BLUEPRINT FOR A BIONIC SOCIETY
BERLITZ: THE UFO CONTROVERSY IN FRANCE

THE UNIQUE YOU: WHY NO TWO OF US ARE ALIKE

STANISLAW LEM: A NEW NOVEL FROM EUROPE'S BEST-KNOWN SF AUTHOR

SILICON SCHOLARS: BY ARTHUR C. CLARKE
NEIL ARMSTRONG: SURFING IN SPACE
HARRISON SCHMITT: THE MOON-WALKER ON WASHINGTON'S NEED TO EMPHASIZE SCIENCE

PHOTO EXCLUSIVE: ORBITING EYES REVEAL EARTH'S BEAUTY FROM SPACE
Artist Michael Parkes provided Omni with this month's cover art. An untitled work, the oil painting exemplifies Parkes's distinctive flair for the abstract. Born in the United States, the artist paints mostly from his home in Fuengirola, in southern Spain.
The Department of Health and Human Services will spend the equivalent of the whole NASA budget every nine years. Defense will spend the NASA budget every two weeks.

This usually happens during an election year when the senator claims, "Let's talk sense to the American people."

This is an election year. In addition to talking sense, let's talk dollars.

In particular, let's look at the dollars proposed by President Carter for the Fiscal Year 1981 federal budget.

The budget message that the President sent to Congress was filled with gigante numbers. A record $16.8 billion in spending, a $15.6 billion deficit, a 20 percent increase in military spending to a total of $36.2 billion, $208.7 billion for the Department of Defense and Human Services. Staggering numbers, beyond true human comprehension.

While the numbers of dollar amounts are so huge as to be virtually meaningless to the average taxpayer perhaps we can make some sense out of the ratios of expenditures for various goods and services.

For example, many scientists have gone on record as saying that scientific research fared rather well in this year's budget. The National Science Foundation received a budget of $14.8 billion. That is a 15 percent increase over last year and marks the first time NSF's budget has climbed above the $1 billion level.

But the consumer price index jumped 13 percent in 1979. So NSF is barely keeping pace with inflation.

The Department of Energy received $8.1 billion, an increase of only 4.7 percent over the previous year. DOE is actually losing ground to inflation. That's still a lot of money, but how are we going to develop the new technologies we need to end our energy woes if we don't finance the necessary research in new ideas?

NASA is also losing ground to inflation. Its FY 1981 budget is pegged at $5.7 billion, an increase of only 8.6 percent over last year. But by the largest single expenditure in NASA's budget is for the space shuttle. It seems to be a lot of money. Meanwhile other parts of the NASA budget are shrinking. The space agency has been forced to drop plans for the Galileo spacecraft program intended for long term studies of the planet Jupiter and its moons, and to cancel development of the solar electric propulsion system, which was the key to a flyby of Halley's Comet and Comet Tempel 2 by 1985.

The biggest "gainer" in the new budget is the Department of Defense. Not only does it get its overall budget increase by a hefty 20 percent, but its research and development budget of $18.6 billion is more than NASA's, DOE's, and NSF's entire budgets combined.

This year, Sam wants to spend your money this way:

The Department of Health and Human Services (formerly HEW) will spend the equivalent of the whole NASA budget every ten years.

The Department of Defense will spend the equal of NASA's budget every two weeks.

While NASA accounts for 18 percent of the total R&D in the FY 1981 budget and Health and Human Services accounts for another 11 percent of the R&D monies, Defense's R&D budget is a whopping 46 percent of the whole. Any wonder that university and industry scientists end up working for the Defense Department?

Of course, these are the preliminary budget figures. President Carter and Congress are busy smoothing away, trying to produce a balanced budget to fight inflation. But the ratios within the total budget probably won't change much. If anyone, NASA and Energy will be cut more deeply than Defense and Health.

Critics of the space program have pointed out that NASA spends billions of dollars every year. True enough, but in return for these tax expenditures we get the solar system. And compared to what we spend on defense and human services, NASA's budget is picayune.

No one wants the United States to be weak militarily, and certainly a good deal of the Defense Department's R&D money is going into space hardware. Probably DOE is already spending more on space than NASA can.

But a strong and vital civilian space effort is crucial to our national economy and international stature. Space technology can help to solve our energy problems and can bring about new capabilities in communications, environmental monitoring, manufacturing and other industries.

The next time you hear someone complain of "all that money wasted on space," remind that person that hundreds of times more money is spent on other areas of the federal budget-- for fair tale return.

And the next time Senator William Proxmire of Wisconsin, tries to knock the NASA budget as a "waste of the taxpayers' money," ask him how he voted on the milk-subsidy bill. A federal budgetary item dealt to the heart of Wisconsin's dairy industry. The federal milk subsidy cost the American taxpayer $245.673 billion in FY 1979. The figures for FY 1980 are not yet available, but they will undoubtedly be higher.

Let's talk sense about our tax dollars, particularly in an election year.
OMNIBUS

In an abandoned darkroom on the campus of Harvard University young Marvin Minsky took apart a crayfish. He connected its nerves to an electrical source and, remarkably, manipulated its claws to pick up a pencil and put it in a jar. Dr. Minsky was unaware at the time that this simple experiment foreshadowed the sophisticated robotic arms he would later invent to perform the same sort of tasks.

Today, from his workbench at MIT, the cyberscientist continues to issue visionary studies in robotics and artificial intelligence. His current project involves the development of a remote-controlled workforce, 'which through a series of sensors, musclelike electric motors, and feedback devices will feel and work much like our own hands.' Minsky calls his system 'telepresence,' and with it, man will accomplish everything from safe nuclear-power generation to the construction and operation of low-cost space stations.

Feeling lost in the crowd? A victim of the Age of Anonymity? The situation may seem a bit grim, but, according to authors Richard Hutton and Zsolt Harsanyi, salvation is close at hand. In their article "The Unique You" (page 52) we learn how science has found a host of new ways to show just how special we really are. Hutton is a freelance writer who likes to speculate about science and society. He is the author of the book Bio Revolution: and coauthor of the newly released Lifespans, which he wrote with former Omni executive editor Frank Kendig. Harsanyi is a member of the faculty at Cornell Medical College and is the project director on genetics research for the U.S. Congressional Office of Technical Assessment. He has coauthored an article on applied genetics with Hutton for the New York Times Magazine.

