color from the radiation of the Cobalt-60. The water shields observers from radiation and helps dissipate the radiation. The more highly radioactive spent fuel elements—those that came from the reactor more recently—are brighter blue. You could see the upright fuel assemblies 6.5 meters down. It was worth the trip all by itself.

ACTIVE NUCLEAR PLANTS: WHERE THEY ARE

ALABAMA
Joseph M. Farley 1 (Houston County)
Browns Ferry 1 (Decatur)
Browns Ferry 2 (Decatur)
Browns Ferry 3 (Decatur)

ARIZONA
None operable

ARKANSAS
Arkansas Nuclear One—1 (Russellville)

CALIFORNIA
Humboldt Bay (Humboldt Bay)
Rancho Seco 1 (Clay Station)
San Onofre 1 (San Clemente)

COLORADO
Fort St. Vrain (Platteville)

CONNECTICUT
Connecticut Yankee (Haddam Neck)
Millstone 1 (Waterford)
Millstone 2 (Waterford)

FLORIDA
Crystal River 3 (Red Level)
St. Lucie 1 (St. Lucie County)
Turkey Point 3 (Turkey Point)
Turkey Point 4 (Turkey Point)

GEORGIA
Edwin I. Hatch 1 (Baxley)
Edwin I. Hatch 2 (Baxley)

ILLINOIS
Dresden 1 (Morris)
Dresden 2 (Morris)
Dresden 3 (Morris)
Zion 1 (Zion)
Zion 2 (Zion)
Quad Cities 1 (Cordova)
Quad Cities 2 (Cordova)

INDIANA
None operable

IOWA
Duane Arnold (Cedar Rapids)

KANSAS
None operable

LOUISIANA
None operable

MAINE
Maine Yankee (Wiscasset)

MARYLAND
Calvert Cliffs 1 (Lusby)
Calvert Cliffs 2 (Lusby)

MASSACHUSETTS
Pilgrim 1 (Plymouth)
Yankee (Rowe)

MICHIGAN
Big Rock Point (Big Rock Point)
Palisades (South Haven)
Donald C. Cook 1 (Bridgman)
Donald C. Cook 2 (Bridgman)

MINNESOTA
Monticello (Monticello)
Prairie Island 1 (Red Wing)
Prairie Island 2 (Red Wing)

MISSISSIPPI
None operable

MISSOURI
None operable

NEBRASKA
Cooper (Brownville)
Fort Calhoun 1 (Fort Calhoun)

NEW HAMPSHIRE
None operable

NEW JERSEY
Oyster Creek (Toms River)
Salem 1 (Salem)

NEW YORK
Indian Point 1 (Buchanan)
Indian Point 2 (Buchanan)
Indian Point 3 (Buchanan)
Nine Mile Point 1 (Oswego)
James A. FitzPatrick (Scriba)
Robert E. Ginna (Rochester)

NORTH CAROLINA
Brunswick 1 (Southport)
Brunswick 2 (Southport)

OHIO
Davis-Besse 1 (Oak Harbor)

OKLAHOMA
None operable

OREGON
Trojan (Rainier)

PENNSYLVANIA
Shippingport (Shippingport)
Beaver Valley 1 (Shippingport)
Three Mile Island 1 (Londonderry)
Three Mile Island 2 (Londonderry)
Peach Bottom 2 (Peach Bottom)
Peach Bottom 3 (Peach Bottom)

RHODE ISLAND
None operable

SOUTH CAROLINA
H. B. Robinson 2 (Hartsville)
Oconee 1 (Lake Keowee)
Oconee 2 (Lake Keowee)
Oconee 3 (Lake Keowee)

TENNESSEE
None operable

TEXAS
None operable

VERMONT
Vermont Yankee (Vernon)

VIRGINIA
North Anna 1 (Mineral)
Surry 1 (Gravel Neck)
Surry 2 (Gravel Neck)

WASHINGTON
Hanford—N (Richland)

WISCONSIN
LaCrosse (Genoa)
Point Beach 1 (Two Creeks)
Point Beach 2 (Two Creeks)
Kewaunee (Carlton Township)

PUERTO RICO
None operable

**Almost universally, nuclear power plants welcome public interest and provide exhibits, tours, or public information at the reactor site.*

LIFETIDES

CONTINUED FROM PAGE 114

Prince, after a year spent observing the situation, concluded that it was impossible for a woman of her limited interests, education, and resources to have written even a small part of the avalanche of words and whimsy. "Either," he said, "our concept of what we call the subconscious must be radically altered, so as to include potencies of which we hitherto have had no knowledge, or else some cause operating through, but not originating in, the mind of Mrs. Curran must be acknowledged."

Now, a half century later, we know a little more about the capacity of the unconscious, which seems to be limitless. We also know that it is possible for the unconscious to be in some way directly aware of what is happening to other people beyond the reach of the senses.

Charles Tart has shown that when subjects are asked to guess when a friend in a distant room is receiving a random but painful electric shock, their conscious response is totally inaccurate. But if they are monitored for unconscious physiological response, their electroencephalographic patterns show that at the precise instant of each shock, they react as though they themselves were receiving a mild shock.

Knowing this, and knowing something of the creative skill exercised by the unconscious in constructing internally consistent personalities, I see no major difficulties in the assumption that Pearl Curran could have been Patience Worth.

In December 1963, Jane Roberts and her husband sat down in their apartment in Elmira, New York, to experiment with a ouija board for the very first time. In the initial two sessions little happened, but in the third they began to get highly articulate answers to their questions. Almost immediately Jane realized that she was receiving this information in her head and could easily vocalize it without the use of the board. So began her communication with a personality that called itself Seth and that has now dictated over 5000 pages of didactic information, organized into informal lectures on subjects such as health, dreams, astral projection, reincarnation, and analytical psychology.

The presentation of all this material is lucid and highly individualistic, embodying a wide knowledge of esoteric teachings to which Jane seems to have had no normal access. Eugene Barnard of North Carolina State University explored Seth's character in sessions with Jane when she seemed to be speaking for Seth and concluded that he had been in conversation "with a personality or intelligence or what have you whose wit, intellect, and reservoir of knowledge far exceeded my own. . . . In any sense in which a psychologist or the Western scientific tradition would understand the phrase, I do not believe that Jane Roberts and Seth are the same person, or the same personality, or different facets of the same personality."

I wish I could be that certain. I have a sneaking feeling that all the way through arguments of this kind we persistently underestimate the capacity and the connectedness of the unconscious. We keep on making limited either/or judgments about things. Either, we insist, the material comes directly from Pearl Curran and Jane Roberts, or Patience Worth and Seth are exactly what they claim to be—spirits from the dead. Their control of the two mediums in these cases is only temporary, but I see no reason why Patience and Seth should not be regarded in the same light as alter personalities in a multiple personality situation.

In a session once with the celebrated medium Eileen Garrett, a psychologist brought Uvani, her spirit control, into a state of confusion simply by asking what he had been doing since their last session. It seems clear that many alternative characters and spirit guides are created for roles that last only as long as they are on stage. Only when they take over completely and abolish the primary personality altogether can one begin to talk about possession. And if they persist and become permanent, showing all manner of inappropriate behavior, can one begin to think in terms of possible reincarnation.

> *"All we have to work with is what seeps past the barrier, what little the unconscious, in unguarded moments, lets slip . . . I think the evidence favors spontaneous telepathic reception."*

Ian Stevenson of the University of Virginia has done everything in his power to make the problem of reincarnation scientifically respectable. And now at last, after 15 years of intensive, almost single-handed, effort, he seems to be gaining some ground. The prestigious *Journal of Nervous and Mental Disease* devoted its entire issue of September 1977 to his work.

Stevenson defines reincarnation as the survival and subsequent reembodiment of the human personality after death and points out that personality consists of more than isolated bits of information. To make a personality, the information has to be organized into particular skills. He uses Michael Polanyi's distinction between cognitive knowledge, which is knowing about something, and tacit skill, which is knowing how to do something. Stevenson argues that we may know all the facts about a skill but can never learn to use it without actual practice. Therefore skills such as dancing, or riding a bicycle, or speaking a foreign language, are essentially incommunicable and cannot be passed, without actual physical practice, from one person to another by any normal means. So his major research effort is devoted to the discovery of individuals who seem to have acquired such skills spontaneously.

Stevenson's painstaking researches have established more than 1600 cases that he describes as "suggestive of reincarnation." Most are naturally from the Indian Subcontinent, Southeast Asia, and the Middle East, where belief in reincarnation is strongest. A typical case of this type begins when a small child, usually between the ages of two and four, begins to remember living another life. Its statements about this life usually harmonize with its behavior in the sense that, if it claims to have been a wealthy person, it is likely to refuse to do menial work, no matter how poor its present family may be. The child often asks to be taken to places it remembers, and if these can be identified and the journey is made, it is usually found to have been correct in about 90 percent of its statements about the life and surroundings of the person it claims to remember. After five years of age, memories of the past life seem to fade and usually vanish altogether, along with the unusual behavior prompted by them.

A few of these cases satisfy the criteria for reincarnation in that the subjects do indeed possess not only knowledge but also special and relevant skills. A young Bengali girl produced elaborate songs and dances, an Indian boy began very early to play the classical drums or *tablas* with great skill, and another child showed unusual expertise with marine engines. In two cases Stevenson even found what he calls "responsive xenoglossy," an ability to speak and respond to an apparently unlearned language. It is tempting to assume that the accomplishments of all infant prodigies could be explained in this way. Woltgang Mozart began composing at the age of four, Johann Gauss was correcting his father's mathematics before he was three, John Stuart Mill and Baron Macauley started writing almost before they could walk. All may have been reincarnations. "Untortunately," admits Stevenson, "to the best of my knowledge, no Western child prodigy has ever claimed to remember a previous life."

He does, however, go on to suggest that the idea of reincarnation could have "considerable explanatory value for several features of human personality and biology that currently accepted theories do not adequately clarify." Among these he included childhood sexuality, the origin of homosexuality, early interest in unusual subjects (Schliemann declared his intention of excavating Troy before he was eight years old), rejection of parents, strange birth-

marks, the differences between otherwise identical twins, and even abnormal appetites during pregnancy.

Stevenson himself admits that "all of the cases I have investigated so far have some flaws, many of them serious ones. Neither any single case nor all of the investigated cases together offer anything like a proof of reincarnation. They provide instead a body of evidence suggestive of reincarnation." And in dismissing the alternative explanation of some kind of assimilation through special sensitivity, he says: "To accommodate authentic cases of the reincarnation type that are rich in detailed statements and in associated unusual behavior statements and in associated unusual behavior shown by the subject, with the hypothesis of super-extrasensory perception, requires the extension of that hypothesis so that it becomes no more credible than that of survival after death."

I sympathize with his position, but I believe that this conclusion is premature. The gap between the known capacity of the brain and the demonstration of unusual skill narrows with every new discovery in the life sciences. The existence of vast untapped information in the genes; the pressure of alternative memories in the rival systems of every cell; and the growing appreciation of the powers inherent in the unconscious make it more and more reasonable to assume that even a three-year-old child could, given the right circumstances, inherit or acquire, and then organize, an elaborate second personality. The very scarcity of those with unusual knowledge or skill tends, I suggest, to support this biological explanation rather than that of reincarnation, which, given the sheer abundance of discarnate spirits that ought to be hanging around, queuing up for reembodiment, is astonishingly rare. I think that, on present evidence, the best conclusion is that offered by Stevenson as an intermediate position: "Once considered about as well-defined as an orange by its skin or a tree by its bark, human personalities now appear to be much more extensible and penetrable than they were thought to be. They can invade and be invaded by processes of extrasensory perception. They may even blend together in the manifestation of a different personality that appears to be new, but that in fact may derive from a fusion of the new and the old."

Time and time again, parapsychological research is drawn into a cul-de-sac with a wall at the end marked 'Death' and, in one corner, a convenient escape clause in the form of a ladder on which hangs a little sign that says, 'This Way for Survival Without the Body.' Millions, perhaps even the majority of those now still alive in the world today, believe that survival is possible, and that a subsequent return in some form of reincarnation is likely. They may be right. If they are, we have in this belief a ready-made answer to almost all the remaining problems posed by apparently psychic experiences. But I am suspicious of easy answers.

Possession by discarnate spirits might be possible, but I don't know. I can't know. With our current knowledge, this concept is too complex to prove or disprove. It is too big a jump from what we know to what might or might not be. The most we can say now with any certainty is that awareness, both conscious and unconscious, seems to be determined at least in part by processes that cannot be localized in the brain and might not be physical at all.

• • •

In 1940 the 12-year-old son of a county sheriff in West Virginia was taken 192 kilometers to the Myers Memorial Hospital at Philippi for an operation. One dark, snowy night, about a week after his arrival, he heard a fluttering at the window of his hospital room. He called a nurse and told her there was a bird trying to get in. To humor the boy, she opened the window and a pigeon came right in. He immediately recognized it as his personal pet. He told the nurse to look for a ring on its leg carrying

"Awareness . . . is in part determined by processes that might not be physical at all. They may be sufficiently free of temporal constraints to operate beyond the limits of the body."

the number 167. She did, and there it was. He was allowed to keep it in a box near his bed, and when his parents came to visit a few days later, they confirmed that it was indeed his bird and had been seen around the house for several days after he was admitted to the hospital. So it hadn't been brought with him, or simply followed the family car. The pigeon succeeded somehow in traveling 192 kilometers and locating the correct window, in the right building, in a strange town, at night, and in a snowstorm.

Joseph Banks Rhine and his researchers at Duke University sifted through hundreds of cases of what they called psi-trailing in animals, trying to obtain precise verification. The one that most impressed them was that of a cream-colored Persian cat called Sugar who in 1951 seems to have trailed its owners across 2400 kilometers of mountainous country between California and Oklahoma. The family intended to take the cat with them, but it was afraid of cars and leaped from the window just as they were leaving Anderson at the northern end of the Sacramento Valley. They couldn't catch him again, but 14 months later Sugar suddenly turned up, leaping through the window of their new home in Gage, Oklahoma. The cat had a deformity of the left hip that served as positive identification, easily recognizable by a veterinarian. Though how he crossed a desert, several canyons, and the entire width of the Rocky Mountains remains a mystery.

An even bigger mystery is why he should have gone to all this trouble in the first place. Why did the pigeon risk death to find the boy?

• • •

Our lack of scientific success in bringing paranormal phenomena to heel strongly suggests that these obey different laws, and can't be approached on a causal basis. So I am not going to set up the contingent system as a causal factor. I certainly don't think the answer is going to be that simple, but I do believe that the existence of an alternative adds significantly to [Arthur] Koestler's contention that we are in a state of essential tension between rival forces. This is the conflict I have called the Lifetide. And I emphasize again that the tidal metaphor is appropriate, because tides and waves are phenomena that have nothing directly to do with the water in which they become manifest.

There is an important contradiction in the apparent ease with which anyone can learn to dowse or to levitate a table, and the rarity with which such phenomena occur spontaneously. This rarity may be only apparent in that we simply don't notice dozens of strange things that occur around us every day, but even taking that possibility into account, it nevertheless seems clear that our internal filter normally exerts a very powerful two-way control. This suggests that paranormal events have limited survival value and a narrow field of applicability, which leaves us in the awkward position of having to make major assessments on the basis of fragmentary evidence. What we can see is nothing like the tip of an iceberg, which does in fact offer an excellent idea of the composition of the rest, but merely the debris left behind by a series of unsuccessful experiments. We have to operate like plastic surgeons faced with the task of resurrecting a damaged face without a photograph of the original to refer to. Perhaps the best analogy is that of the psychiatrist with a severely disturbed patient, who has to search for health in the evidence of pathology. All he has to work with is what the patient tells him. All we have to work with is what seeps past the barrier what little the unconscious, lets slip.

You can collect as many seawater samples as you like, but none will contain, nor tell you anything about, the tide. You can dissect as many living organisms as you can lay your hands on, breaking them down into their subatomic components, and still find no answers. Life is a pattern, a movement, a syncopation of matter, something produced in counterpoint to the rhythms of contingency, a rare and wonderfully unreasonable thing.

LANGUAGE

CONTINUED FROM PAGE 95

Worse, the incidence is currently increasing at a horrendous rate. A few cases are due to certain peculiar 'physical" lesions, but the vast majority are what is called "Idiopathic" or "essential" hypertension, which means the cause is unknown. Some doctors feel that it is inherited or "genetic" (loosely translated, "good luck, buddy"). Others blame diet, salt, your job, your wife or husband, etc., etc., *ad infinitum*.