This issue's UFO Update features a fascinating interview with French astronaut Chateau. An engineer in U.S. manned space programs, he has worked on the Mercury and Gemini missions. He holds a master's degree in physics from the University of Paris and has studied space physics at the University of Southern California under Wernher von Braun. "The famed linguist Charles Berlitz provides the interview for Omni. An anthropologist and underwater explorer, Berlitz is also author of many popular nonfiction works, including "Without a Trace, Mysterious from Forgotten Worlds, and Atlantis." Read page 32.

"Jupiter's Nonexistent" is this month's Space column, written by British science writer John Gribbin (page 20). This distinguished author has been a frequent contributor to such publications as Nature, Astronomy, and New Scientist. Some of Gribbin's more notable books are "Our Changing Universe" and, most recently, "Time Warps."

Stanislaw Lem presents "Return from the Stars" (page 54) for this month's fiction. Co-founder of the Polish Astronautical Society and member of the Polish Cybernetic Association, Lem has written many books; among them, "Solaris, The Cyberiad, and Star Diaries."

Another contributor of fiction ("Marchianna," page 100) is Kevin O'Donnell. Born in 1950, this Cleveland native has lived in Seoul, Hong Kong, Taipei, and New Haven, Connecticut, where he now resides. O'Donnell made his first short-story sale to Analog in 1973 and has since appeared in nearly all the major science-fiction magazines.

Our apologies to O'Donnell and John Keelauver. In our April Omnibus we inadvertently placed Dale Leifeste's picture of Mr. O'Donnell above Mr. Keelauver's name.

We are proud to present a story by Arthur C. Clarke (Electronic Tutors, page 78). Mr. Clarke's latest novel, "Fountains of Paradise," was a Literary Guild alternate, and won the Galaxy award as best science-fiction novel of 1979.

Senator Harrison Schmitt is the guest for our June Interview. One of the last men to walk on the moon, the junior senator from New Mexico is now taking on far greater challenges, such as trying to convince the rest of the Senate that he is as serious a senator as he was an astronaut. Schmitt was interviewed by Daniel S. Greenberg, a Washington-based journalist who has been covering the science and government scene for many years. See page 80.
Communications

He Makes the Law

In your April Games column you quote from Godel, Escher, Bach by Douglas Hofstadter. Is this the same Douglas Hofstadter who won your Competition #2 in 1979 with Hofstadter's Law? It always takes longer than you expect even when you take Hofstadter's Law into account?

Geoffrey Edelhart
Battle Creek, Mich

Yes — Ed

Pitt Falls

Martin J. Pitt's Last Word on telepathy [March 1980] is a conglomerate of contradictions. If he truly assumes telepathy desirable, why has he not expounded on any of its assets? He assumes telepathy to be limited to the laws of our universe as we know them now. But how can he assume that telepathy would be no faster than the speed of light? If telepathy is indeed concurrent thought, then it transcends the mere speed of light, it enters the dimension of time, which then would drastically revolutionize our laws. And how mundane to put a price tag on such a quality?

Open your mind, Martin, if you're not too afraid of it.

Jane Held
Los Angeles, Calif

Martin J. Pitt makes some good points about telepathy in "Thinking Out Loud." However, he underestimates the potential value of telepathy by suggesting that it could do nothing for us that we cannot already do by means of the spoken word and the various electronic means of transmitting the spoken word. To speak and to hear the speech of others, there are a variety of anatomical requirements: one needs a mouth, tongue, vocal cords, ears, auditory nerves, etc. Most of us possess these requisites, but some of us do not. Those who are deaf and/or mute would doubtlessly find telepathy to be of great value if it were possible for them to employ it.

On an even more speculative level, telepathy offers obvious advantages for interspecies communication. Both man and dolphins speak but at such greatly different frequency ranges and in different ways of using sound that only by elaborate computer translation can any communication between these two species occur. Even so, relatively little communication now occurs. Telepathy would certainly make things easier. Telepathy would offer a considerable advantage over speech because it can function independently of both the condition and the species of body that one happens to have.

David Patter
Hollywood, Calif

Obvious

I have a complaint about Belinda Dumont's article entitled Orthohealing [February 1980]. My complaint concerns a statement on page 108 wherein the author refers to "the male hormone progesterone" which to my understanding is an obvious error. My primary concern is not the error itself but the editorial process that let it slip by. As a layman, I depend on Omni's editors to ensure the article is factual. If my complaint is not valid, I apologize.

Joe L. LaRocque
Bembrook, Tex

You're correct. We mean testosterone. Progesterone is a female hormone. — Ed

Mister Misnomer

The cartoon that appears on page 125 of your March issue would have been very funny if I said "would" because I am a dentist and because I resent seeing or hearing a dentist called Mr. Gladstone. This is an insult that demands an apology. We dentists are not physicians, but we most certainly are doctors.

G. Gerard Massine, D.D.S.
Farmingdale, N.Y

The cartoonist Tony Scott is English. In England dentists are called Dr. until they have completed their residency, then they are called Mr. Thus Mr. is the proper title for an English dentist. — Ed
Woodpecker Power
A report in Continuum in your February issue caught my interest. According to the item, a woodpecker's beak hits a tree at 1,300 miles per hour.

Let's assume that a typical woodpecker head weighs about 0.3 ounce. The force required to accelerate the head to 1,300 mph in a one-inch stroke is about 13,000 pounds. (Strong neck!)

The kinetic energy of the head at 1,300 mph is over 1,050 foot-pounds. If the bird can maintain a pecking rate of 1,000 strokes per minute the power developed is almost 39 horsepower or over 100 horsepower per pound of woodpecker.

The harnessing of woodpecker power to solve our energy crisis should be begun at once. Three or four woodpeckers could power a compact car by pecking at a simulated tree hiding very rugged pistons. A worm dispenser would disgorge a worm every so often to keep the birds interested.

A thousand or so peckers would power an airliner and 50,000 would power a large electrical generating station.