A few researchers, particularly those into biofeedback, currently hold that anger is a cause. They are close, but not close enough. One person came much closer, back in 1952. While studying the attitudes of patients with a variety of diseases at New York Hospital-Cornell Medical Center, Dr. David T. Graham found that those with hypertension "felt that they constantly had to be ready for anything." (The reference is: Psychosom Med 14:243-251, 1952.) This was a genuine, gold-plated clue, though his work was put down, ignored, and largely forgotten, but in a few moments you will understand the significance of his finding.

Remember, I called all diseases "behaviors." In other words, things that people do, and hypothesized that *if* something was wrong, then there was something that the person was unhappy about. When I found a patient with elevated blood pressure (140/90 mm/Hg or more), I said to myself not "He has hypertension" but "He is hypertensioning." While doing a physical examination I would keep talking to the patient while regularly checking his blood pressure. I discovered I could make that pressure go up or down—not by what I was saying or asking, but by what I was making happen in the person's head. Naturally, I found patients with no anger who had high blood pressure and people with horrible jobs and nasty spouses who did not have high blood pressure. But the ones with high blood pressure did have what is called "anxiety." There, with a little conniving, is where I found an answer, not the only answer but one that works.

Anxiety is a common term and one of the mainstays of psychiatric theory. It is defined as an emotion. It isn't. It is a compound of two things: an awareness of the existence of ambiguity and a depressive reaction to this awareness. More simply, it means that you don't know what's going to happen, and you are unhappy about this. And this is exactly what I consistently found in people with elevated blood pressure—that they did, indeed, have an incredible intolerance of ambiguity. I have described a person with high blood pressure as a person with his head in a neck brace—so he can't look up—who must walk through a forest on a narrow, winding path, and who knows that up in *one* of those trees there is a very large and very hungry boa constrictor waiting just for him. Do you get the picture?

The awareness of ambiguity is not a bad and unpleasant thing but a *good* thing, a major survival mechanism. It is to be welcomed as a warning sign saying, "Attention! Be careful!" And we learn that with proper attention to this warning, great success will come our way in getting things accomplished.

For example, suppose *you are* driving the freeway. The traffic is heavy and you begin to feel jittery. You don't know what that turkey in the next lane is going to do. You have several choices. You can keep getting more nervous and/or angry. You can get off the freeway and pop a Valium or you can have a cocktail which will seem to resolve your problem but will not improve your chances of reaching your destination. Or you can drive carefully and watch everything around you like a hawk. (There are, of course times when a brief coffee stop or a rest or taking surface streets is a bright idea.)

> *Anxiety is a common term, one of the mainstays of psychiatry. It is defined as an emotion. It isn't. It's a compound of two things: awareness of ambiguity and a depressive reaction to this awareness.*

We have looked carefully at the thinking behind high blood pressure and found that this thought pattern is not unique to the hypertensive person but common to all people. The person with high blood pressure just does it more and better. Further, it means that the common garden variety of hypertension can be prevented—or can be treated while it is still "labile" (when pressure goes up under stress and down when the stress is over). We can continue now and list those things that I advise not only for the person with high blood pressure but for the treatment or prevention of any kind of problem.

- Learn to quickly identify the onset of anger and depressive feelings in yourself.
- Pick something you don't want to have happen to you—a heart attack, an ulcer, the removal of some organ—and when something happens that would normally make you become either angry or unhappy, ask yourself if giving in to these negative feelings is worth the disease price you'll have to pay. If the answer is yes, seek professional help, preferably from a therapist who is *not* depressed.
- Discontinue any medications that are central nervous system depressants—this includes many of the drugs now so frequently prescribed.
- Use alcohol only in *trivial* amounts. It's probably the worst brain depressant we have.
- Start observing other people: their postures, their choice of words and tones of voice, pitch, and stress. Study the reactions of others and try to guess what is going on in their heads. And then watch yourself. A good item to start with is shoulder posture: down and forward is depressed, up and forward is hostile, up and back gives you the feeling that you are working toward the control of your own reality. Try these postures alternately and observe your own reactions and those of others to these postures. You'll be amazed.
- Decide each morning that throughout the day whatever happens will not make you as angry or as unhappy as it would have the day before.
- Get rid of the words "got to," "have to," "should," "must," "ought to," and that old favorite, "willpower." You *can't* do anything except what you want to do—so enjoy it.

There are obviously many more guidelines that I could list and undoubtedly many more I have not seen. But these are, at least, a start in the right direction. Believe it or not, such behaviors help with the "real" medical problems, whether abnormal gastric acidity, elevated cholesterol, or a pimple on your nose is your particular problem.

And for the curious—what were the results of this approach to hypertension in my practice? Previously uncontrolled patients could be brought down to normal levels (below 140/90 mmHg) utilizing only thiazide diuretic medication, and thus avoiding the complex-acting and unpleasant ganglionic blocking agents, many of which, by the way, have depressing effects. Many patients learned that their "early" hypertension could be eradicated. Typical of one of these was a person who for years had been found to have elevated blood pressure upon each consultation with a new doctor. And the blood pressure would fall with rest, reassurance from the new doctor, and the like. These patients, I believe, are the pool from which later fixed hypertensives are developed. Other doctors claim that this entity is meaningless and no risk. I do not agree. Finally, as far as results, when I closed my practice I had *no* paralyzed patients lying in nursing homes waiting out the dreary years.

It is my carefully considered opinion that negative states, particularly anger and depression, are critical components in the development of all the most common medical and psychiatric problems we can get—and this includes cancer. And I do believe that by learning how our heads work and how to work our heads, we can all learn to live longer, healthier, and happier lives. OMNI

DOLPHINS

CONTINUED FROM PAGE 109

one else can imagine. Alternatives to human language and communication with another species could be the goals of a program that would capture human interest around the planet, interest of an intensity comparable to that which we currently devote to human warfare.

An entire industry can be initiated by those seeking new areas of investment in a relatively short time (two–ten years) a major breakthrough will be made in communication with dolphins/whales. With the proper approach in the technical and commercial spheres, relatively large returns could be realized on a relatively small capital investment within the next ten years. Through franchises, leasing arrangements and contracts, a satisfactory level of profit can be realized.

The first persons to establish and use communication with the cetacea will be in a preferred position to market the information gained. The market includes commercial fisheries, the Navy, the entertainment industry (film/tape/records), marine industries, oceanariums, computer manufacturers, software companies, education businesses, and conservation groups. Specific areas of useful and profitable enterprise are as follows:

- *Commercial Fisheries*. The yellowfin tuna industry needs means of communication with dolphins to warn them of netting activities and to avoid the capture of dolphins in their nets. Public pressure on the industry is at a high level to reduce or eliminate the capture and killing of dolphins.

Other commercial fisheries have problems of net destruction by dolphins caught in their nets. With means of communication/warning aboard their vessels, such conflicts can be avoided.

- *The Navy*. The activities of the Navy in the area of the use of dolphins/whales in the service of human warfare is well known. Mounting public opinion opposes this area of naval activity. The prestige of the Navy is being lowered by such publicity and activities.

With dolphin/whale communication, the Navy could initiate a new publicly approved policy of significance: world-wide cooperative education of cetacea to avoid areas of human warfare. The knowledge gained from the cetacea would aid the Navy in their other tasks. The first Navy of the world to use such communication will possess, for a time, a strategic advantage. Eventually however, such short term advantages will disappear.

- *Entertainment Industries*. The first corporation to open communication with cetacea will have the opportunity to market the results worldwide. With cooperative efforts from dolphins/whales, entirely new varieties of motion pictures, records, tapes, and tv shows are possible.

Dolphins and whales interacting with one another and in communication with human camera crews can do underwater ballets of dramatic and novel content. Interacting with human swimmers in communication with them opens up new possibilities for the motion picture industry heretofore not imagined.

The recording market (records/tapes) can be sold, new music/songs from the cetacea interacting with human musicians—each side teaching the other new forms of music.

- *Marine Industries*. Offshore oil drilling industries operating in cooperation with communicating cetacea can control their operations in more detail. Small oil leaks can be detected by cetacea rapidly and efficiently.

The manufacturers and developers of sonar and underwater communication equipment can benefit from cetacean knowledge of natural sonar use.

Cooperative underwater surveys with cetacea open up new areas of enterprise for those industries in marine geology and industrial exploitation of sea bottoms and structures. Cetacean knowledge of mapping the oceans can be used by these industries.

Worldwide communication of ships/yachts with dolphins/whales opens up new regions of navigation/rescue activities heretofore unknown to man.

- *Computer manufacturers*. Once the communication breakthrough is made via special methods, manufacturers of the necessary equipment will have a ready market in the above-given uses of the equipment. Each of these industries will need special equipment for their specific use.

The modern microprocessors and minicomputers designed for use in salt-air environments is the basis for the breakthrough in communication with cetacea. The speed of these computers is currently enough to realize these objectives.

- *Education industries*. The public should be kept up to date on current cetacean work through public educational channels, including schools, colleges, universities, and the public media. Marketable products—books, tapes, records/motion pictures—can be sold readily.
- *Conservation groups*. Rather large groups of people (numbered in the millions) have become interested in saving endangered species, especially whales and dolphins. The passage of laws forbidding importation of industrial whale/dolphin products has been facilitated by these groups in the U.S. and Britain. The Marine Mammals Protection Act of 1972 was one result of such public pressure.

Communication with cetacea will give these groups their best argument for cessation of industrial use of whale and dolphin products. Such public opinion will be advantageous to the new industries operating in cooperation with the dolphins and whales. **OO**

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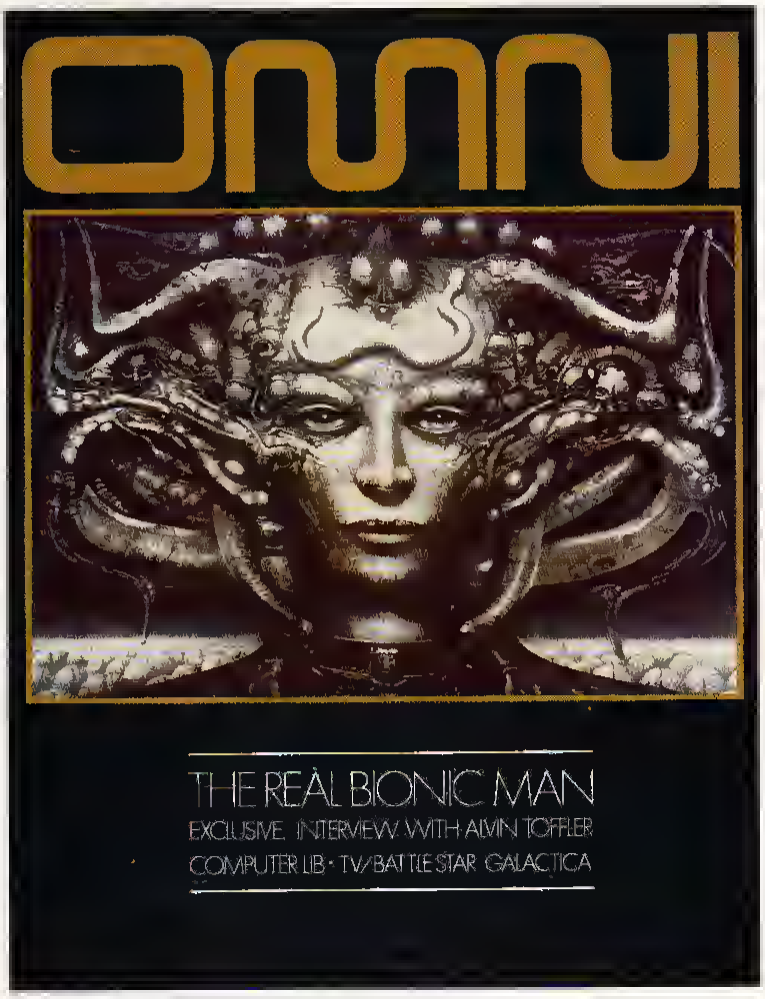

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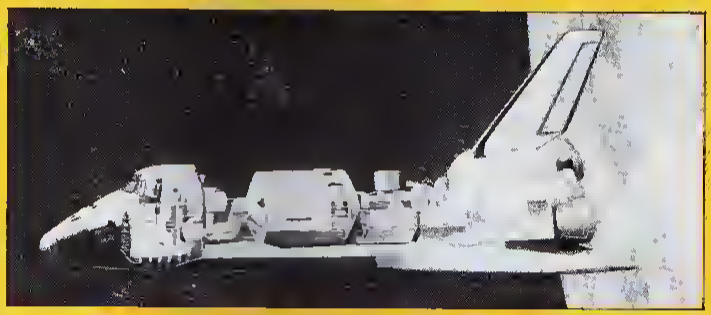

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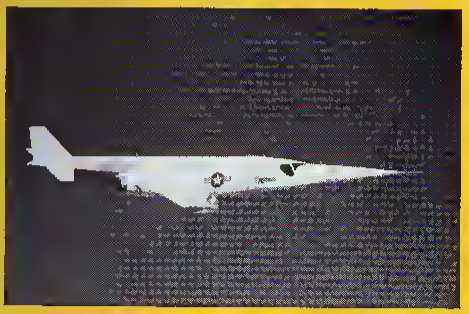

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Seventy-five years ago, on December 17, 1903, Orville Wright climbed into the pilot's cradle of a biplane called 'the Flyer' and took to the air. He was airborne only 59 seconds and traveled a distance of only 852 feet but, as his brother Wilbur put it, "The age of flight had come at last." To celebrate the diamond anniversary of this epochal event, OMNI devotes its December issue to man's continuing efforts to escape the grasp of terra firma. In words and pictures, the December OMNI traces the history of flight, from the inspired drawings of Leonardo to the incredible reality of the space shuttle, and then leaps to the future where man will finally become a true creature of the air. You'll want to be there for the take-off.

WEARIEST RIVER

CONTINUED FROM PAGE 52

more than he deserved.

They turned the distant corner, walked almost the full length of the grounds, and finally reached a seldom used service entrance. The guard there regarded all of them suspiciously before he unlocked the gate.

"In case you didn't know," the boy Lynar said good-naturedly as they started across the grounds, "we don't need exercise. We've been walking for two days and nights."

"So have I," Connager told him sourly.

They followed the drive, circling a wing of the hospital to reach an unused loading dock. At regular intervals they passed guards, who nodded to Connager. At the dock entrance they signed in, after which another guard spoke to a com disc and a guard inside opened a door for them. They walked along a corridor, passed through another guarded, locked door, and emerged in a lobby.

The sign said EMOTIONAL THERAPY CENTER.

Patients flowed in two directions. Those departing were taking descending escalators to the hospital's underground trans terminal; those arriving were stepping from ascending escalators, fumbling for their treatment cards, and hurrying toward the queues formed at gates that matched the color of their cards.

The pickets took in the scene perplexedly and then turned questioningly to Connager.

"I wanted to show you your problem," Connager said.

Stel asked sarcastically, "*Our* problem?"

"Humanity's problem, if you prefer it that way. As long as people feel a need for emotional therapy, are willing to pay for it, and have psychiatrists willing to prescribe it and call it necessary, we'll have laws about natural death. There are the people you should picket."

"They're sick," Stel announced scornfully. "What good would it do to picket sick people?"

"Picket their psychiatrists, then. If this kind of therapy is necessary, the psychiatrists should be able to provide it humanely."

All three of them turned on him. "You sound as if you're on our side," Stel said.

"Ever been inside a terminal ward?" Connager asked.

They shook their heads.

"I have to take a minimum of three daily tours of the place. You kids can't imagine how bad it is. Yes, I'm on your side. But you're challenging a universal medical practice that happens to be legal. The only way to stop it is to get the law changed."

"Bringing the public's attention to such horrors will put pressure on the legislature," Stel said confidently.

"More than half the public you're trying to arouse needs the emotional therapy you're trying to do away with," Connager said. "At least twenty-five percent couldn't function without it. Because of your picketing, the directors have closed the outpatient clinics, restricted admissions, and even cut back on some emergency services, but they wouldn't dare interrupt the emotional therapy treatment schedule. Look at the patients waiting for treatment, and then look at those leaving."

They were an abstracted cross section of gross humanity. Some were withdrawn, moody, depressed, some were elated, talking volubly, and laughing shrilly at their own pointless jokes, some were nondescript and would not have been taken for mental patients except in that particular lobby. Almost all of them carried binoculars. As their turns approached, they displayed the craving, the sickening eagerness, of cotics addicts about to receive a fix. And those emerging from treatment had a dazed, drugged appearance, sometimes ornamented with the smug smile of satiety.

"Now you know the problem," Connager said. "If I could think of an answer, I'd be glad to tell you what it is."

He took them back to the service entrance and left them. When he reached his own headquarters, he watched briefly a pair of monitor screens that showed the pickets marching peacefully along the fence and waving their signs. In the background, a lone Public Security agent was watching indifferently. Public Security, at least, did not panic at the sight of a few peaceful pickets, but Public Security wasn't responsible for what occurred inside the hospital.

Connager turned to an assistant, who was watching the row of interior surveillance screens. "Argorn made any interesting contacts?" he asked.

"She rarely speaks to anyone. She even eats alone."

She was walking with slow deliberation along a corridor: Nellisly Rhoodhal Argorn, a sturdy-looking woman with a large frame and hefty shoulders. The hospital needed such help. One thing machines could not do was lift and care for patients, and Argorn was very good at it. She was strong but gentle. Her superiors thought highly of her, and they were indignant when Connager placed her on surveillance.

She stopped to look in both directions before she entered Ward 9E. The assistant punched a number, switching the monitor to another camera. Inside the ward, Argorn was slowly walking along a row of coffins.

Hospital employees called them coffins. They were life-support systems for the desperately ill, boxes with curved plastic lids that were closed when the patient was using oxygen, and they contained all of the complicated electronic instrumentation and apparatuses necessary to monitor a patient's vital signs and supply nourishment or medication as prescribed—and sound an alarm at any

significant deviation from the predicted norm.

Argorn paused several times to glance at the patients she passed, and finally—after cautiously looking about her again—she stopped by the coffin of patient 7-D-27-392A. Connager's assistant clicked a stopwatch. Argorn remained there for five minutes and 17 seconds, performing the routine chores a nurse's aid was responsible for—she sponged the patient's face, she performed a synch test on instruments and monitors, she rearranged the pillow, smoothed blankets, and saw that the patient was resting and breathing comfortably, and then, for a full two minutes, she stood and watched her. Finally she moved on, with brief glances at other patients.

Connager dialed the daily report on patient 7-D-27-392A and studied it thoughtfully. Ritella Downley Smithson, a widow, aged 102, diagnosis Retland's cancer, curable if detected in time, but hers hadn't been. The deteriorating-prognosis line had dropped below 20 percent. She would not be moved to a terminal ward until it reached zero. She had no known living relatives, she'd had no visitors.

And Argorn demonstrated a special interest in her. Connager asked his staff to find out why.

Connager's jacket pocket beeped twice. Connager took the com disc activated it, and responded, "Hospital Security, Connager."

"Emergency board meeting,' the seductive voice announced. 'They want you.'

"Everyone wants me," Connager said wearily. "It's because I'm so handsome."

The voice giggled warmly.

The board members were doctors of varying specializations, splendidly competent in medical matters and completely lost when confronted with a problem in security. All of them turned expectantly when Connager entered. Before he seated himself, he passed around a stack of reports.

"I've put my appraisal of the situation in writing, gentlemen," he said. "I see no reason to change a syllable of the recommendations I gave you at your last meeting. There is no external threat to this hospital. Those youngsters on the picket lines aren't about to storm the building. They think they're much more concerned about your patients than you are, because they include the terminal patients in their concern, and they're convinced that you don't. There *is* a serious potential threat to the patients, and you're right to be concerned about it, but it's an internal threat."

Dr. Alfnol said incredulously, "After all that's happened in the past three days, do you still maintain that this hospital's patients may be in danger from our own employees and staff?"

"Yes, sir, because of the lax procedures followed in hiring and in inventories prior to my transfer here. I state my recommendations in this report, and I'll repeat them

verbally. Cut the external security to a reasonable minimum. Let me move my people inside, where they're needed."

"Are you aware that the number of pickets has doubled since noon?"

"Yes, sir. And I've never seen a more peaceful group of pickets. They may make threatening gestures, but that's only to attract public attention to what they consider a serious moral problem. Frankly, gentlemen, I'm wondering if they aren't performing a useful social function. They've managed to frighten everyone in the hospital, including you. When was the last time any of you were frightened? An occasional strong emotional reaction is healthy. If you have one often enough, it keeps you out of Emotional Therapy. Ask your psychiatrist."

Several of the doctors were looking at him angrily—which was, Connager reflected, another healthy emotional reaction. He said again, "The threat to this hospital's patients is an internal one. I've found no trace of the missing syringes. I've found no explanation for the alarming pharmaceutical shortage. I don't know how many undesirable employees we have because the proper checks weren't made at the time they were hired. I request permission to move my people inside."

"Do you still suspect Argorn?" the director demanded. "Her superiors think that's ridiculous."

"She was hired recently enough so that the information on her application could be checked, sir. And she lied about everything except the fact that she's female and her present address. I'd like to know why. I can't ask her, because that would alert her to the fact that I'm suspicious. If she has coconspirators, I want her to lead me to them."

"Ridiculous!" Dr. Alfnol muttered.

"No, sir. It's sufficient reason for watching her carefully, which is my job. I'm giving you my recommendations about security, which also is my job."

"Very well, Connager." The director wasn't enjoying being frightened. However therapeutic his psychiatric colleagues might consider it. "We'll consider your report and let you know."

It was almost dark when Connager left the building. He walked slowly down the drive to the main gate. He stood there for a time with the guards, watching the pickets. Two dark-haired girls, walking one behind the other, looked at him curiously and then looked away. There were now two indifferent agents: Public Security had doubled its force for the night shift.

"The kids shouldn't be blocking the gate," Connager announced.

The guards looked at him perplexedly. No visitors were being admitted, and there hadn't been any ground traffic in three days. Connager signaled for the gate to be opened. "The idea," he said, "is to be firm." He went out to the parkway and began walking alongside the pickets, joking, asking questions, and then moving on.

It was quite dark now, and several were carrying torches.

Finally, Connager reached one of the dark-haired girls. She spoke softly. "Stel made the arrangements. Everything is ready."

"Good. Tell her she can't be late. Everything depends on the timing."

"I wish we could come."

"No. There's risk enough without that. Your being there would turn a protest into a conspiracy."

He moved along to the other dark-haired girl and spoke to her about blocking the gate. Then he turned back. He motioned to the guards, who opened the gate for him. The pickets already had arranged their lines into two circling segments to leave the gate clear.

"How come they do what you tell them?" one of the guards asked.

"I always say please," Connager told him.

He returned to his headquarters. Doctor Alfnol was waiting there, talking with one of Connager's assistants. "Where have you been?" he demanded.

"Out persuading the pickets not to block the main gate."

"Oh. The board has rejected your recommendations. There are more pickets now than there were this afternoon. Keep the guards outside."

Connager said, "Sir, I'm worried about the terminal wards. At least let me bring enough people inside to put them under maximum security."

"The board sees the situation differently. Keep your people outside."

The director left. Connager told his assistant, "I'm going to rest awhile. Call me when you have to." He went to his office, stretched out on an uncomfortable sofa, and tried to sleep. At 2200 he was up again and making his rounds.

An uneasy quiet had settled on the hospital. The routine went its inexorable way without incident, and except for an occasional prentice nurse moving from one ward to another, Connager met no one. He missed the humming PTVs; theirs was the most characteristic sound of the modern hospital, but few patients were sent anywhere between their evening meal and breakfast, and none at all were moving about on this night.

He descended to the first level and spoke to his com disc. "Connager here. I'm going for a swing outside. I'll be out of contact for 30 or 40 minutes."

"All clear here," his assistant responded.

"What's Argorn doing?"

"Taking her break."

"I'll check in as soon as I'm back inside."

Connager turned into a short exit corridor that was off monitor, and he actually opened a seldom used exterior door and closed it again. Then he stretched on a pair of surgical gloves. He unlocked and opened the metal cover to a service shaft, climbed in, and closed and locked it

"Technical advisors."

With a light dangling from his wrist, he climbed down a ladder to the hospital's lowest level. He emerged in another off-monitor corridor, crossed to a square metal door, and unlocked it. The tunnel to the hospital's power plant stretched before him—low, half filled with pipes, but easily negotiable.

He reached the end, unlocked the door there, and stepped into the power plant. Now he was outside the hospital's fence and the cordon of guards. The old boilers were no longer in use; the building was kept in maintenance in case of emergencies. There was no night attendant.

Connager went directly to an exit at the rear and unlocked it.

Stel stood there with eleven carefully chosen recruits. "Five females and seven males," she said. "It better be right. You're late."

"One minute early," Connager said. "Five and seven—check. Let's move." He passed out surgeon's gloves, and all of them, with unpracticed awkwardness, stretched them on. Then he motioned them inside and locked the door.

The time was 2244 when Connager emerged from the service shaft at the second-floor level. Leaving the 12 pickets clinging to the metal ladder, he replaced the cover and went to scout around.

"Connager here," he told his com disc. "Back inside."

"Everything's still quiet," his assistant answered.

He returned to the shaft, motioned the pickets out, and led them to a storage room across the corridor. "You'll find uniforms there," he said. "Get dressed."

He left them and went for a brief inspection tour of that wing—up a flight, along a corridor, down a flight. A door at the end of the corridor opened. A group of nurses and prentices emerged. Connager counted them as they passed, nodding at him: the nursing staff of the terminal wards, going for its 2300 break. They all went together—who could be concerned about an emergency among patients placed on the hospital's discard heap to die? And they always left early and overstayed.

As soon as they turned the corner, Connager opened the door to the storage room. He motioned out the pickets, now dressed as nurses. He handed them a carton that had been hidden behind a stack of large containers: two gross of disposable hypodermic syringes, each of which Connager himself had filled with five cc's of Tharmenol—a lethal dose of a powerful, injectable barbiturate.

"Be back at this door at 2315 regardless," he said. He unlocked the door, hurried them through it, and closed and locked it after them.

Then he took out his com disc. "Connager here. I'm going into the terminal wards. ET levels. Mark me down as disconnected."

"Right. Everything's still quiet."

"I'll relieve you at 2400. You need some sleep."

"Right!"

Connager climbed a flight of stairs, unlocked a door, locked it after him. Three strides brought him to a second door, and he emerged from that one into an Emotional Therapy treatment session.

The balcony slanted steeply; the psychiatric patients sat staring down into the arena, most of them using binoculars. And in the arena were the rows of terminal patients dying the natural deaths that the law guaranteed and demanded, dying without medicine or medical condolence, dying in agony. Their twisted bodies heaved with pain, their moans and screams and wails reverberated from one sound amplifier to another.

And the ET patients—the mentally ill whom this society had insulated from pain, from fear, from all the strong emotions it considered socially undesirable and who now had to be exposed to death agonies as therapy—these were bathing themselves in effusions of terminal torment. They sat transfixed, totally absorbed in the horrendous sufferings of the doomed patients below, vicariously experiencing a few minutes of death agony each day to make an emotionally barren existence possible.

On the lower level, the dying patients' cots were arranged in double rows, with a space between them for the use of medical personnel, and those psychiatric patients with high disability indexes walked along a transparent wall on either side, stopping here and there to press their faces against the plastic barrier and drool at the convulsive anguish just beyond their noses.

Connager had never been able to view the scene without an impotent anger that sickened him, but on this night he had to remain tensely alert. Six of the pickets, disguised as nurses, were working along the dozen rows of patients, the males in pale blue trousers, coats, and caps, the females dressed the same except for their traditional nurse's headpiece. All of them wore surgical masks. In the adjoining ward, the other six would be working. They had 15 minutes to get to the far end of the ward and return. Stel had briefed them with care. Their nurse's posture was more than adequate as they routinely checked their patients—here bathing a face, there straightening a pillow, rearranging a twisted leg, covering a tormented body—and as a final caress injecting five cc's of Tharmenol into the patient's upper arm muscle.

It meant 20 patients for each masquerading nurse—240 in two wards, for only the most agonizing deaths were put on display for Emotional Therapy. Those patients with the bad taste to die quietly were allowed to have their natural deaths without spectators.

Connager looked about for the psych

fechs They had noticed nothing irregular but they were watching their own patients not the terminals whose suffering provided the treatment He saw no psychiatrist on either balcony, but there rarely was one at this time of night—even though the treatments were available on a-24-hour schedule because the dying patients suffering was continuous

Connager turned his attention to one of the phony nurses Already his movements looked practiced and efficient He had achieved the mechanical indifference of the regular nurses who knew that no kind of unsympathetic handling would distract from a profundity of torment A touch of the brow with his left hand a smoothing of a blanket, and his right hand swung home the syringe emptied it withdrew it returned it to the cart he pushed ahead of him The instrument of death was handled almost invisibly

In the next aisle one of the girls had reached the end of the row and started back Connager looked at his watch They were making better time than he had expected

Anxiously he turned his attention to the patients already injected If they reacted to the drug too quickly if their agonies subsided before the pickets got out of the room the result could be catastrophic The ET patients would protest Instantly Connager had seen a near riot when three terminal patients had died simultaneously, thus depriving the watching ET patients of their therapy

But there was no reaction—yet Seven minutes All of the nurses were working back on the opposite row of patients Five minutes Four

Connager left the balcony and passed through the double doors back into the main hospital The general alarm gong was sounding when he opened the second door He ignored it coolly locking the door behind him He ran down a flight of stairs unlocked the stock room door and went to open the door he had passed the pickets through

Stel and another girl staggered out Both had ripped off their surgical masks The other girl was holding hers to her mouth trying not to be sick Their faces were pale and dripping with perspiration Connager waved them to the stock room and they began to strip off their uniforms before the door closed on them A boy hurried out and went to join them And another The others came in a rush and Connager counted 12 and locked the door He went to the service shaft and removed the cover As fast as they were able to change the pickets hurried to the shaft and started down Connager went last pausing to lock the stock room door and dump the uniforms down a laundry chute Moments later he had the pickets scurrying back through the tunnel

He took his com disc from his pocket It beeped stridently when he activated it "Connager here "

"Emergency!" his assistant gasped 'The pickets are rioting Argorn turned off the life-support system on patient 7-D-27-392A The director wants you"

'About the pickets, nonsense Have you got Argorn?"

"Yes but—"

'Then it's a medical problem We've handled the security problem Tell the director I want all available medical staff rushed to the terminal wards Get those terminal wards nurses off their tails and back to the wards Class one emergency It's hot and I'm chasing it Forget the pickets Don't call me

He dropped the disc back into his pocket and climbed into the tunnel

As he let the pickets out of the power plant door they stripped off their gloves and handed them to him 'It was ghastly, Stel told him Then she added 'Thank you

"Get around there and get involved in the riot " Connager snapped

They vanished into the night

Connager retraced his steps, locking doors removing traces He dropped the gloves into an incinerator unit and watched them vanish Then he climbed the stairs to ground level and took out his com disc

"All right," he said "Whoever it was they got away Where are my people?'

"They've all gone to the terminal wards "

"How's the riot?"

"They're still making lots of noise and they threw something over the fence that's burning but I guess they aren't doing much "

"Then I'm going to the terminal wards "

He pocketed the disc and walked along briskly, ignoring his fatigue He would be up the rest of the night but after that he could go home and go to bed For the first time in three days

The director's face was ashen 'They're all dead! They killed every one of them!"

"Not dead," Connager said Murdered

Dr Alfnol's jaw moved, but no sound came out Then, abruptly, he was angry "You—the director of security Where were you?"

"A director of security" Connager said bitterly, with a board that vetoes every recommendation I make You wouldn't let me move security personnel in here so I came myself "

Dr Alfnol stared "You were here?"

'In person," Connager said still sounding bitter "But one person can't cover all the levels I must have witnessed at least 50 murders and I didn't suspect a thing until it was too late "

'You mean—you saw it done?'

"I saw it done By people wearing nurses' uniforms And it wasn't until it was almost over that I suddenly remembered that the ward nurses take their break at 2300 They all go together and I saw them go But I was watching the ET patients and I'm tired, and I didn't react to what was

"Will a scotch and soda cost less if I order it generically?"

going on until it was too late.'