We should proceed with caution for the amazing energy source hiding under those innocuous feathers may have unforeseen—and potentially disastrous—consequences. Something akin to a critical mass might be reached with enough woodpeckers in close proximity. We certainly don't want 100,000 woodpeckers suddenly going berserk and in an insane frenzy pecking their way clear through to China.

F C Risteen
Fredericton, N B, Canada

Woodpecker a misadventure but still remarkable

Dr. Philip R. A. May, one of the authors of the study cited, replies. Whoever wrote the press release on the woodpecker study made a mistake in taking the figures from my paper. Our data give on the order of 650 centimeters per second. If you convert this to miles per hour it comes out more like 131. Essentially it was a misplaced decimal point in the conversion.

We should add, however, that the 1,000 g's figure stands as it was taken directly from the paper's data. In fact, computer analysis showed g forces more than twice that high in some cases. The study indicates the bird's low brain weight/surface area ratio and its ability to keep its head in perfect alignment (without lateral motion) are what enable it to withstand such force. Apparently the greatest problems for a human brain are impact, its high weight/surface area ratio and shearing forces in the tissues caused by angular (lateral) motion. —Ed

Cheap Shot or Healthy Skepticism?
I respect James Randi's healthy skepticism in his Continuum report on the Transcendental Meditation levitation courses (March 1980). However Randi may have created some misconceptions which I would like to clear up.

First, the TM movement is not a church. TM is an easily learned completely non-religious technique whose physiological, psychological, and sociological benefits have been verified by literally hundreds of scientific experiments at several universities. It is too bad that many people assume that religion is involved just because the technique is taught by someone who happens to be a monk from India.

As for the flying technique itself, it is true that foam rubber gives the flyer an assist but the foam is not necessary. I have lifted off in a sitting position from my living-room floor the carpet certainly wasn't assisting me! The foam in your photo is there for protection in the event of a hard landing.

No one technique costs $1,500 to $5,000, the price range quoted in the article. That is the cost of a whole course, including several techniques and excellent room and board.

Finally, the EEGs of people practicing any of the advanced techniques show remarkable synchronicity between the right and left halves of the brain indicating integration of the 'creative' and 'analytical' ways of thinking. Also mind-body coordination is improved.

These are the brain abnormalities that Randi mentions.

Roane Dantzler
Greenbelt, Md.

Is it asking too much that your magazine be accurate? I refer to an item in Omni's March 1980 issue entitled "Invisibility Lessons." The Transcendental Meditation continued on page 112.
Albert Einstein on space:

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Benjamin Franklin preferred the turkey but more romantic, less utilitarian sentiments won out and the bald eagle became our national bird. We proceeded, in the next 150 years, to eradicate our republic's symbol from the original 13 colonies, then from most of the states of our western expansion. Today, in the Lower 48, the bald eagle is an endangered species, *Haliaeetus leucocephalus* — the white-headed sea eagle is numerous only in Alaska and even there it has not found an easy refuge. The Territory of Alaska paid a bounty for bald eagles until 1952, and records show that more than 128,000 birds were killed in this century alone for cash. We do make progress, however. Thirty years ago in Alaska the government paid you to kill a bald eagle today the same deed sends you to jail.

The last stronghold of the bald eagle is the Panhandle of southeast Alaska. The Panhandle is a sea-eagle paradise — a maze of islands, fjords, and inlets, and inside passages — 30,000 miles of coastline where an estimated 15,000 eagles dwell. Several summers ago I traveled that coast by kayak. Not all 30,000 miles of it but a straightline 300 or so, as the raven flies or the killer whale swims. I pointed and exclaimed on the first morning of my trip each time a bald eagle sailed over me on its dark, broad, seven-to-eight-foot wings. I had seen golden eagles before, but never this eagle, my national emblem. A nobler more dramatic bird has never been fledged. Franklin couldn't have been serious when he wrote, 'The eagle is the bird of my country.' But on that first day we would see 12 eagles, and by afternoon I was no longer pointing and exclaiming. I remember the moment. An eagle soared over me, and I made no gesture or comment. I felt very strange. That a bald eagle could pass without exclamation from me seemed as great a wonder as the bird itself.

Our kayak was built on an Aleut model, designed for the open ocean, but enormous seas come up suddenly in the Gulf of Alaska. For safety we hugged the shore, staying within the kingdom of *Haliaeetus*. (The sea eagle is primarily a littoral hunter working just the edge of the ocean.) Southeast Alaska is a land of promontories, and upon nearly every point is a bald eagle. The birds seem to like the vantage from the seaward points of land, and a solitaire eagle or a pair has staked out the tips of most peninsulas. The eagles perch broad-shouldered and regal, on the tallest of the salt-pruned spruces atop each headland, surveying the sea. There is a huge country where miles are almost meaningless, and in the kayak we measured our progress in promontories. When one point of land fell behind us we would paddle for the next. A ten-promontory ten-eagle day was a good day.

It was hard for me to imagine a bird of prey more proper for its terrain. In its very form and color the eagle echoes the country. In southeast Alaska the fjords dark-forested mountains rise vertically from the sea and end in snow-capped peaks. The eagle is made that way: dark shouldered, white capped. The skies here are leaden; the light subdued, the greens of the mountains intense yet somber. The white of the eagle is the brightest thing in all this country.

Once when the moon was full we paddled all night. We could not see the eagles then, but we heard their calls, a crazy, high-pitched laughter. The eagle's falsetto at first seemed out of keeping with its weathered s- torso; but with time that deranged laugh became as natural to us as any of the other Alaskan night sounds — the complaints of gulls, the nearly human coughing of seals, the superhuman exhalations of humpback whales.

One day a dead Steller sea lion, a bull washed ashore in the fjord where we were camping. The next day 12 eagles were feeding on the corpse. Curious, I put ashore nearby. As I walked toward the dead bull the eagles reluctantly hopped off and flew away. Retreating to low branches of the encroaching trees, they waited for me to leave. I stood at the corpse, within that semicircle of great birds. The tidal boulders were big, and the Steller bull was gigantic. The eagles slanting down at me had eight-foot wing...
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PET DREAMS

LIFE

By Dr. Bernard Dixon

Do cats and dogs dream? If so, what do they dream about? Anyone who has watched a dog sleeping in front of the fire suddenly twitch its paws and pant in apparent pursuit of something tasty will think there's an obvious answer to these questions. But zoologists might not agree. Wary of the tendency to anthropomorphize, they have long resisted the temptation to assume that our pets dream about their daily experiences in the same way we do.