But—what did they do?

They fussed with each patient, the way nurses do. What they did is a medical problem."

"Yes. Of course." Alfnol paused. "Argorn. You were right about her, too. But she claims that a gauge was malfunctioning and the alarm didn't go off and she set it off deliberately to get help quickly."

Could it have happened the way she said?"

"Yes, I suppose it could."

"Then maybe I was wrong about her. I'll have a look. I want the data sheets on the murdered patients." He turned.

The director said, "Connager—"

Connager turned again and faced him.

"I'm sorry, Connager. You were right. We were stupid."

"No, sir." Connager said, "but you violated one of the basic principles of your profession. Don't call in a specialist if you're not going to believe him unless he agrees with you. I don't tell you how to fix people's insides. You shouldn't be telling me about security. I've been doing the one as long as you've been doing the other."

"I never thought of it that way."

"What about the ET program?" Connager asked.

"We're bringing in terminal cases from the other hospitals. Each one will let us have a few. We'll have the program going again shortly."

Connager had a brief interview with Argorn, and then he told her superior to put her back to work. 'She may be entitled to a commendation,' he said.

The nurse looked at him strangely. "That's odd. I thought you didn't like her."

"Emotions such as like and dislike belong to Emotional Therapy. The only emotional luxury a director of security can afford is to be suspicious."

He returned to his headquarters and relaxed for a time, watching the pickets on the monitors. They had quieted down, and several Public Security agents were standing by conspicuously.

Then his assistant came in. "Those pickets that were here this afternoon. They want to see you. To apologize for the fires—they say."

"I'll see them in my office," Connager said.

They came in quietly, escorted by a Public Security agent whom Stel had persuaded to bring them to Connager. "It's all right, officer." Connager told him. "You can leave them with me."

The agent nodded and stepped back. The door closed.

"We just heard," Stel said angrily. "They're bringing terminal patients from the other hospitals. We didn't do a bit of good. You lied to us."

'Two hundred and forty patients were dying in agony." Connager said softly. "Now they're no longer in agony. That isn't good?"

"It didn't change anything."

"Changing things takes time." Connager said. "You've been picketing for three days, and no one outside the hospital has noticed. But the public will notice this—two hundred and forty murders can't be hushed up. People will start thinking about those patients, thinking about what will happen to them when it's their turn for a natural death. And *that* may change things—eventually."

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She brightened. "I didn't think of that. You're right. They can't hush up murders." She started to get to her feet, and then she turned to him again. "There's something I've been wondering about ever since—I mean, why don't people realize how horrible it is? I know there's all that double-talk about the law, but those who make the laws are voted for, and the medical profession advises them, and why does everyone let it keep happening?'

"People do surprising things for money," Connager said. "The Emotional Therapy centers are immensely profitable. The public won't pay taxes to support hospitals, but it's always willing to pay for entertainment."

They left, and Connager leaned back and closed his eyes and reminded himself that he was no longer young. For these youngsters, it was an achievement. Something they would always remember. For him, something he preferred to forget with another weary night of security routine to follow.

His assistant came in. "Here are the data sheets on the murdered patients."

Connager took the stack of folders and began to leaf through them. He found the one he wanted. Veranone Janling Marcone. Age ninety-seven. Relatives, none known. Visitors, none.

No relatives except a daughter willing to take a job as a nurse's aid just to be near her mother, and a son willing to take a demotion to transfer to the hospital as director of security so he could visit her several times a day. And—when her illness became terminal—two granddaughters willing to organize pickets in a monstrous conspiracy they all took part in to end an old woman's death agony.

A pity, Connager thought, that the psychiatrists practicing emotional therapy couldn't expose their patients to love instead of suffering. But perhaps they considered love a dangerous emotion better left suppressed. It could lead to murder.

But it's also a beginning. ' Connager said softly. "It's one suffering old woman's ending, and it's a beginning."

He closed the folder. DO

CHESSMEN

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cow?) Even at his trial, where he learned he was a traitor and a spy and that this was in some way connected with his chessmen, Tomov was not surprised, because there was not room for surprise amid his efforts to understand what was going on. No one thought—or took the trouble—to mention the "poison" in the dye used to color the proletarian pieces of Tomov's entry. But when the attendants carried his body from the bullet-studded wall, certainly the expression on Tomov's dead face was one of surprise.

The day following this correction of Tomov's error, Petroev, Champion of Chess, arrived in Moscow. When Petroev and the peasant chessmen, playing before several members of the Politburo, lost to each of the five local experts, to Donovich, to Dosiev, and to Donovich's ten-year-old son, the final confirmation had to be sought. It had to be sought if only because word had somehow got to the people of the city. Quietly, but very widely, in the shops, in garages, on the streets, discreet questions were being asked about the losing proletarian chessmen. So wide this knowledge seemed to be that the affair could not be handled by a few swift moves after dark. Faced with the prospect of purging all of Moscow and probably beyond, one realized other measures were demanded.

The Laboratory for Chemical Analysis sent its report.

"*Except for the usual chemical elements found in dyes (no doubt stolen from the Woolen Mill at Rybinskh), there are no chemical properties in these wood pieces. The same dyes, in identical color combinations, were used for pieces of both sets. The slightly different appearance of one piece is not due to any detectable additional material used in its manufacture, nor is this one piece part of the set suspected of poisoning.*"

The laboratory report was labeled "SOV ERSHENNO SEKRETNO," "ABSOLUTELY COMPLETELY SECRET," and rushed to a special meeting of the Politburo to be presented to Comrade Stalin and his immediate lieutenants. Since Comrade Stalin was indisposed for two days, the meeting had to be postponed.

Comrade Stalin became disposed. The meeting was held. Petroev was invited. Krakov and Donovich were allowed to wait just outside the door for word. A table was placed, and two chairs. The chessmen were set up on the board. Comrade Stalin challenged the evil and himself sat down behind the peasant king. The other chair was taken by that one man in the Politburo most skilled in military maneuvers, most read in the battles of Bonaparte, Caesar, and von Clauswitz, ablest of all the lieutenants at chess. That he had been hurriedly recalled from a foreign post because of a developing taste for western ways added spice and a touch of humor to the game.

Stalin moved a sickle-swinging pawn. A chess expert? Not he. But a leader with faith in the peasant people represented by his chess set, a leader with faith in the principles for which he lived and fought, a leader with faith in his power over the lieutenant playing opposite him.

Whatever Muses, Fates, or gods watch over games of chess, they were sorely abused that day and are no doubt shuddering still. Perhaps the spirit of Tomov also watched. Justice, not one to understand a special need, soon turned her eyes and dimmed her lamp. For none of the leader's faith had been misplaced. The lieutenant, however hard he tried, could not make an intelligent move. The Donovich boy would have shrieked with delight at the ineffectiveness, but there were only serious faces on the Politburo members crowded around the table. In less than a dozen steps the gaudy queen was gone, the puny soldier-knights and shoddy castles lay aside. Only the bishops, king, and a few stray pawns remained. Yet it happened.

Breath stopped in every watcher, in both players. Not to make the move would have been too absurd. So a bishop stepped a single pace and stared down open passage to the peasant king.

"Check."

Perhaps it wasn't ever said aloud, the whisper was so low. But every ear heard it. And in the stillness following the word, there was time, too, for every ear to hear the quiet questions of the people of the city.

It was Stalin, the leader, who dared to lead now, to break the stillness. The words came softly in the exhale of a long-held breath.

"Not mate."

His fist then thundered on the board, hurling the pieces far. His voice was large now, strong and low.

"Check, yes. But not check mate!"

Then still the leader, still the one with strength to act, Stalin picked up the pieces one by one, from the floor, the table, the board. He walked to the fire, dropped the chessmen in. He waited while they burned. For a minute, and another, he watched the smoke.

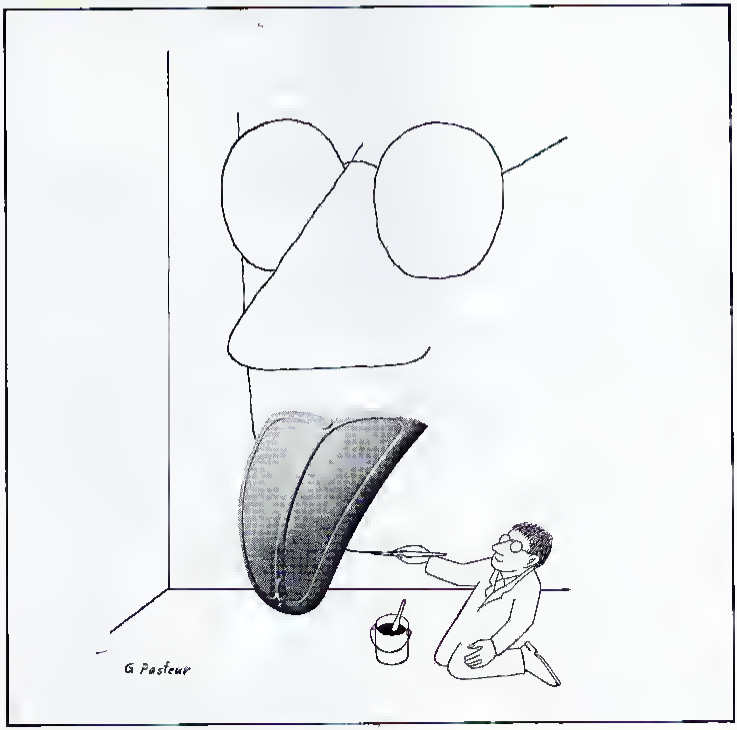
And then he turned. Again, and quietly he spoke.

"Always there is a way, by skill, or then by cunning, or by force."

The others hurried out to tell the people of the city that Stalin, again, had won.

The last to leave knew better. They saw the leader's fist still clutch the wooden bishop. They saw the fist compress and crush till veins stood out and flesh was white. They saw—those last to leave—one tear from the hardened eye run down the cheek and "plop" upon the hearth.

They saw what they would never say, without the skill, the cunning, or the force, the chessmen won. ☒



INTERVIEW

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democratic society was. In my view, it's an attitude that goes with a full belly.

People in India or Burma, Guatemala or Colombia, can't afford to be as cavalier about stopping technology as some of the middle-class rebels of the sixties were.

There's something arrogant, anyway, about the idea of doing away with technology, as though it were ours to dispose of. We tend to think of it as a product of Western society, and we forget that it's also a product of Arab mathematics, of Chinese inventions, and so on. Science and technology are the common inheritance of the human race, and it's not for a few well-fed middle-class Westerners to say, "Let's pull the plug and begin again."

But the technophobes are really only a small, romantic group. Most people, by and large, do want science and technology in their future. But they want a new, more human science and technology. They want advances that are carefully thought through, carefully selected to minimize adverse side effects. And they want some say in the choice.

It has always seemed to me that both extremes in this debate are dangerous to our health and ought to be labeled as such. At one end, the blind "progressmanics" who want to push forward with the same kind of brute force technologies that have already imperiled the planet. At the other pole, the equally blind and arrogant past-glorifiers who want to go back to a past as prehuman as it was pretechnological.

What we need, even more desperately today than when I called for it in *Future Shock*, is a movement for *responsible* technology. That means a technology that recognizes our own limitations and the real or probable limitations of the biosphere.

Omni: Isn't it really too late? Haven't we gone so far toward destroying the environment that nothing short of a screeching halt can now save us?

Toffler: No. I don't believe in apocalypse. I still believe that, over the long haul, we will pull through.

But, having said that, I also think the 1980s and '90s will see some terrible technological disasters if we continue on our present track. If we keep proliferating nuclear plants, siting them on geological faults or near volcanoes or dumping radioactive wastes into the seas and into the earth, somewhere along the line, despite all the fancy computer models and all the assurances we get from the experts, some unexpected series of human errors will occur. All those beautiful fail-safe systems will fail to prevent a tragedy because they themselves will prove irrelevant. You can't ever cover all possibilities.

If it isn't a nuclear catastrophe, who's to say it won't be something worse? We are beginning to play with genetic engineering, weather modification, and other high-powered technologies we know little about. Considering our abysmal environmental record with far more traditional, less powerful technologies, there is plenty of cause for concern.

But none of this means we should turn the clock back, that we should stamp out technology—which can't be done anyway—or that we should doom three-quarters of the human race to perpetual hunger or poverty in the interest of preserving the environment. What it does mean is that we can no longer play the technological game the way we have.

It's a new game, and Rule Number One is "proceed with extreme caution."

Omni: You say we must proceed with caution, yet you've also often said that we are on the edge of fantastic breakthroughs in science and technology for which we are unprepared. Can you give us some examples. How do you foresee scientific and technological development in the next twenty years?

> *"I know perfectly sweet, intelligent people who are so angry at what they regard as the arrogance and dogmatism of the men in white coats, they would gladly lynch a few before breakfast."*

Toffler: I think we'll see three separate, but converging, lines of development. I call them "high-stream," "low-stream," and "out-of-the-stream" technologies. The first of these—"high-stream"—depends on advanced theoretical knowledge or on complex techno-engineering.

Under this heading, for example, I would include space exploration. Gerry O'Neill at Princeton is still pressing for manned (and womanned) space colonies and has mustered considerable political and intellectual support. Work is proceeding on space manufacture—which will someday give rise to new processes and materials that can't be duplicated on earth. Work on the space shuttle moves ahead. Budgets will rise and fall, but we are irrevocably committed to space, in my opinion, and that commitment is likely to deepen.

Similarly, while matters are confused because of the failure of the Law of the Sea conferences to arrive at an international agreement, there is no doubt whatever in my mind that we are about to take a historic step into the sea within the next decade or two. We'll go from simply harvesting ocean life—i.e., fishing—to growing what we need—i.e., aquaculture. We'll also start taking manganese nodules off the ocean floor. And we'll build semi-submersible floating platforms on which we will put not only airports and oil refineries, but large numbers of people. We're going to make our own islands and populate them. That was Bucky Fuller's dream a generation ago.

Omni: What new problems will this kind of high-stream development bring with it?

Toffler: Just look at the political and international issues you raise when you suddenly create a new island! To whom does it belong? Can it declare independence? Or join the UN? Environmentally, how do you carefully, cautiously develop these ocean resources without turning the seas into poisonous soup? How do you avoid killing off the algae we depend on? How do you prevent overfishing? Who has a right to the krill that populate the seas between Argentina and the Antarctic?

Should American and other multinational corporations have the right to plunge madly into the oceans, in a competitive race for profit, and be given wide-open squatters' rights, or is the ocean—like technology—"the common heritage of humanity," as the poor nations insist?

Many of these same questions will apply to operations in outer space as well once manufacturing begins to take place there. And once the Pentagon and the Soviets begin knocking down each other's satellites in earnest. Once again—though we devote less money and brainpower to them—the social and political questions linked to technology turn out to be far more important than the purely technical or even scientific issues.

Omni: What about genetic engineering? We've heard a lot lately about cloning and test tube babies. Is that "high-stream" science and technology too?

Toffler: Yes. I would include them under that heading. They certainly depend on advanced theoretical knowledge of biology. Years ago, at the time I described cloning and birth technology in *Future Shock*, most people thought it was wild speculation, science fiction. Today it's front page news. And it will be even bigger news in the near future.

When you get into genetic manipulation, you touch the life force itself. And like so many other breakthroughs, it has both its hideous risks and its positive side.

Omni: What's good about genetic engineering?

Toffler: Genetic manipulation can yield cheap insulin. It can probably help us solve the cancer riddle. But more important, over the very long run it could help us crack the world food problem.

You could radically reduce reliance on artificial fertilizers—which means saving energy and helping the poor nations substantially. You could produce new, fast-

growing species. You could create species adapted to lands that are now marginal, infertile, arid, or saline. And if you really let your long-range imagination roam, you can foresee a possible convergence of genetic manipulation, weather modification, and computerized agriculture—all coming together with a wholly new energy system. Such developments would simply remake agriculture as we've known it for 10,000 years.

Omni: What's the downside?

Toffler: Horrendous. Almost beyond our imagination. When you cut up genes and splice them together in new ways, you risk the accidental escape from the laboratory of new life forms and the swift spread of new diseases for which the human race has no defenses.

As is the case with nuclear energy, we have safety guidelines. But no system, in my view, can ever be totally fail-safe. All our safety calculations are based on certain assumptions. The assumptions are reasonable, even conservative. But none of the calculations tell what happens if one of the assumptions turns out to be wrong. Or what to do if a terrorist manages to get a hold of the crucial test tube.

A lot of good people are working to tighten controls in this field. NATO recently issued a report summarizing the steps taken by dozens of countries from the U.S.S.R. to Britain and the U.S. But what do we do about irresponsible corporations or nations who just want to crash ahead? And completely honest, socially responsible geneticists are found on both sides of an emotional debate as to how—or even whether—to proceed.

Farther down the road, you also get into very deep political, philosophical, and ecological issues. Who is to write the evolutionary code of tomorrow? Which species shall live and which shall die out? Environmentalists today worry about vanishing species and the effect of eliminating the leopard or the snail darter from the planet. These are real worries, because every species has a role to play in the overall ecology. But we have not yet begun to think about the possible emergence of new, predesigned species to take their place.

Omni: What about that old-fashioned species, *Homo sapiens*?

Toffler: Well, what about us? Who is to redesign the human body? Who is to decide what your child and your grandchildren are going to look like? How shall we prevent such techniques from falling into the hands of the Hitlers of the future?

As usual, we are racing wildly ahead in the lab with innovations but crawling when it comes to social and political innovation. I think every dollar used for scientific and technical research and development ought to be matched by a dollar devoted to research and development on how to deal with the social and environmental consequences of that research.

We complain that political and social systems lag behind scientific and technological invention, but we put precious little money or brainpower to work on the problem of *social invention*. We're trying to cope with things like genetic engineering with obsolete regulatory concepts.

Not surprisingly, the guidelines and controls on genetic engineering are still only feeble at best. The geneticists (with some honorable exceptions) and the big drug companies (with fewer honorable exceptions) don't want anyone telling *them* what do to. They will want to play the game by the old laissez-faire rules.

Omni: What other "high-stream" developments are ahead?

Toffler: Things are breaking loose on many other fronts—like brain research, for example. Dr. José Delgado, the man who once stopped a charging bull by sending radio waves to electrodes implanted in its brain, is now in Madrid, after having left Yale. I saw him recently at a UNESCO roundtable in Paris, and he predicts that within one year we'll see non-sensory communication from brain to brain—the direct input of electrical signals from one brain into another, bypassing the sense organs. This has staggering implications for our understanding of perception and communication. Delgado is speaking out, trying to tell us that revolutionary changes are about to explode. He says that before long we will have the ability to deliberately alter evolution of the human brain.

> *"There's something arrogant about the idea of doing away with technology. We forget it's also a product of Arab mathematics, of Chinese inventions. It's not for well-fed Westerners to say, 'Let's pull the plug.'"*

Omni: Whew! If that is all "high-stream" development, what's "low-stream"? Give us some examples.

Toffler: Well, "low stream" is technology that is designed to be more human, more responsive to local and community needs, less environmentally degrading. The people working on this say technology doesn't have to be big and wasteful. They point out that where capital is scarce and labor plentiful, technologies should be deliberately labor-intensive. They say that the energy system must be decentralized and built on renewable sources.

This whole concept, as developed by E.F. Schumacher, is a constructive one, since it challenges the assumption that the technology that works in Birmingham will necessarily be good for Bombay or Brooklyn. It attacks the basic premises of brute force technology, and many of the underlying principles of industrialism.

I can give you one simple example of low-stream technology. A futurist friend of ours, M.S. Iyengar, some years ago headed up the Indian government's research laboratory in Assam. He looked for new processes that could be used by village people without much capital, without supporting staffs of Ph.Ds., without much energy input. He noticed that India was importing caffeine for pharmaceutical use, but that, at the same time, it was burning millions of tons of waste from its tea plantations. Now tea has a substance in it that is extremely similar to caffeine. So he invented a simple, cheap, village-scale machine for extracting this substance from tea waste. Then he invented a technology for using the waste from *that* process to make low-cost building materials.

I think we'll see much more of this approach in the years ahead, and that it will develop at the same time as our high-stream technologies, which will, themselves, begin to embody some of the same principles. Eventually, we'll see high-stream and low-stream begin to come together in appropriate systems.

Omni: You spoke of three main lines of development. What's the third?

Toffler: In addition to "high-stream" and "low-stream" I would add what might be called "outside-the-stream" science and technologies—developments from fields that our scientific and engineering establishments today, for the most part, regard as kooky, weird, or unrespectable—beyond the pale.

Omni: Like what?

Toffler: Like, for example, the new interest in the work of Nikola Tesla. Tesla was a genius who was supposed to share the Nobel prize with Edison but refused to appear on the same platform with that "tinkerer." Tesla believed that the earth itself could be used as an electrical conductor and that one could resonate electrical waves from point to point without wires or other connectors. For many years, Tesla has been a forgotten figure.

Today there are persistent reports that the Soviets, the American military, and others are doing strange things with low-frequency electromagnetic waves based on Tesla's unconventional theories.

Two years ago, for example—on October 14, 1976, to be precise—radio communications around the world were disrupted by some mysterious influence. It turned out, as I understand it, that these were caused by secret Soviet experiments. The U.S., Canada, Britain, and the Scandinavian countries formally protested to the Russians. Intelligence sources reportedly now believe they were caused by waves originating at a Tesla magnifying transmitter in Riga, Latvia.

Omni: What about fields like parapsychol-

ogy and the occult?

Toffler: Well, this comes back to what I said at the beginning about the revolution in science itself. We are witnessing a slambang attack on rigid, restrictive conceptions of science. This is coupled with a demand that the frontiers of science be expanded to encompass many subjects that have until now been regarded as taboo.

Now, much of this—much of the interest, for example, in the occult, in irrationalism, mysticism, or parapsychology—is either naiveté or quackery. Millions of people, having lost faith in industrial civilization and its ruling ideas, are desperately searching for a new world view or a new religion. And many of them are extremely gullible, easy prey for the para-scientific hucksters and hoaxsfers, for phony gurus and psychics.

Some people—dissatisfied with the criteria science uses to determine truth—use no criteria at all. They believe everything.

But while this is true, it's only half the story.

Omni: That's rough language. What's the other half?

Toffler: The other half is that establishment science itself has become a church, with its own dogmas, hierarchies, and heresies. It has its popes and cardinals, and the power to excommunicate. This power has been used to pillory scientists who challenged prevailing scientific orthodoxy.

Look what happened, for example, to some of those who suggested that Velikovsky's theories be tested. Whether Velikovsky is right or wrong is not at issue here. What is at issue is the nasty retribution dished out to the few who seriously wanted to explore his ideas about astronomy.

Smart scientists are usually agnostics; dumb ones are dogmatic and religious about science itself. Science is a powerfully revealing mode of thought. It has proved so powerful in explaining so many things that seemed "mystical" or "miraculous" at one time that many people treat science itself as though it were a religion. Pretty soon the adherents of this religion say that if a phenomenon does not lend itself to analysis by the approved methods of the church, it does not exist. I can't buy that. It tends to draw too tight a perimeter around inquiry and it all too tidily disposes of a lot of phenomena that—if real (and I stress the "if")—would make reality far more complex than we like to imagine it.

Reality *is* more complex than we can imagine. And it is at least theoretically possible that there are dimensions of "real" experience that scientific method, as we now know it, cannot illuminate. What if our basic assumptions about probability turn out to apply to some, but not all, phenomena? What if our present rather crude conceptions of time make it impossible for us to understand certain fundamental processes? What if physical laws do not apply equally throughout the universe? What if some parts of the universe are "decoupled" from the minor suburb we happen to inhabit?

I can sum it up this way: there are two basic issues. One has to do with subject, the other with method. So far as subject is concerned, scientists make value judgments about what to study. These value judgments are influenced by money prestige, and the prevailing culture—which, at any given time, holds some subjects to be "uninteresting" or "unacceptable." Today, I think that dogmatic scientists are probably too restrictive in what they regard as "worth" studying.

The other question is more complicated, and it is related. The kit of tools called scientific method, which was put together chiefly in the 17th and 18th centuries when industrialism began, has been powerfully useful. Today there is a growing belief that these tools, which some took to be universally applicable, may not be, and that we need alternative methods for dealing with anomalies.

The problem, so far as I can tell, is that no one has come up with a coherent alternative methodology, or alternative set of principles of evidence that has any rigor and that makes it possible to test hypotheses, rather than merely assert them. As part of the birth of the new civilization, we may very well develop such alternative intellectual tools for dealing with aspects or dimensions of reality that may—repeat, may—lie beyond the reach of scientific method today.

This would be a major intellectual accomplishment. We will—and must—continue to use existing scientific method. But we may come up with parallel, equally useful and practical, methods for other aspects of experience. If so, the "single vision" of industrial civilization will be replaced by a culture based on multiple vision.

Omni: In any case, we are clearly left with a lot of anomalies.

Toffler: The anthropologist Roger Wescott has proposed we create a whole new branch of science devoted to questions that seem to defy scientific analysis. Let's take all the things that don't fit our preconceptions—our model of reality—and look at them in a new way. What he's asking for is, so to speak, a science-of-the-oddball. Under this heading he lists a number of fascinating phenomena that probably ought to be given more attention.

Wescott lists anomalies or unexplained phenomena ranging from quasars and tektites to the Bermuda Triangle. He says we ought to investigate the Tunguska explosion of 1908 in Siberia. Apparently, we have eliminated the hypothesis that this was caused by either a comet or a meteor, and at least one Soviet astrophysicist claims it must have been a thermonuclear blast.

Then there are the various unexplained, but repeated tales describing animals we now term imaginary and there are odd ob-

jects like chains we have found in rocks geologists claim are millions of years old. (Of course one ought to be skeptical too about all our dating procedures.) In physiology, Wescott suggests, someone ought to look into the phenomenon of firewalking: why does it cripple some and not others? And what do we make of all those megaliths and other apparently ancient structures we find around the world from Peru to Britain whose function we still don't fully understand and whose construction methods remain a mystery.

I happen to believe, as I said a moment ago, that most of what is reported about the so-called "paranormal" and the "occult" is pure nonsense and that many of the people writing books about these things couldn't distinguish a non sequitur from an Abominable Snowman. They show no judgment, no critical faculties. They apply no principles of evidence at all. And when you ask me to believe everything, I'm tempted to believe nothing.

But when we start putting together the kind of hard, respectable scientific research of a Delgado, for example, with some of the as yet nonrespectable speculation about telepathy, we may find wholly new answers to old puzzles. Some of these could have immense technological implications.

Omni: Are you saying you believe in telepathy?

Toffler: No. But I believe we are still at the beginning of exploring our tiny little piece of the universe, that we're still scientific and technological primitives, and that as we revolutionize science itself, expanding its perimeter, we will put mechanistic science—which is highly useful for building bridges or making automobiles—in its limited place. Alongside it we'll develop multiple metaphors, alternative principles of evidence, new logics, and new ways to separate out useful fictions from useless ones.

Omni: Is this what you mean by moving to a new civilization?

Toffler: It's part of it. The epistemological revolution in science is part of a much larger revolution in our culture that, in turn, is a reaction to the exhaustion of industrial civilization.

Omni: What will this new civilization be like, and what role will technology play?

Toffler: The shape of the new civilization will be determined by population and resource trends, by military factors, by value changes, by changes in family structure, by political shifts—not by technology alone. I'm not a technological determinist.

Nevertheless, the technological choices we make in the next five or ten years will have an extraordinary impact. If we choose to develop the energy system as against another, or one communications network as against another, we will drastically shape the world of our children. That's why we need a technological strategy.

Omni: What do you mean, a technological strategy? Don't we have one?

Toffler: No. The U.S. has nothing remotely resembling a technological policy. My wife and I have just returned from Tokyo, where we met with, among others, people from MITI—their ministry of industry and trade. What interested us about the Japanese was *not* their very advanced research, but that this research was part of a larger plan.

They expect their manufacturing sector to decline and their service sector to grow as it has in many other nations. So they are busy inventing practical applications of advanced technology for the service sector of the economy.

Omni: You have been quoted as advocating greater "citizen participation" in the making of major technological decisions. But isn't it naive to think that ordinary people, without scientific training, can make intelligent recommendations?

Toffler: I don't think untrained people can replace experts—on questions that need expert answers. But you don't need to be an expert to know what you want, and you don't need to be an expert to make the kind of *value judgments* that technological policies are necessarily based upon.

Dr. José Delgado, who once stopped a charging bull by sending radio waves to electrodes implanted in its brain, predicts that within a year we'll see nonsensory communication from brain to brain—the direct input of electrical signals.

I would put it the other way. I think it is naive, not to say anti-democratic, to go on letting major technological decisions—that will affect our lives and the lives of our children—be made by small elites from the business, government, and science communities.

Granted, we don't know much about how to get intelligent citizen participation in such matters. We lack the necessary social and intellectual technologies, so to speak. But I think we can invent them. In this respect, the Swedes may have something to teach us.

Omni: What have they done?

Toffler: The Swedes were hard-hit by the energy squeeze of '73, and they decided they'd better have an energy policy and a lot more conservation. But they also recognized that if the policy came from the usual elites, and the people were not involved in formulating it, then no one would pay the slightest attention to it. So they tried to find a way to democratize it.

The immediate objection was, "What do ordinary people know about energy? They can't tell a solar cell from a fast-breeder reactor, so how can they make intelligent decisions?"

The Swedish government said, "OK, so the people don't know. Let's teach them." And it set up a program that, in effect, said that any Swede willing to spend ten one-hour sessions in a class learning about energy would have the right to make formal recommendations to the government.

Every political party from the right wing to the communists, every trade union, every adult education center, promptly offered its own ten-session courses on energy. The government people assumed that 10–15,000 Swedes might enroll. In fact, 70–80,000 signed up. That's like 2 million Americans sitting down, taking a crash course, and trying to learn something about a national problem.

I don't think this is a panacea. I'm not romantic about "the people." I don't think we can handle complex technological and scientific questions, or begin to control our own technological and scientific drive, without experts and scientists. But I also don't think we can afford to leave science and technology to "the best and the brightest."

If we do, we'll find the future has already been staked out in advance by small elites who got there first and colonized it for their own purposes. And that's dangerous.

Omni: Undemocratic, maybe. But why dangerous?

Toffler: Because the trajectory to the new civilization takes us through unknown territory.

At the end of the line, after a generation or two, we may very well have a much better, more decent, more democratic, and more humane world than we do now. But I don't believe getting there will be smooth and easy.

If history is any clue, the succession of civilizations is accompanied by bloodshed, disasters, and other tragedies. Our moral responsibility is not to stop the future, but to shape it, to channel our destiny in humane directions, and to try to ease the trauma of transition. One way to do that is to invite millions of people, especially the dispossessed and disfranchised, who are seldom consulted, to share in basic decisions.

This means giving them a stake in tomorrow. It means designing new institutions for controlling our technological lunge into the future. It means replacing our obsolete political structures. It means new decision-systems that are both future-oriented and, at the same time, broadly participative.

Only by opening the decision process by democratizing our basic scientific and technological decisions, at least to a degree, can we hope to pass safely through the decades that stretch before us. ∞

WHALE SONG

CONTINUED FROM PAGE 73

mone into the sea here . . here and here . . . I don't know if it will be stronger than the whales' instinct to head north, but if we could lure them south . . .'

"Of course." Barbara looked at the map a moment, visualizing what had to be arranged. Marsha watched her, knowing that they were going to do it. Neither of them would let by even a slight possibility.

As they slid along the icy pathways, sometimes they bounced so high that John saw his father almost lose his balance in the seat of the snowmobile. John wanted to be at home instead of out here, not that he cared about the whales—there were always whales, there always would be whales—but he had been teaching his mother to play chess, and that seemed more amusing than the whale hunt. He wondered about the woman from the University. Were the other villagers thinking about her as they wound between the walls of ice twice a man's height?

John wanted to take out his little notebook and look again at the word she had brought with her—"pheromone." A nice sounding word. It had taken him several days to find the word in a dictionary. He'd found "extinct" again, too, and found that he'd gotten it confused with "explicit", but they were different words altogether, though they sounded good together. Like pheromone sounded, with a "ph" and not an "f." John wondered if anyone else had looked up the word. Perhaps only he, of all the people who lived in the village, knew how the word was spelled and what the dictionary said. After all, he'd had an entire year of accounting at college; he was the only one who carried a notebook and a pen all the time.