Now as a result of some remarkable research at Claude-Bernard University, in Lyons, France, we are gaining the first real glimpses into the dream life of animals. Professor Michel Jouvet has been studying REM (rapid eye movement) sleep in cats. Human beings dream during this state. It's also possible that we dream during the other sort of sleep, called slow-wave sleep because of the type of brain activity observed. But psychologists discovered many years ago that the best way to interrupt a dream is to awaken the sleeper while the brain waves are occurring. Invariably the subject will vividly recall a dream.

Like all mammals (and birds, too), cats exhibit these different stages of sleep. Jouvet has centered his investigation on two aspects of cats: REM stage of sleep. First, he found that REM sleep is related to electrical activity, known as PGO waves, in particular parts of the brain. Second, a cat in this state is also in a condition of intense relaxation—called postural atonia. Although it may twitch its ears or whiskers occasionally, a dreaming cat lies totally flat on the ground.

Jouvet's discovery has come from observing cats that have sustained damage to just that part of the brain that is responsible for postural atonia. In every other way they are normal. They eat, play and behave as usual; and they even have ordinary slow-wave sleep. When REM sleep begins, however, peculiarities become readily apparent. Because postural atonia is prevented, the animal will quite literally act out its dreams. Instead of remaining in a resting state the cat raises its head and moves it horizontally or vertically as if watching something. It may stand up and walk around, apparently stalking prey, perhaps attacking an imaginary mouse.

Yet a cat behaving in this way is assuredly not awake. Its pupils are covered by a third (mictitating) eyelid—normally a clear indication of deep slumber. The cat does not follow moving objects placed in front of it—not even a dead or "play" mouse. The PGO waves can be measured in the animal's brain. What we are seeing is REM sleep, but without the bodily relaxation that normally accompanies it.

Another type of dream behavior commonly observed in these animals is grooming. The cat will lick its forelegs, for example, but even here the action is abstracted. Suck a piece of paper to the cat's fur and the cat will ignore it. Try the same thing while the cat is awake and it will attempt to remove the offending object.

Jouvet believes that damage to the brain region responsible for postural atonia has "disinhibited" a repertoire of activities usually inhibited at the upper region of the spinal cord. Normally, playing, the stalking of prey, and grooming are restricted to the dreaming cat. Even now we can see them, although the animal remains as soundly asleep as before. Further confirmation comes from the fact that drugs that suppress REM sleep (e.g., the antibiotic chloramphenicol) also stop this strange behavior.

There are two possible explanations for such feline "sleepwalking. A tempting idea is that PGO waves reach the cat's visual system and produce hallucinations, which the animal then acts out. Indeed this ties in with the theory that human dreaming involves looking at pictures. Several researchers have reported correlations between rapid eye movements and the scenery of dreams. Whether cat, dog, or human, the dreamer is thought to be scanning an internalized view of the world and to be reacting accordingly.

In his latest report (France in Neuro-science, 2: 220), Jouvet argues that this persuasive theory is probably incorrect. He says that rapid eye movements may begin 20 minutes before the onset of PGO waves. Thus they cannot be a response to visual hallucinations generated by those waves. He also notes that the alternative explanation is more likely. Parts of the brain that generate PGO waves are probably themselves directly responsible for programming "visible dreams."

More questions than answers have arisen from Jouvet's fascinating studies. What is the code through which PGO waves carry their instructions? Are those messages genetically programmed? Or are they—as we sentimentally believe from watching our sleeping pets—determined in large part by experience? To add confusion to uncertainty, observations of dreaming mice can be marshaled to support either view.

Nearly 2,000 years ago one of Nero's courtiers, Petronius Arbiter, wrote a poem in which he observed "et canis in somnis reportis vestige iustrat" ("and the dog in sleep traverses the tracks of the hare") We now know this is true. What we don't know is whether the hare's tracks have to be real.
Six years ago a book written by two scientists forecast the date of the next major California earthquake. The prediction was based in large part on the unusual alignment of the planets in 1982. As the fatal year approaches, interest in the prediction has naturally grown. A great many people in fringe cults have interpreted the forecast as a prediction of the world's end, divine retribution on mankind for their sinful ways.

I have bad news for the doomsayers. The book has now been proved wrong, the whole basis of the 1982 prediction is gone. I should know. I was coauthor with Dr. Stephen Plagemann of *The Jupiter Effect*.

Because of the way the book has been misused by cultists who must never have read it, I want to make it clear that there is no reason now to expect any unusual seismic disturbance in 1982 from the causes given in the book. This does not of course rule out the possibility of big earthquakes then. But if you want an astrological prediction, I'm afraid you are going to have to ask someone else.

My work with Dr. Plagemann drew on two pieces of evidence. Back in 1971 Dr. R. A. Challinor of the University of Toronto published some results that suggested a small but significant increase in seismic activity at the time of maximum solar activity. This tied in with other evidence that when the sun is more active, there are changes in Earth's atmosphere and even in the length of the day—by a few milliseconds—as Earth's rotation is affected. The Space Age discovery of the gusty solar 'wind' of particles that streams out across space, blowing more strongly when the sun is more active, offers a neat physical explanation for the link between solar activity and terrestrial seismicity. Clearly, anything that shakes up our whole planet enough to alter the length of day by even a few milliseconds, could jar into action any earthquake regions that were waiting to slip.

Then there was the straightforward geological evidence that regions along the San Andreas Fault are decidedly overdue for a major disturbance. The last great San Francisco earthquake occurred in 1906. And the modern theory of plate tectonics tells us that the coastal region of California is trying to slide north past the North American continent at a more or less steady drift of about five centimeters a year. Where earthquakes happen frequently, as in central California, this slip can be accommodated without disaster.

But when there are long intervals between quakes, the accumulated strain is likely to be released in one big jump—now perhaps as much as 4.5 meters around San Francisco and 7.5 meters in the Los Angeles area. Geological evidence showed that the great quake in 1857 near what is now Los Angeles was caused by a sideways shift of about nine meters.