They reached the edge of the ice, where the cold sea rippled in a choppy channel. Perhaps they would think the sea too choppy to go out. John got off the snowmobile and looked at his father, but his father didn't look at him. He never did.

John understood from his father's actions that they would load the *umiak* right away. As he looked around at the other villagers, each preparing for the hunt, he saw that they were grim. As a boy, he had known the hunt as a glad time, full of expectation and excitement. But things had changed so that the Eskimo had to defy the others from the south. Defiance weighed them down. They smoked and stood at the edge of the ice in their bright orange, blue, or green down-filled jackets, peering out at the sea. A few of the older men still wore their white skin hunting parkas.

Long ago, the men from the south had come and told them about their God, and how God made the world and everything that happened was God's will. Now the men came out of the green valleys and tall cities to tell the Eskimo that man had slaughtered God's creatures, and they would not come back unless they—who had never killed a great amount of whales—didn't stop the hunt.

John wondered why God didn't put the whales together instead of waiting for the scientists. Could it be that all the tales they brought north were lies?

John helped his father and other men load the yellow-white sealskin *umiak*—a long, slender, silent boat that barely whispered in the water. For thousands of years, even the acute whales never heard the soft whisper of skins gliding in the cold water. They loaded in food—walrus and sweets—a tent, warm caribou hides, a tool box, ammunition, close-range shoulder guns, inflated orange plastic or sealskin floats which still resembled the seal in a comical way, a box of diversions—magazines and a few western novels. Most important was the harpoon with the little bomb that would shoot into the whale's back and explode within.

> *Please, please don't kill any whales this year. They had heard it before. Marsha knew about the Eskimo–she knew that the whale and the Eskimo had lived a life together for thousands of years . . .*

"Are we going out?" John asked in surprise.

"Of course!" his father said irritably.

John hadn't heard any whale sounds and from the others still casually loading their *umiaks* and checking their harpoons, it seemed that no one else had, either.

The boats slid into the sea. John worked his oar hard, not wanting the men to think that the year at college had taken any of the Eskimo out of him. Soon all the boats were out, but one man stood at the edge of the ice. It looked like old George.

They rowed and waited, rowed and waited. No one spoke. The men lit cigarettes and stared at the sea. John read a paperback by a man named Camus, who wrote about a hot, sandy land.

Twilight, midnight, dawn passed again in such a short time that one could almost hear the soft hiss of the pink sun dipping into the sea, resisting with a bounce into the cold blue morning. It was too short for the transition of feeling a new day had come. Instead, it was intermission in a long, long day.

He was glad to rest again, though the silence was oppressive. Arching his back, then rubbing his sore arms, he wondered what his father and the others were thinking through those hours of paddling around and around, waiting for a dark underwater rush, a betraying vapor spout.

The sea had remained silent for several days.

Were they thinking about the woman from the University? Or the lack of whale to divide in the village? Or perhaps the way others would look at them when they paddled back without a catch?

"There aren't any goddamned whales out here," someone said loudly.

John was startled by the sudden voice—a forbidden voice. It snapped the tension so abruptly that he felt a physical confusion in his shoulders and eyes and neck. At once everyone began to speak, relieved to have their anger spilt into each other's ears. John heard them talk about 'them' killing all the whales, about starvation, about being exterminated by conservationists and sociologists.

John didn't worry about starvation. He knew that he could get a job with the government after another year of school on government grants. He knew that all the village could move away to work for the oil companies, or the fisheries, or collect welfare. No one would starve. But things would never be the same again.

The village would be extinct—explicitly extinct.

When he mused on the words, it seemed that they had a special meaning, that only he could grasp. How could he explain it to them? This combination of sounds—didn't it apply to them, too?

John remembered suddenly that the woman had said that whales were smart. Almost as smart as people, but in a different way. And she had played a tape of the whales talking to each other underwater. It sounded like funny electronic music.

He knew a word that described those sounds. A word from his little notebook that he'd written down a long time ago.

Plaintive.

They dragged the skin *umiaks* up onto the ice floe, grumbling with disgust and frustration. John hesitated as the men all headed for the tents of the hunting camp where they'd spent their futile weeks. John's father looked at him.

"Come on. We're going to have a meeting. Or is that below your dignity, too?"

John shrugged and followed.

They decided to break up camp and appoint a delegation to write a letter to the President. Everyone in the village would sign it. Maybe they would get other villages to sign it, too. Maybe they could get compensation. And maybe they would be on the six o'clock news.

The rest of that morning they packed their harpoons, magazines, and anger onto the snowmobiles. John prepared to ride with his father, but he turned away from John and said, "You ride with George."

Tom is going to ride with me so we can talk."

George was slow. John tried to help him, but still they were left behind. John felt a little fear because he'd been left behind, because his father had scolded him. Even with their radios, it wasn't safe to be so far from the village alone. John thought about asking George what he thought about it—was it because they were the only ones who didn't speak during the meeting? Was it because George didn't go out on the hunt, but stayed at the camp? But he didn't want George to know that he'd noticed anything.

They were just about to go. The buzzing motors of the other snowmobiles had faded beyond the mounds of ice between the village and the sea. John and George heard the whale sound at the same time—a great throbbing rumble, wet and strong.

They ran to the edge of the ice and watched as a mass of gray-black rose out of the water, making a tremendous sucking noise. A fountain of vapor shot into the air, then a giant's breath.

John laughed and hurled toward the snowmobile's radio. He had his hand on the switch when George, old and frail as he looked, pulled him away and pushed him down on the ice.

"What did you do that for?" John asked, his pride wounded.

"Do you want to kill the last whale in the world?"

John got to his feet and brushed the sharp ice crystals from his jacket. "There must be more," he said simply.

"Where?" George demanded.

John just looked at George.

"Come and watch." George put his hand on John's shoulder as if to apologize for knocking him down, but he didn't say it. They walked together to the channel and waited. Again, farther out, the fluttering, slurping sound and a black mountain rising out of the sea. The whale swam in a half-circle then arched down for a dive, its shining tail giving a last teasing glimpse.

They stood for a long time, watching the sea.

"It's too late for us," George said. "We're already changed beyond recognition. What do you think my grandfather would say about snowmobiles and radios? About shoulder guns?"

John nodded. He knew this set of thoughts. Every old villager had told every young child about it over and over. He had read one of the books that the sociologists had written—he knew what Eskimos were supposed to be.

"It's probably too late for him," George said, squinting as if to see a rise or ripple on the horizon.

John suddenly understood something. Not something he could put into words like "plaintive" or such, but it had to do with the voice of the whale. The whale was like the last villager. There was no difference. Somehow, both of them had been squeezed out of the world. They were so alike they couldn't destroy each other, could they? John felt that George understood that even better than he did, and he felt less alone inside himself. He wondered why his father and the others didn't have this feeling, too.

Yes, if I were the last whale, I would sing a sad song, too.

He'd felt the danger for weeks, tasting man-ness and potential death in the water. Cautiously, he'd called and called for others. Usually he heard distantly his kind in the cool summer waters of the north.

This season, he heard nothing. Not one faraway voice rippled the water.

I am lost.

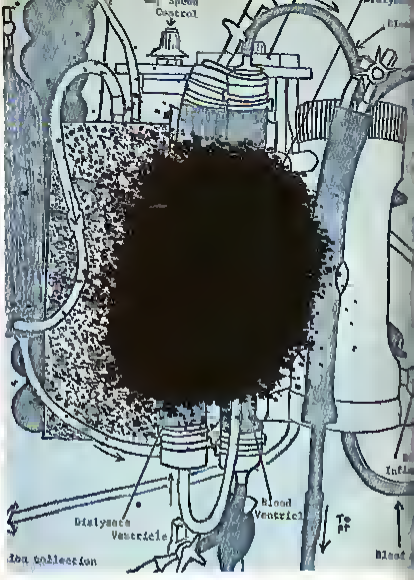
I am alone.

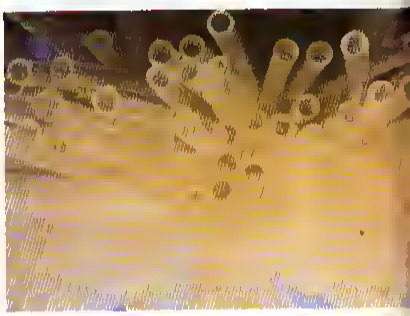
He coasted close to land, in spite of his fear, curious about the alien invasion of the sea. He found nothing and turned back to the sea. Diving deep, he found a warm current with a startling taste-smell.

He traced the taste tentatively at first. Pausing now and then, he tried to resist, not wanting to leave the cool waters. The trail was taking him away, back to winter water. He became warmer and the scent was stronger.

Experimentally, after days of traveling, he called out to meet the bearer of the irresistible scent.

Someone answered. ∞





BIONIC

CONTINUED FROM PAGE 49

Craig s right ear

Mladejovsky was thus able to connect the electrodes implanted in Craig s brain to a computer, which in turn was connected to a tv camera The camera was pointed at a simple image such as a piece of masking tape on a dark green screen The visual image was simplified by the computer and carried as electrical impulses to Craig's brain

It worked He was able to see the strip of tape as a white line and tell whether it was vertical horizontal or tilted at a 45-degree angle The Utah team also stimulated letters of the Braille alphabet in Craig s brain and he was able to visually read simple sentences like 'He had a cat and ball Mladejovsky found there was no limit on speed he could flash new letters to Craig faster than Craig could read by the normal tactile Braille method

But blind people don t want artificial vision for reading but rather for mobility They want to be able to navigate without being led around by another person or a dog They want to find their way through unfamiliar territory without tripping over obstacles they want to spot curbs, doors, follow crosswalks, see automobiles Can this be done? Probably

Mladejovsky foresees building a miniaturized television camera mounted in a dummy pair of glasses The electronics needed to convert the images would be carried on a belt A cable could be run from the electronics package up the person s back under his clothes and then concealed under his hair, finally connecting to the implant s exterior "button" and to the camera-carrying eyeglasses

What would the blind person see? Mladejovsky believes phosphene-dot moving pictures could be created, similar to those you see on electronic scoreboards in baseball and football stadiums Only the images would be much cruder The device implanted in Craig's brain contains 64 electrodes, which produce 42 phosphenes (you don t get a 1-1 ratio) The next step is an implant with 256 electrodes

Assuming that it will produce 256 useful phosphenes, which it might not, you d still only be able to create crude silhouettelike images But they would be adequate for navigation Mladejovsky showed me two pictures, each composed of only 256 dots One I could make out clearly as a man's bearded face The second image, a pair of scissors I didn t recognize But Mladejovsky emphasizes that the blind person would have other clues to guide him in recognizing objects—sound, smell, an object's size in proportion to its surroundings If he was standing at a crosswalk and he saw a large oblong object getting closer and closer, accompanied by the sound of an internal combustion engine, he would know enough to get out of its way

Mladejovsky thinks that eventually they may be able to stimulate as many as 500 useful phosphenes in a person s visual cortex Of course, many problems have to be worked out first

William Dobelle recently left Utah to head the artificial organs department of Columbia University in New York City, where he continues his work trying to solve the phys

At left, Utah researcher adjusts wearable artificial kidney on dialysis patient. Portable kidney allows patients more freedom than conventional hospital treatment. Charcoal (top) helps filter wastes from blood in wearable kidney. Above, tubing used in the device.

iological mysteries of eyesight. Craig is still part of the project, shuttling back and forth between Utah and New York.

"In the meantime," says Mladejovsky, "I'm just biding my time. I can't do anything more until Dobelle or somebody like him can finally sit down and set up concrete specifications for what the artificial vision device should do." When that day comes, Mladejovsky and his colleagues in Utah's Microcircuit Lab are prepared to build the 'Utah eyes.' "A mere technological problem," Mladejovsky repeats.

The artificial hearing project at Utah is quite similar to the eyesight project. Electrodes have been implanted in the cochlear membranes of the inner ears of four deaf volunteers.

Mladejovsky and other Utah researchers are stimulating the cochlea with electrical signals to create sounds of varying pitch and loudness. As with artificial vision, the ultimate goal is to understand how human hearing works, and then build miniaturized computer circuitry that can be used in a portable hearing device. (The computer used in the artificial hearing experiments, like that used for artificial vision, is presently gigantic—2.7 meters long by 2.7 meters high.)

While artificial hearing may not sound as spectacular as artificial vision, Mladejovsky claims it is a much more difficult venture because deaf subjects have great trouble communicating what they're experiencing. It is difficult to describe subtle variations in pitch and loudness, and most subjects are mute and must communicate by writing or sign language.

The team's biggest break came when they found a willing subject who was deaf in one ear only. Paul, the unilaterally deaf subject, has electrodes implanted in his deaf ear. When his cochlea is stimulated electronically, he tunes an audio oscillator to produce a matching sound on his good ear. This way he can tell the researchers exactly what they're producing with their electrical signals.

But Mladejovsky admits that producing artificial hearing is much more difficult than anyone had suspected.

Donald Olsen, a veterinarian in Utah's artificial heart lab, gently kicked a sleepy looking calf named Theodore. It was enough to bring Theodore rapidly to his feet. "See," said Olsen, 'this calf is perfectly healthy." Theodore did, in fact, look very healthy. The only thing distinguishing him from a normal calf was an array of air hoses sticking out of his side. The hoses connected Theodore to an external compressed-air pump that powered his artificial heart. Some 85 days earlier, Olsen had removed the calf's real heart and replaced it with a molded polyurethane model called the Jarvik-7. Designed by Robert Jarvik, head of Utah's heart program, Jarvik-7 is similar to Jarvik 5, the plastic heart that holds the world longevity record for artificial hearts. It kept a Holstein calf named Abebe alive in the Utah facilities for over six months, 184 days to be exact. Abebe died in May 1977, not because of a malfunction, but simply because he was a growing young cow and had outgrown the heart. (Calves are used because their cardiac output is similar to man's, they are good animals to operate on and they are far cheaper—at $200 apiece—than gorillas or baboons.)

Theodore's Jarvik-7 brings Utah one step closer to artificial heart implantation in man because, unlike Jarvik-5, it is the exact size needed for a human being.

An artificial heart has been implanted in man on only one occasion. That was Dr. Denton Cooley's controversial operation on Haskell Karp in 1969. Karp survived only a span of hours with the implant.

Since then, blood pumps have been used as temporary assist devices to keep cardiac patients alive for short periods of time, but there have been no more total replacements.

This hiatus is partly due to now stricter federal regulations for all medical devices to be used in human beings, as well as obviously due in part to technical problems still to be worked out. Perhaps most important, however, is the recent decision by the National Advisory Heart Council to give left-ventricular-assist devices (LVADs) first priority and to deemphasize total hearts. This has brought a partial drying up of funds for the Utah heart team.

"Our aim," says Kolff, "is to restore people." Utah boasts spectacular programs in artificial vision and hearing, the most successful artificial heart project in the world . . . and other bioengineering marvels of medical care."

Willem Kolff differs strongly with the Council's philosophy. If the patient is sick enough to need an LVAD, claims Kolff, he really needs a whole new pump. Kolff feels that an assist pump cannot sustain a heart patient whose condition is so bad that all conventional remedies have failed.

The drying-up of funds has temporarily killed one of Donald Olsen's favorite projects: the nuclear heart. Olsen favors hearts with a built-in power source because they offer the patient independence. He also feels there's less chance of infection because you don't have to run electric wires or air hoses into the body.

An electric heart will probably be the next step but Olsen says the batteries would have to be recharged every three to four hours. A nuclear-powered heart, on the other hand, could run 40 years on a small supply of plutonium 238.

There is one potential problem, however. While plutonium 238, unlike plutonium 239, is not fissionable (you can't make a bomb out of it), it *is* highly carcinogenic and could be used to poison a city's water supply. The nuclear heart conjures up a horror scenario of terrorists kidnapping several cardiac patients and killing them for their plutonium capsules.

Kolff is not overly enthusiastic about the nuclear heart. He doesn't share Olsen's pessimism over running wires into the human body and calls the electric heart a perfectly sane solution. The power pack would be worn outside the body, with wires leading inside. When asked about the risk of infection, Kolff said, 'So what? We're talking about patients with a life expectancy of five minutes.' Kolff also made note of Dobelle's success in implanting wires into Craig's head and leaving them for three years with no sign of infection.

Another solution would be to induce electric current through the skin. Two coils—one inside the body, one outside—would transmit power from an external battery to the heart's motor.