So when Steve Plagemann and I put these two pieces of evidence together, we came up with the idea that the southern region of the San Andreas Fault now building up a massive strain, could be triggered into violent movement the next time the sun's activity peaked. Blowing gusty winds across space to shake the earth. So far, the hypothesis was speculative but uncontroversial. It caused little comment when published in 1971 in *Science*. We roused the hackles of many establishment scientists and caught the eye of the outcasts when we tried to predict the year in which the next peak of solar activity "ought" to come.

To do this, we drew on a theory that the sun's activity (the roughly 11-year long "sunspot cycle") is modulated by the tides raised on the sun's surface as the planets move in their orbits. Since Jupiter is the biggest planet in the solar system by far, it exerts the greatest influence on the solar tide. So we took its name for our sunspot-tidal theory.

From 1600 on, the varying tidal pull of the planets has been very nearly in step with the varying levels of sunspot activity. Being young and perhaps a little rash, we were emboldened by this to extend the tidal curves forward and pick out 1982 as the likely date of the next solar maximum.

The tidal theory alone is really only good enough to forecast a maximum sometime between 1980 and 1984, but we got really
Once upon a time, when we were young, stories became terribly important. At about age two, we began to call our parents and other adults to read to us. Virtually overnight our language capability exploded. From a few words we leaped to short sentences. We became verbal communicators.

Many of our first short sentences were actually miniature stories. Just as advertisers can tell their tales in 24-second epigrams—so could we as children. Could storytelling have been the basis for this verbal explosion?

For 50 years psychologists have been searching for the engram, the basic unit of learning that would be for psychology what the atom was for physics. Psychologists have examined ever smaller units of learning in their futile hunt for this "informational quark." Did they fail because they were searching for something too small and elusive when they should have looked at the elemental stories of two-year-olds? The simple human story may hold the key to that elusive engram.

From the distant jungles of New Guinea to the nearer jungles of New York's ghettos—wherever there have been people, they have told stories to one another. Today the greatest storyteller ever—television—unfolds adventure and fantasy nightly as millions watch with rapt attention. This universal fixation is usually reserved for such essential acts as eating, drinking, and sex. Stories and storytelling may be equally essential.

Since nearly the dawn of humanity we have sought to explain our existence through stories. All civilizations have expressed their central beliefs through symbols and myths. From simple legends of gods and demons we have progressed to the complex tales of science whose cosmological theories contain the ultimate story of the universe.

Looking at our fellow creatures on Earth we may wonder at what evolutionary stage the story concept developed. Is it unique to humans, or does it have antecedents and parallels as so much of our behavior does, in other species? Aren't the games of catch-and-fetch, tag, and hide-and-seek that we play with our dogs simply nonverbal stories?

Many other mammals understand isolated words. An intelligent dog, for example, can comprehend as many as 50 to 100 words. Still, our communication with animals is primarily nonverbal—assuming the form of a charade.

The apes, however, may provide an interesting exception. In recent years psychologists claim to have found ways to communicate verbally with some apes. Scientists at Emory University in Atlanta taught a chimpanzee to communicate by pressing computer keys. Three other teams claim that, after learning American Sign Language, their apes produced sentences spontaneously.

None of these investigators, however, have done with their apes what every parent does with his child—tell stories. Would the apes listen to stories? Would their vocabulanes, like those of children, explode? Most important, would they attempt to tell the stories to each other and to their human friends?

It wouldn't be a difficult experiment. Once an animal has the vocabulary of these apes, it could comprehend a signal that it and a human companion were entering game time, that what followed would be make-believe. In a similar way we indicate to children that we are entering verbal make-believe by beginning with "Once upon a time...."

I don't know what the results of such experiments would be. It would be fascinating, though, if the chimpanzees actually did understand the stories their human companions had left and told the stories to each other in the course of their play.

Dolphins would perhaps be likely candidates for such an experiment. Their brains are bigger than ours, and dolphins make all sorts of curious, complicated noises. Are these noises the telling of tales? Are dolphins the poets of the deep?

I would be very much surprised if intelligent animals couldn't learn stories and tell them back. I think the problem in achieving this lies with the scientists who are uncomfortable as storytellers instead of with the animals.

CONTINUED ON PAGE 119
The future is coming. And with it will come great benefits for mankind. And a whole new set of problems. Because we are a forest products company, and plant seeds that take up to 50 years to become mature trees, Champion International has to think a lot about the future. We’d like to share some of the things we’ve learned with you—to help you make intelligent choices in the years to come. Here is something you might want to think about.

In the future, a new science called gene splicing could produce miracles—like the regeneration of limbs, a cure for cancer, even the flowering of a “better” human being.

But who is going to decide what makes a “better” human being?

Some years ago, a child was checked into a hospital; the tip of one finger had been sliced away. The wound was dressed, but the patient neglected. Days later, the dressing was removed. The finger tip was growing back.

At the time, regeneration was a baffling and spooky phenomenon.

Today, we are beginning to learn more about it through the science of genetic engineering. Genetic engineering has the potential to alter the make-up of mankind as no other science ever has or possibly ever will. Gene splicing, a one aspect of this new science, is the transfer of genetic material from one living thing to another. With this technique, a gene can be isolated and, when planted in a bacterium, start a whole new process of organic reproduction.

The realizable benefits of genetic engineering are both stunning and myriad.

Splice a gene that produces human insulin into a replicating microorganism, and diabetics have ready access to a purer, yet less expensive insulin. Researchers have already synthesized the hormone responsible for human growth, an immediate boon to children with stunted growth. It’s increasingly likely that gene splicing will be able to mass-produce interferon, the anti-viral wonder drug that may put the brakes on flu, hepatitis, and certain kinds of cancer.

Eventually, bacteria may become assembly lines for the creation of whole new life forms, including “better” human beings.

In the long reach after his own betterment, man has covered incalculable ground: from primitive man domesticating wild wheat to his use, to modern man on the threshold of making a better organic self out of his existing self.

The promise for our future is almost beyond comprehension.

Which means questions have to be asked (and answered) right now:

Most critical: who is qualified to decide what makes a “better” human being? Who among us has the capacity, much less the right, to choose?

Also: what safeguards will there be against bacteria containing poisoned genes escaping from the laboratory and contaminating the very life we’re trying to improve? Can patents be awarded to private industry for what is essentially life itself? If so, can science retain its necessary purity and freedom in a commercial situation?

These are questions that desperately concern us all because we are the subject matter.

If you’re concerned with the immediate future, and would like a bibliography for further reading, send for our free brochure. Write: Champion International Corporation Dept. 200N, P.O. Box 10142 Stamford, Connecticut 06921

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Progress in the physical and mechanical sciences determines a progress in art"—Composer Carlos Chavez 1957

Though a number of other factors intervene, Chavez's words ring truer every day. Everywhere you look—young pop musicians are making music with electronic equipment. In most cases exclusively electronic. M's recent hit single "Pop Muzik" listed geographical points of reference and concluded, "Everyone's talkin' 'bout pop pop pop pop music!" And creating it. Future shock has arrived, finally! Say hello to electronic hits like the Flying Lizards' "Money" and Gary Numan's "Cars." But wait! Hasn't rock and roll always been based on electricity? Isn't the electric guitar its primal icon? Isn't virtually all music made these days produced in sophisticated recording studios that depend on ever-expanding high technology? Don't most pop rock, disco and what-have-you albums now feature synthesizers and myriad other forms of electronic circuitry?

Yes, yes, yes. And yes. But now there's something new happening. While synthesizers have been with us a good quarter century—ever since Robert Moog and Donald Buchla simultaneously created their own sharply differing varieties—rock-and-rollers until recently regarded the instrument with a high degree of suspicion.

Why the change of mood today? Because, for one thing, in these post-Harrisburg, pre-Apocalypse times, ruled by high tech, a workable synthesizer can now cost less than a comparable electronic guitar. Youngsters can now cut their teeth on devices that 20 years ago were a gleam in some MIT engineer's eye.

"Look around you," advises Larry Fast, who programs and plays complicated synthesizers for such top-selling acts as Hall & Oates, Boz Scaggs, and Peter Gabriel (whose brand of music no doubt is despised by the current crop of electric-people). "Television, telephones, radios, stereo, recording studios, everything is run on high technology. It's our world. To ignore it because it's cold and inhuman or something is like burying your head in the sand."

But how did the erudite instruments of scientists filter down into mainstream popular music, to be accepted as the sound of pop music? In the Sixties psychedelic and art rock bands introduced a certain amount of open-mindedness about electronic devices in the service of pop. Bands made more extensive use of instrument modification and newer and more exotic devices in the hands of such innovators as Robert Fripp and the late Jimi Hendrix. The new synthesizer's worth was proved, and even the Grateful Dead used some musique concrète, "found" tape effects on their 1968 album Antherm of the Sun. But electronics synthesizers and such were generally considered novelties, gimmicks added on the basic rock setup. The Beach Boys made inspired use of the theremin effect on "Good Vibrations," but they remained the exception. Walter (now Wendy) Carlos's Switched-On Bach started the world with its wittily all-electronic realizations of familiar classics, but it sure wasn't rock and roll.

In the meantime, though, on the fringes of a complacent corporate rock superstructure—electronics began to blossom. In 1972 a duo called Suicide began infuriating and transforming New York audiences. Their music—based on the drone rock of the Velvet Underground, was hyperamped and aggressively electronic. Martin Rev, wearing a leather jacket and wrapper around shades, stood impassively behind his portable organ and rhythm box while singer Alan Vega contorted himself spasmodically at center stage. Here was the first harbinger of things to come: music that was loud, repetitive, pneumatic,
rhythmic, with percussion provided by an inexorably precise machine instead of by a human drummer.

Suicide's tunes were short and to the point; the point being the effect of dropping a leather-jacketed mannequin directly into the horrifically clanking machinery of Fritz Lang's Metropolis. Their hard-to-find, self-titled first album on Red Star Records remains a masterpiece of uncompromising mechanistic rock. It took more than 10 minutes for this kind of machine-oriented sound to take off. It finally did so with the music of four German computer operators who called themselves Kraftwerk. Their long trances inducing all electronic hymn to the Machine Age called Autohahm began to appear on college radio stations in the United States in the spring of 1975. The robotic refrain went Fahn, fahn, fahn, auf der Autohahn with gentle, thumping electronic snarls, burbling rhythm boxes, and sweeping, simple synthesizer melodies. Hordes of listeners around the world began to jerk around like androids wanting more. Autohahn was a hit and Kraftwerk had effectively bridged the time warp between early twentieth-century Constructivists/Futurists and the electro-pop of today. They called forth a whole decade of Teutonic electronic bands with names like Can, Neu!, Düsseldorf, and Tangerine Dream.

What is important about Kraftwerk and their cohort is that, like Suicide they were celebrating the idea of man-machine fusion. As the international success of Autohahn indicated, people liked this stuff even if they didn't realize its future-shock implications.

The German school was highly influential. It instigated the direction of David Bowie's most recent albums recorded in Berlin. Of course, in collaboration with self-described archfuturist and nonmusician Brian Eno. However, Eno may describe himself as an inspired way pater for the New Electronic Rock. His Another Green World further elevated the importance of rhythm box and synthetic percussion in pastoral computer daydream interludes that sounded like Kraftwerk recollected in tranquility. With his intuitive approach to the synthesizer, Eno showed us how to live with and love electronics and how to use them expressively with felicity and taste. And then punk rock happened in England. While Americans had no comparable audience of disenfranchised working-class youth, there was disco in the United States, a comparable minority protest music. Disco began as the mindlessly mechanized dance and escape music of blacks was adopted by homosexuals, and soon spread throughout the country. While punk wanted to rip the system to shreds, disco advocated that you just peel away and forget the system altogether with rhythms made by or imitative of machines. Both punk and disco were equally subversive mechanistic movements despite their stylistic differences.

Much of what seemed mindless in disco was in fact quite well thought out. The paradigmatic example is the work of the Munich Machine production team of Giorgio Moroder and Pete Bellotte who elevated sequencer programming into an art form unto itself. Sequencer rhythms are intricately arranged synthetic patterns of repetitive beats that seem, and probably are, timed to the booty-shaking synapses of the brain. The 154-beats-per-minute criterion for danceability was the result of such sequencer programming. Moroder's arrangement of Donna Summer's I Feel Love remains a great sequencer epiphany of our time.