The heart isn't the only internal organ that can fail in the human body. Blood vessels, nerves, bile ducts, ureters, bladders, and lungs also fall victim to disease and injury. Utah's plan: repair and replace these damaged tissues with synthetic plastics and rubber. Armed with a $1.4 million federal grant, the university recently set up the nation's first Biomedical Engineering Center for Polymer Implants.

Donald J. Lyman, director of the new center, has already implanted in dogs tiny blood vessel grafts made of a new polyurethanelike material. Very large grafts made of Dacron have been used for years to repair major blood vessels such as the human aorta. But Dacron and similar materials are too rigid and fail quickly when used for smaller arteries and veins.

What's needed is a flexible material that has enough give as the blood pulsates through it. That's exactly what Lyman and his staff of 20 have created. The flexible grafts in dogs are only three millimeters in diameter—smaller than needed for humans—and have lasted 18 months. Polymer implants in humans are expected within a year.

Lyman explains that 80 percent of the human body is made of polymers, which are simply very large molecules (Europeans call them macromolecules). DNA, for example, is a polymer. And Lyman's office reminds one of something out of Watson and Crick and the search for *The Double Helix*. The day I visited him, it was cluttered with atomic models that looked like long chains of different-colored plastic baseballs. One 1⅔-meter-long model had claimed sole possession of the office couch. Lyman said it represented only 1/20th of a polymer he was designing.

That's basically what the center is doing. "We're mapping implants atom by atom," Lyman and his colleagues are creating brand-new synthetic polymers, which he said could be loosely described as plastics or rubberlike, in order to find the perfect implant materials. Lyman expects his polymers to have mind-boggling characteristics. First, they must survive far longer in the human body than conventional implant materials. Second, they must eventually degenerate. Initially, this seems contradictory.

But Lymen's plan makes infinite sense. Polymer blood vessels, ureters, bladders, or whatever must last long enough for the patient to survive. However, Lyman believes only a few synthetics can last forever in the body. Human tissue is constantly changing while the implant is not. The trick then is to create materials that will encourage tissue growth on their outside surfaces. In this way, a blood vessel could be implanted, and over a number of years, it would slowly degrade while natural polymers would take its place, eventually replacing it entirely. In other words, you could rebuild a man's insides with Utah implants and in, say, ten years you could cut him open and find nothing synthetic—only normal, natural tissue. The real goal of implantation, then, is regeneration.

Once the right polymers are invented, Lymen foresees building any number of body parts: lungs, an esophagus and trachea, skin, testicles, fallopian tubes, even nerves. "Blood vessels are rather simple," says Lyman. "They're really just pipes. The bladder is a bag. But nerves are more like telephone wires." Even so, Lyman plans to make implant, and regenerate nerves. Eventually.

It seems odd that with all the medical-science heavyweights concentrated in the establishment East and on the innovative West Coast that the most sophisticated bioengineering effort in the U.S. is going on in Salt Lake City. At first I suspected a religious motive, considering the overwhelming influence of the Church of Latter-Day Saints on the city. That idea was quickly dispelled.

"Salt Lake is a beautiful city for skiers and backpackers," said one researcher who asked not to be identified. "With all these beautiful mountains, you can put up with almost any number of Mormons."

Dr. Kolff gives a more mundane reason for Utah's success: money. The university has set up Kolff in a special position that allows him great freedom in acquiring federal funds. Kolff reports directly to the vice-president in charge of research.

The university's bioengineering program is not without its fund-raising problems, however. The school is sometimes out-maneuvered by more powerful and better-connected rivals in the fight for federal money. I mentioned Michael E. DeBakey, perhaps the most famous name in heart research, to Dr. Kolff and obviously hit a sore spot. President Nixon awarded DeBakey's team at Baylor College of Medicine in Houston a real plum several years ago: the opportunity to work with Soviet scientists on a joint U.S.-U.S.S.R. artificial heart project. Kolff claims Baylor only got the job because of DeBakey's tremendous power in Washington. "They sent the least successful heart group in the country to Moscow," said Kolff. While that may ring of sour grapes, DeBakey's longevity results with artificial hearts are rather meager when compared to those of Utah's heart program.

And there's another funding problem. Kolff says Utah sometimes suffers from the government's peer-review system of awarding grants. "We're so far ahead in our field," says Kolff immodestly, "that it's sometimes hard to find peers."

And that pretty much describes the bioengineering effort at Utah—peerless. The Six Million Dollar Man as portrayed on television will probably never exist. But the $8.4 Million Man is alive and well and living in Salt Lake City.

OTHER MARVELOUS MEDICAL MIRACLES AT UTAH

THE INSTANT BLOOD TEST

Utah scientists are on the verge of eliminating one of the biggest annoyances of a visit to the doctor—the blood test that requires a wait of several hours to a week before you get the results. Often, a doctor must send your blood off to a lab, and you must make a second appointment—and pay a second fee—before you can be properly diagnosed and treated.

Bioengineers Stanley D. Moss and Jiri Janata think the Chemfet, or Superprobe, will end all that. About the size of a needle point, it's a microprocessor chip (like those used in pocket calculators) to which a tiny chemical membrane of the type used in medical labs for blood tests has been bonded. What you have then is a tiny computer that instantaneously measures concentrations of vital blood chemicals.

Let's say the doctor wants to know how much potassium you have in your bloodstream. He would take a syringe fitted with a Chemfet and stick it in your arm. But he would draw no blood. A desk top computer connected to the syringe would display an immediate readout of the blood's potassium level.

The Utah scientists have already built a prototype that measures potassium and are close to making pH and calcium probes. Next on the horizon will be fluoride and oxygen Chemfets. Moss says that a different Chemfet will not be needed for each chemical measurement. He's confident they can fit at least six, and possibly ten, different membranes on one computer chip.

Chemfets have already been used in testing rhesus monkeys, dogs, and cats. Moss believes it will be a few years yet before they have an FDA-approved device.

PAINLESS ANESTHESIA

One of the problems of painkillers is that it hurts like hell to get them when a needle is used. But the Dermatron, developed by Stephen Jacobsen and the Projects and Design Lab, delivers anesthesia without puncturing the skin. A band containing two electrodes and a dose of an anesthetic drug is strapped over the skin to be anesthetized. The band is connected by cable to a power unit the size of a pocket calculator. By a process called iontophoresis, the drug is driven through the skin into the tissue. It's painless and avoids possible infection and irritation from standard needles.

The Dermatron has been used to anesthetize dialysis patients and those undergoing wart removal, minor finger surgery, and the draining of abscesses.

THE WEARABLE KIDNEY

When a person's kidneys fail, he must be hooked up to an artificial kidney, or dialysis machine, in order to cleanse his blood of urea and other toxic substances. The standard artificial kidney is about the size of a washing machine, and the patient must go to a hospital three to four times a week and sit for several hours while the apparatus filters waste from his blood.

Now Utah researchers have built an artificial kidney that can be worn right on the body. It weighs eight pounds and can be strapped to the patient like a life jacket or set down next to him. In either case, it allows the kidney patient infinitely more freedom and mobility than standard dialysis does. Even though the wearable kidney must be connected intermittently to an 18-liter tank, it still means dialysis patients can travel and lead more normal lives.

3-D TELEVISION FOR YOUR BODY

Utah scientists have built a "television" that transforms x-rays into three-dimensional images. Brent S. Baxter and Steven A. Johnson of the Advanced Imaging Methods Laboratory have already projected a realistic 3-D illusion of a human brain onto a television screen. It doesn't require special glasses as the old 3-D movies did, and several people can look at the image at the same time. The image also has parallax, that is, when you shift your head, you can see around the outside of the image, or you can bend down and look up into the image (or vice versa) and get a different view.

Baxter says the device could be used for air traffic control (creating 3-D pictures of planes over an airport), architectural design, and for making 3-D geological maps of potential ore beds.—*D.T.* ◻◻

PHENOMENA

CONTINUED FROM PAGE 67

confident, enthusiastic. Golob has the clean casual white-shirt-and-chinos look of a Harvard graduate student. He also has in abundance two qualities that may prove vital to the center's growth: a canny entrepreneurial sense along with a very serious commitment to environment awareness. His devotion to the center and his missionary concern for spreading ecology consciousness infects his conversation, and one is easily engaged by his enthusiasm.

In his small, neatly organized office overlooking a bucolic Cambridge street, Golob brainstorms about the future. In the forefront of his thinking is a variety of plans aimed at helping the center reach a larger audience.

Educating the public in terms of environment awareness is very much a part of this future. Already, the center has moved into classrooms across the country. Some five years ago CSLP established the Environmental Alert Network, inviting students and teachers throughout the world into their activities. Some 60,000 students formed a junior league of environmental monitors and used the center as an educational tool. Participating schools and classrooms became local CSLPs, and students corresponded with the headquarters center.

Today, classrooms; tomorrow, science museums. With evangelistic spirit, Golob described a strategy for expanding the center's information net through science facilities. There is a real need in museums, he says, for the kind of reporting that CSLP does. "Too much material in museums is historical," he complained. "It does not convey a sense of immediacy, a you-are-there feeling about the world."

What he would like to see are CSLP message boards in science centers that provide viewers with a continual flow of information about environmental changes. "Message boards," Golob feels, "have an immediate and striking impact on viewers." He speculates that this message board would be connected to a huge world map, offering push-button access to news of environmental phenomena throughout the world as they occur.

"Press a button, and you would see all the active volcanoes worldwide light up. Another button might pinpoint the location of recent oil spills, insect infestations, or earthquakes. It would be a visual newspaper dramatizing the constant changes going on in our environment." Concluding with a flourish, Golob envisions a whole network of museum displays, a communications hookup transmitting continually between museums throughout the country—and perhaps the world. Cassette tapes would provide general science background and would constantly be updated to provide present-tense immediacy.

Golob's scenario is more than wishful thinking. Several museums, including Boston's Museum of Science, have shown real interest in the concept, and now he is applying to the National Science Foundation for support.

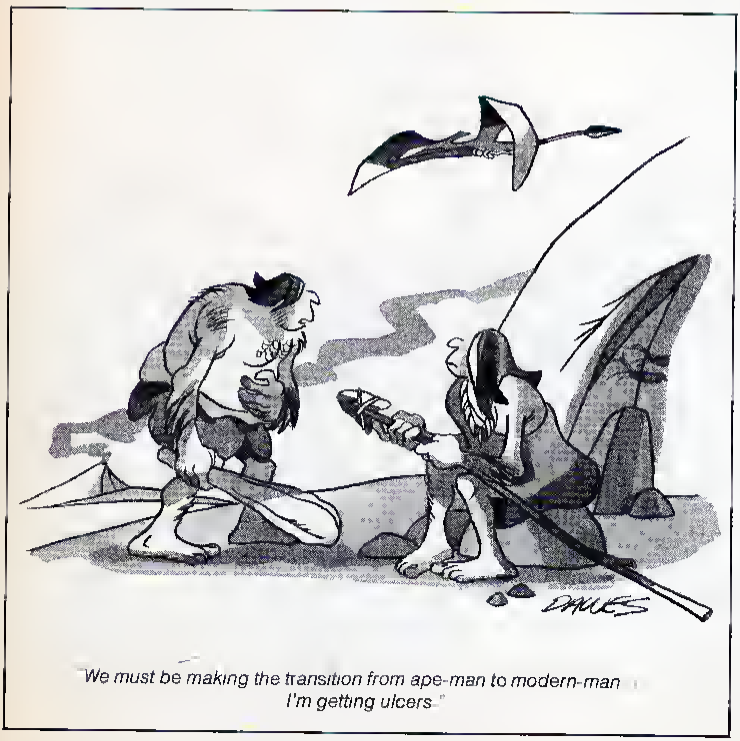
These activities, of course, highlight the fact that the center has moved far beyond its initial clearinghouse role. "Our name does not really describe our functions at this point," declares Golob. However, he adds, "We have built up respect from government and scientists, and they connect our activities with that name."

"Our future lies in nonadvocacy," Golob continues. "Once we become involved in causes, we lose our impartiality and our integrity." This extends to the center's environmental educating. Rejecting doomsday rhetoric or special pleading, Golob wants to "bring science to the people" but in "an impartial, nonadvocacy way."

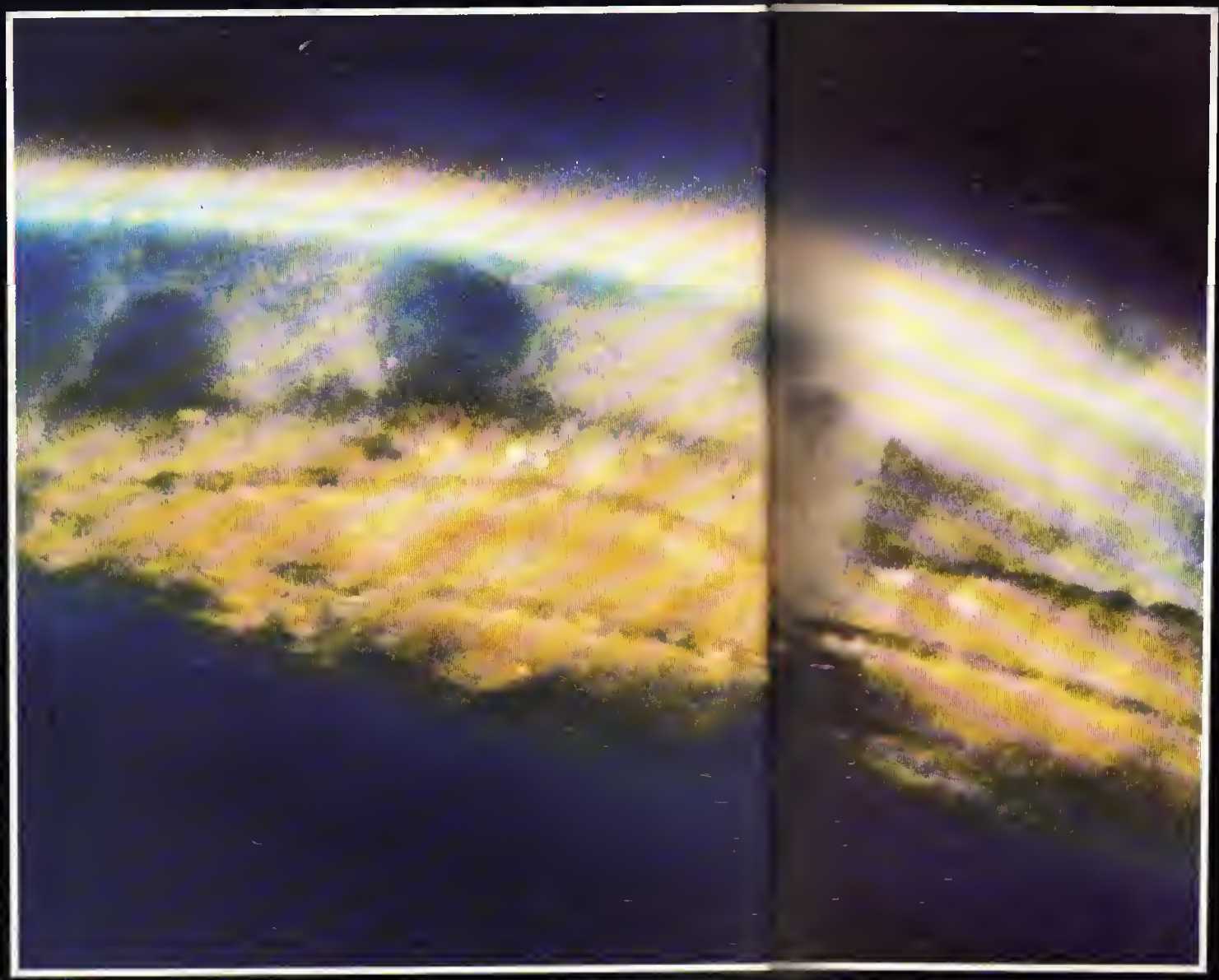
An informed citizenry finely tuned to the natural world around them. This is what Golob would like to see evolving within the near future. A good example of this ideal, he points out, is the "barefoot scientist" in China. These "barefoot scientists" are simply informed laymen—farmers and workers—who intelligently help scientists cover a natural event. They actually function as monitors on the environment. When a meteorite falls in China, the government can count on factual reports from its citizenry about the trajectory of the object, its luminosity, and other matters of scientific interest. In America, on the other hand, Golob laments, "If anybody sees a sudden bright light in the sky, they immediately think ... UFO."