Punk approaches electronics overtly, embracing a nonthuman future. DEVO (De-evolution Band) from Akron, Ohio, is not entirely electronic although the players say they'd like to be. But they come on stage like chemistry class nerds rubbing their hands with glee as they formulate pop perversities in the lab. Their cover of the Rolling Stones' Satisfaction is set to an unrelenting robot beat. Even more at home with electronics, and also from Ohio, Pere Ubu has been operating for years on sawgently danceable rock and roll that features synthesizer work by Allen Ravenstai. Ravenstai has single handedly bridged the gap between those who used synthesizers in rock bands and those who esoterically explored the pure sonic possibilities of synth. On his machine, he conjures up distant, half-remembered factory whistles, grinding gears, sirens, making palatable the urban paranoia of the heart of punk rock's vision.

And there are many more. Batches of new all-electronic rock singles and albums seem to arrive weekly from France, Germany, Great Britain, and other countries to be gleaned by voracious futurists at punk and import shops. Why the proliferation? Rock's gone about as far as it can go. A member of England's all-electronic rock combo the Human League was quoted recently as saying to the British press: "It's had a fair crack of the whip. Electronics are obviously where things are headed."

The Human League's album Reproduction is a good example of the widening scope of electro-pop. On it is a detached, straight-faced reworking of the Phil Specter/Righteous Brothers classic "You've Lost That Loving Feeling." Specter used the limited layering possibilities of the studio to make some of the most sentimental music of all time. The Human League's version—stripped down, remodeled—can be seen as a key to the new attitude. Whereas Specter made the technology work for his own vision, the new electro-pop's vision works according to the technology and is dictated by it. Again, the message is Accept the inevitable.

Numan, who has topped the British charts twice with albums and singles showcasing whistling pneumatic synthesizers, has already accomplished in two years the amazing feat of finding electro-pop's middle road. He combines just the right amount of cold, clean machine feeling, familiar rock rhythm, and space-manne voice musing on the edge of complacent lunacy. Numan's first hit single "Are Friends Electric?" was inspired, he says, "by an incident in which people I thought were my friends proved themselves not to be. It upset me over so much." So I wrote the song wishing for an electronic friend: a perfect, dependable machine that wouldn't turn fickle.

Yes, but is it rock and roll? That quotation from the Human League notwithstanding, I think well might be. To be sure, many of the new songs sound cold, unforgiving, noisy, nasty, and parvenu—but they're supposed to. Like any and all new (subversive) art forms, electronic rock represents a disturbing cry from "the other side," dealing with things most people would rather not hear about. It implies a leap of faith into the gleaming maw of a man-machine affair that has been politely ignored, covered up, or repressed. Yet much of this music is full of its own curious humor and humanity.

"I got the idea [for writing Metal] from reading a magazine," Numan says on the subject of his latest hit. "It said some American scientists postulated that within ten years or so they could formulate a partially organic computer that could regenerate itself. So the song is about a machine wishing it could be human, have friends, babies, and such. Imagine a whole bunch of baby computers running around your house."
Would you believe a lunatic fashion designer has invented the Nude Bomb? Would you also believe that he plans to destroy every stitch of fabric in the world, then dress humanity in his own paisley designs? And would you believe the sole obstacle between this gold thimbed villain and his dream is that legendary operative of the PITS (Provisional Intelligence Tactical Service), the indefatigable foe of KAOS and other bastions of evil and rottenness the bumbling Agent 86, Maxwell Smart?

No wonder the PITS has evolved a contingency plan to dress people in flank steak, linguine, and romaine lettuce.

Get Smart is one of the most popular television programs of all time. Created by Mel Brooks and Buck Henry as a comedic answer to the James Bond films, the series aired from 1965 through 1970 on network television and has remained in syndication ever since. It starred comedian Don Adams as Smart, Barbara Feldon as his loving and patient coagent 99, and the late Ed Platt as the chief. Now Universal Pictures has brought Don Adams as Agent 86 to the big screen in The Nude Bomb. And while Agent 99 is gone—replaced by Smart’s beautiful new aides, Agents 36, 22, and 34—the picture is stocked with everything audiences have come to expect from a Maxwell Smart adventure. And then some.

The timbre of the original Get Smart has not been changed in its translation to the big screen. It remains broad comedy flavored with slapstick and satire. What is different is that the filmmakers had the time and money to do an epic, all-out parody of the Bond adventures, and it’s a challenge they accepted with zeal. There is a skydiving sequence reminiscent of the opening of Moonraker, spectacular ski stunts, an abundance of seductive women, and hordes of malevolent thugs. There is also a wealth of exotic locales spanning the globe from Innsbruck, Austria, to Boulder, Colorado, from the United Nations Building to Buckingham Palace, and even to the Universal Studios Tour where Smart participates in a wild tram chase with a one-eyed, one armed, one-legged enemy agent.

And of course there are gadgets more than ever before. The most spectacular of these is the Clonatorium with which the Nude Bomber plans to produce enough seamstresses to clothe the world.

However, the real crowd pleaser promises to be the snappy D-1 Turbocharger Deskmobile. Besides possessing a blower windshield and 50-caliber machine-gun drawers, the Deskmobile runs on ink and gets 35 miles per gallon on the highway 12 in the living room. Devices like these give the movie its air of high technology and enrich, rather than overshadow, the impact of returning favorites. But it would take an astounding new contrivance indeed to steal the limelight from the quant but classic Cones of Silence and Smart’s shoe-phone, which has been improved with touch-tone and abetted by a backup pocket-pan Finished sugar cubes and a little bag of propellers. The Deskmobile runs on ink and gets 35 miles per gallon on the highway 12 in the living room.

Great films have a way of snaring the public Fancy and creating trends in all walks of life. With society hungry for improved forms of technology, can we hope to see any practical spinoffs from the sophisticated Smart appurtenances? According to Bill Dana, who coauthored the screenplay and appears briefly as a science manufacturer Jonathan Levinson Segal, the answer is an unqualified no. "Little attention was given to scientific accuracy," Dana apologizes. "The Deskmobile is not all that good aerodynamically unless you get a very smooth secretary. As for the rest of it we didn’t do any really deep research."