Despite the ground swell of interest in UFOs, the Center for Short-Lived Phenomena stays clear of this short-lived phenomena of the popular kind. UFO sightings are usually unverifiable and thus below the center's credibility threshold. This is not to say, however, that some pretty strange events don't make their way into the center's files.

Two years ago, for instance, they were called in to investigate the disappearance of a ship off Nova Scotia. The Liberian tanker *Grand Zenith* vanished suddenly, the only evidence of its voyage a solitary lifejacket and some flotsam. The *Grand Zenith*, Golob now feels, may have fallen victim to what is known as a rogue wave. He explains, "Sometimes, when a strong wind collides with a powerful water current, they produce an abnormally high wave—a wave that seems to come out of nowhere." This wave, he continued, could create in turn a hole in the ocean, a vortex that might completely engulf an unsuspecting ship. "Most ships never recover from the incident, and that's why scientists have so little data on which to develop their theories." This wind-opposed current theory, he adds, may provide a good clue to eventually unraveling the mystery of the Bermuda Triangle. ∞



"We must be making the transition from ape-man to modern-man. I'm getting ulcers."



PHENOMENA

"It is a picture of photosynthesis happening," says photographer Roman Vishniac of this remarkable photomicrograph of common green algae called desmids. Almost all photosynthesis in the oceans and most of that in freshwater is performed by algae—the ultimate food source for fish and many higher organisms. It is the presence of chlorophyll, the green beadlike structures seen in the photograph, that allows the algae to transform the radiant energy of sunlight into chemical energy. Stored in the bonds of such molecules as glucose, this chemical energy transforms carbon dioxide and water into carbohydrates and other foodstuffs. The oxygen released as an end product of photosynthesis is essential to replenishing the air we breathe. Without these microscopic factories transducing sunlight into chemical energy for synthesizing food, all life in the oceans would rapidly die. DQ

The intuitive answer
is often totally wrong.

GAMES

BY SCOT MORRIS

You've seen the type of vocabulary test in which you are given a bunch of strange-looking words and you're supposed to supply the appropriate definitions. And you know the tests in which you are given pictures or descriptions of things and you're supposed to supply the correct words.

Here's a vocabulary test that's so tough we'll let you look at both the definitions and the words—and you'll still come out feeling like a dummy. First, you'll find a list of *things*: doohickeys, whatchamacallits, gizmos. All of them have *names*—proper, correct, English names—that are listed in mixed-up order at the top of the column at right. Each thing has only one name, each name applies to only one thing. Just match them up. Easy.

(All answers are on opposite page.)

DOOHICKEYS

___ 1. The metal frame on a lamp that sticks up around the bulb and holds the shade
___ 2. The part of a pair of eyeglasses that hooks around your ear
___ 3. The hollow lump in the bottom of a wine bottle
___ 4. The tip at the end of your shoelace
___ 5. The business end of a cuff link that you put through the buttonhole and fasten
___ 6. The gymnasium wall exercise apparatus with wooden uprights and horizontal rungs about every five inches
___ 7. The part of your nose above your lip that separates your nostrils
___ 8. The small rubber typewriter rollers on the bar above the main roller
___ 9. A band worn around the upper arm such as the one with the swastika on it that Hitler wore
___10. The curly part of a corkscrew
___11. The round braid trimming on the border of pajamas and bathrobes
___12. A tiny saucepan for melting butter
___13. The cleft in the middle of your upper lip
___14. The party favor that unrolls when you puff on it
___15. The connect/disconnect buttons that the receiver of your telephone rests on

THEIR NAMES

A	Aglet	I	Columella
B	Philtrum	J	Blowout
C	Pipkin	K	Comfort cable
D	Punt		temple
E	Brassard	L	Stall bar
F	Bale rolls	M	Airplane-back
G	Soutache	N	Worm
H	Harp	O	Plungers

NO INTUITION, PLEASE!

The following 13 puzzles are classic science problems. They all require some scientific knowledge to help solve them. The intuitive answer is often totally wrong.

HOT DROPS. Two mercury droplets having exactly the same temperature combine into one. Is the new droplet's temperature any different from that of the original two?

BOOTSTRAP ELEVATOR. Study the drawing carefully. Can the man lift both himself and the block off the ground?

BOILING POINT. The boiling point of water is lower when atmospheric pressure decreases. Theoretically then, you could attach a suction pump to a pot, suck out the air above the water level, and the water would come to a boil faster, thereby saving energy. Do you see anything wrong with this invention?

COOLING POINT. Which method will cool your cup of coffee fastest? (A) Let the coffee sit for five minutes, then pour in cream from the refrigerator, or (B) pour the cream in right away and let the mixture sit for five minutes.

UP AGAINST THE WALL. If you stand with your back and heels against a wall can you touch your toes without bending your knees? (Try to solve this problem without actually attempting the exercise.)

A HARD SKATE. Is it easier to ice-skate when the air temperature is at 0° F or at 30° F (−32°C or −1°C)?

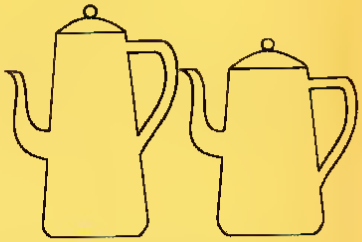
WHEELING EASY. Which is easier: pushing a wheelbarrow or pulling it?

WATCH THIS. If you take your watch to the mountains, will it run faster or slower than usual?

POLES APART. Antarctica has eight times as much ice as the Arctic. Why?

HOT AND COLD MILEAGE. Which gives the better mileage—4 liters of cold gasoline or 4 liters of warm gasoline?

POTTED PROBLEM. Which pot will hold more coffee? (The cross sections of the coffeepots are the same, but the pot on the left is taller.)



TILTING BALLOON. Inside a moving automobile a child holds a helium balloon by a string. All the windows are closed. Which way will the balloon move if the car makes a right turn?

SUNKEN SUB. The captain of a submarine tries at all costs to avoid letting the sub come to rest on a clay or sandy ocean bottom. He knows that if this happens, it can be fatal. Why?

YOU MAKE THE LAWS/ A COMPETITION

Morris's First Law states that if there is any generally recognized human foible someone is sure to reduce it to epigram form, attach his last name to it, and announce the discovery of a new law Thus, we have Murphy s Law "If anything can go wrong, it will " Murphy s Law is the generalization from which many more specific laws can be derived such as Gumperson's Law 'The outcome of any desired possibility is inversely proportional to its degree of desirability' Gumperson's Law explains why there are always so many parking places on the other side of the street Sometimes the specific cases are so significant and universally recognized that they get names of their own such as Ettore s Law "The other line moves faster " Or (Calvin) Coolidge's Law "A lost article invariably shows up after you replace it"

The problem with this whole law business is the temptation to take mere clever sayings and call them laws A prime offender is Lawrence Peter, of the Peter Principle "Bureaucrats rise to their level of incompetence " He had a neat little insight there one that deserved to have a name But recently Peter rose to his own level of incompetence by announcing a new Peter's Law 'Today, if you're not confused, you re just not listening "

This is not a law It s a cute saying with someone's name attached to it The same goes for Levinson s Law attributed to comedian Sam Levinson "Insanity is hereditary, you can get it from your children '

What the world needs is more laws with clear social insights "If ... then" type statements that truly enlighten us to the universality of our condition We are firm believers in Gates's Law "If there isn't a law there will be"

Readers are challenged to send in an insight capable of qualifying for the great *Omni Law Book* First-prize winner will receive $100 Runners-up (2–10) $25 each

Entries, postmarked by January 1 1979 should be sent to *Omni* Competition-2 909 Third Avenue, N Y N Y 10022

ANSWERS

THE DOOHICKEY QUIZ

1-H, 2-K, 3-D, 4-A, 5-M, 6-L, 7-I, 8-F, 9-E, 10-N, 11-G, 12-C, 13-B, 14-J, 15-0

NO INTUITION, PLEASE!

Hot drops New drop is warmer Its surface area is smaller than the total surface area of the two original droplets That means less surface-tension energy is needed to pull the mercury into a sphere The extra energy goes to heat the mercury in the droplet

Bootstrap elevator Although it looks as if the man is trying to lift himself up by his own bootstraps he really isn't True, for every pound of force that he pulls up on the rope, he also pushes down an equal force on the block, but if he is strong enough to lift his own weight plus the weight of the block he will rise from the ground (Tests have shown that an 85-kilogram man can lift both himself and a 50-kilogram block in this way)

Boiling point The invention will work, but who cares? Boiling water of say 160°F (53°C) would take forever to cook food and wouldn't kill bacteria either

Cooling point Method A is faster wait five minutes According to Newton's law of cooling, the rate of cooling is proportional to the difference between the temperature of the cooling body and that of the surrounding medium If you begin by cooling the coffee with cream, the difference between the coffee s temperature and that of the air is decreased, and it cools more slowly

Up against the wall You can t do it, no matter how limber you are When you bend over, your hips must move back to keep your center of gravity over your feet The wall prevents that so you fall over

A hard skate It's harder to ice-skate when it's very cold When you skate, ice beneath your skates' sharp runners melts temporarily, creating a thin lubricating film of water When it is very cold the ice does not readily melt making it difficult to skate

Wheeling easy Pulling a wheelbarrow is easier Pushing presses the wheel harder against the ground, adding to the workload Pulling takes weight off the wheel, reducing the friction you must overcome

Watch this Your watch runs faster in the mountains The balance wheel has less air to push around (atmospheric pressure is less at high altitude as is air density), so it oscillates a bit faster

Poles apart Antarctica is a continent, and land is a poor heat conserver Therefore, it has more ice than the Arctic which is over an ocean, which has a high heat capacity

Hot and cold mileage Cold gasoline gives better mileage Cool gas fills a smaller volume than warm gas When you buy gasoline on a cold day, each liter contains a bit more gas, by weight, than it would on a hot day

Potted problem Both pots hold the same amount A coffeepot can be filled only to the level of its spout, otherwise the coffee will spill out The spouts on both pots rise to the same height

Tilting balloon The balloon will move to the right though the child moves left As the car turns right the child and the air in the car are pushed to the left because of the inertial tendency to keep going straight But this builds up pressure toward the outside of the turn as each air molecule presses on its neighbor to the left Air pressure becomes stronger to the left of the balloon, hence it is pushed to the right

Sunken sub Water pressure pushes perpendicular to a submarine s hull at every point—at the bottom as well as at the top and sides When a sub settles on a clay or sandy bottom, the water layer may be squeezed out from beneath the hull, robbing the sub of much of its upward buoyant force In effect, the downward forces can then "glue" the sub to the bottom

TEST TUBE BABIES

CONTINUED FROM PAGE 81

this planet is awash with children abused starving for both food and love It's not a question of supply it's a question of distribution, and the sad fact is we don't seem to be directing resources to improving that distribution Let's take care of the kids we've got

Worry #5 *In vitro* fertilization divorces procreation from sex, and that is a Bad Thing This is one of the chief worries expressed by organized religion It is certainly true that *in vitro* fertilization bypasses a good deal of fun as it bypasses the fallopian tubes, and while that's a pity it's not quite fair to say it's a Bad Thing in the cosmic sense Nor is it the first technique to do so We've been trying hard to find an effective way of divorcing sex from procreation ever since we made the connection between a night of love and the day of reckoning nine months later It's called birth control In comparison with The Pill, *in vitro* fertilization is an inconsequential toy

Worry #6 My God Professor, this time you've gone too far in probing the secrets of the universe

Will you believe me if I tell you that all the preceding worries are rationalizations constructed by inventive human minds to cover up the fact that *this* is the real reason *in vitro* fertilization makes us nervous? This worry takes two general forms both of them literary in inspiration

a My colleague Willard Gaylin calls the first The *Frankenstein* Factor, the terror of human intervention into natural processes particularly by means of elaborate technology A portion of that terror is, of course, perfectly rational Look at the record It is spotty The rest is geared to something like a religious awe, a dread of human hubris in the assumption of such God-like powers

It is good to try to improve our ability to predict the consequences of technology and we ought surely to have learned by now that caution and conservatism in applying it is wise But we are kidding ourselves if we don't face the fact that we are nature's experiment in an interventionist animal We humans or rather something very much like us only smaller and not quite so bright, made and used tools millions of years ago Attempting to call a halt now is about as effective as trying to make a well-fed housecat stop chasing birds Of course that doesn't mean the fat tabby won't fall out of a tree and get killed, and we may blow it too But our chance to succeed depends on learning to cope with our powers

b The *Brave New World* Brood A pity Aldous Huxley hasn't been around to hear himself so often hailed as a prophet in past months It was he who predicted totally artificial reproduction and genetic manipulation in his novel almost half a century ago and now many others are looking into the Petri dish that gave rise to Louise Brown and seeing it too

Reproduction totally *in vitro*—from conception to decanting an infant nine months later—is, for technical reasons, so far away it's hardly worth listing as a worry Some people think we may never be able to manage more than a shabby and inadequate approximation of the miraculous apparatus half of us come equipped with Work will go forward on the artificial placenta because of its medical applications in saving very premature babies, but it will go slowly because it makes more sense to try to prevent premature birth by finding ways of maintaining pregnancy for the proper length of time

Surrogate mothers—women who lend their womb for the duration of pregnancy—are certainly a technical possibility before too long, and there may even be an occasional reason why such an arrangement would be desirable

> *Do you fear test tube babies? Should you? Perhaps, but maybe not for the reasons you've been told. If we ever make it to the Brave New World, we're likely to have more worries than test tube babies.*

Some have wondered what would happen if either party changed her mind, and other such ingenious scenarios But why couldn't a contract drawn up beforehand take care of such issues and also specify that, for instance, the surrogate mother agrees to avoid substances known to be harmful to a fetus, such as tobacco and alcohol?

People who worry about surrogate mothers, however, are usually worried that they will be used to relieve other women (usually pictured as those vicious, narcissistic, hard-driving career women) of the inconvenience of pregnancy Well maybe But consider these factors against it.

a To obtain the eggs requires abdominal surgery, beside which the inconveniences of pregnancy seem minor

b The uterine environment is so influential that a child carried by one woman will differ from one carried by another, even though the eggs and sperm they come from are identical Thus a woman who wants "a child of her own" will be losing something if she limits her role to egg donation

c She will probably be missing some pleasure too Pregnancy is not a pathological condition it's a normal female state It often feels good, and so it should There are very few jobs it interferes with Pregnancy, in fact, is the simple part of being a parent Ask any mother which is harder the first nine months or the next 20 years That's the point at which a woman who wants to avoid inconvenience needs a surrogate mother

But the big argument against worrying about artificial reproduction—assuming it were technically possible—is that there is no sense whatsoever in going to all that trouble and expense Tell me a clear economic reason to reproduce this way and I'll join you in worrying, but until you think of one, ponder the following

a making babies the usual way is so easy that we have to go to some lengths (sometimes even life threatening ones) to avoid it

b it's also more amusing

There may, of course, be economic benefits arising from the use of these techniques in domestic animals A large cow could mother many calves simultaneously just as a prize bull fathers many now, if her fertilized eggs were implanted in less valuable surrogates Or the embryos could be frozen and implanted in a surrogate many years later after her death Which brings us to genetic manipulation, a subject so complex and touchy that I can give it only the sketchiest attention here But, to allay anxiety on this score a bit

a Precise manipulation of individual genes is a long way off—not as long as the artificial uterus but long enough so that you can probably safely leave this worry to your grandchildren in your will Manipulation of characteristics controlled by several genes (height, I Q , and most other things we find interesting about ourselves) is a worry they can probably leave to their grandchildren

b We are not without experience in these matters Genetics, in fact, is our second oldest science (astronomy is our oldest) and civilization as we know it is built on the purposeful breeding of animals (for at least 20,000 years) and plants (for at least 10,000) Do you like roses? Corn? Your dog? You invented them all

c Any society tightly controlled enough to make possible planned breeding of people for specific purposes would be in such trouble in so many areas that its reproductive methods would be the least of it

Worry #7 *In vitro* fertilization is a breakthrough more psychological than real, but it is glamorous and full of human interest and therefore captures an inordinate amount of our attention In the process unfortunately it distracts us from our genuine and pressing technological problems, such as the disposal of nuclear waste, the decreasing quality of our water and the proliferation of carcinogens

And those friends are worries worthy of the name. OO