The reason for this, says science buff Dana—whose José Jiménez character was mascot to the Mercury, Gemini, and Apollo space programs—was not a lack of interest but the unique demands of the genre. In comedy—particularly in SF comedy—the fewer barriers there are between the audience and the material, in terms of comprehension, the easier it is to get them to laugh. Though I really love to get the laugh-thing going, that was really not our intent in The Nude Bomb.

Adams agrees: "The whole secret of comedy is that you need someone away from where you’re going and you catch..."
Maurice Chatelain is a French astrophysicist, now an American citizen, who was chief scientist for Apollo Communications Data Processing during NASA's Apollo program. Previously Chatelain worked as a research scientist for Convair Aeronautics, which played a pivotal role in the Mercury and Gemini space programs. Berlitz's most recent book is The Philadelphia Experiment. His other works include The Bermuda Triangle (Fawcett).

Berlitz: Mr. Chatelain, you were at NASA. Did you believe in UFOs?
Chatelain: No. Fifteen years ago I did not believe in flying saucers. And if I did, I certainly would not have advertised the fact. Now things have changed. First, I am not working for NASA anymore. Second, NASA itself has been forced to recognize the existence of the UFO phenomenon and to admit that it does not know what it is or where it is coming from. Civilizations might exist in outer space that could be far more advanced than ours. It would be logical to try to establish contact with these worlds, first by listening to the messages that they might try to transmit to us, then by sending them simple messages with the primitive means at our disposal, such as radio and laser.

Berlitz: What do you think would be the best way to establish contact?
Chatelain: We must first try to determine the kind of message that would have the best chance to be received and understood by us. Most information scientists now agree that the best message would be one made of simple numbers representing mathematical ratios. It seems that we have already received such messages, which have gone completely unnoticed by those who could have deciphered them.

Berlitz: How were the messages sent?
Chatelain: They may have been contained within the landing patterns of the UFOs themselves. As you are probably aware, many of the UFO landings reported in recent years have occurred in France. The gendarmes are instructed to investigate all landing sites. In 1954, France was seemingly inundated with flying saucers. There were 76 UFO landings in 25 days from September 24 through October 18 of that year. As usual, the gendarmes recorded the time, longitude, and latitude of each landing site and its dimensions. It was also noticed that some of these sites were separated by an average distance of 63 kilometers. These were the first numerical data ever obtained from UFO observations and the only logical conclusion that could be derived from them was that the distances were always exact multiples of 21 centimeters, the wavelength of hydrogen, which could represent an ideal measuring unit for astronauts from another world.

Berlitz: Why not face-to-face contact?
Chatelain: Perhaps they want to avoid panic on our part or simply to avoid potential danger to themselves. The most fascinating part of the UFO mystery is not so much what UFOs are or where they come from, but how they can manage to travel at fantastic velocities of 32,000 kilometers an hour in our atmosphere and suddenly turn at 90 degrees for the opposite direction. There is no terrestrial spacecraft that could even try to reach that velocity or perform such incredible maneuvers without disintegrating on the spot. There are only two possible explanations. Either flying saucers do not really exist and are just an optical illusion or they are extraterrestrial and come from another world somewhere in outer space.

Berlitz: What propulsion system do you think they could use?
Chatelain: Along with several French scientists, Claude Poher for example, I think that UFO propulsion might be based on a combination of electric, magnetic, and gravitational forces or in other words on Einstein's unified field theory which could provide fantastic power from a small mass of matter such as hydrogen.

Berlitz: As an astrophysicist, do you really believe in the physical existence of UFOs?
Chatelain: What is important is not whether flying saucers exist physically or are just an illusion of our minds. I believe that they exist, and I therefore keep trying to find out what they are, where they come from, and why they come and visit us now.
The launching of a satellite, once an event of cosmic significance, is usually thought of by the average American these days, if he thinks of it at all, as nothing more complicated than a big blowtorch blastoff. Familiarly breeds yawn. To the known 4,555 man made objects now in orbit are added each month half a dozen from the Soviet Union and another six from the United States.

But the mystery of Satcom 3, a communications satellite owned by RCA and sent into orbit last December by NASA from Cape Canaveral, has baffled the most erudite diagnosticians in the space business. NASA had launched and RCA had successfully placed in orbit two similar satellites in 1975 and 1977. But some demonic hand seemed to have grabbed the latest sister ship. The launch was perfect, says Ken Senstad, who as an officer of the external affairs section of NASA, was present.

"But when we handed it over to RCA it simply disappeared."

As on previous occasions the NASA controllers transferred to RCA technicians in Vernon Valley New Jersey authority to place the satellite in geostationary position once it reached an apogee of 35,980 kilometers. An awful lot was riding on Satcom 3. Not only was RCA staking its technical reputation but cable television operators—notably Ted Turner of Atlanta with his 24-hour news service—were depending on a successful launch to fulfill their contracts. One RCA executive said tersely "Blip! There it was. Blip! It was gone."

A lot of questions raised by this singular event (the first loss of a privately owned satellite) trouble some powerful constituencies. As an example the North American Air Defense Command (NORAD), charged with identifying both friendly and strange traffic in the skies, could find no trace of the vanished satellite. NORAD is mum on the matter, but John Williamson, an RCA official, suggests the limits of the defense agency's prowess by describing the search as like "looking for a grain of sand on a ballet floor."

The grain of sand is a box about the size of a household refrigerator, weighs 907 kilograms, and is powered by two extended rectangular wings with seven square meters of silicon solar cells. Had Satcom 3 been enhanced by some esoteric place of technology untested in space, its disappearance might have been attributed to its novelty. But the hardware and the launch system were by the standards of the industry well tested. The launch was the one hundred fifty-first performed by NASA's Delta System. The hardware, used in previous satellites, was to carry 1,000 voice circuits or one color television transmission on each of 24 channels. Nothing new.

Almost two months after the Cape Canaveral blastoff RCA announced, "Just about all possibilities of recovering it in usable condition have been exhausted. That set alarm bells ringing all the way to Lloyd's of London. Insurance carriers had issued a $50 million policy to cover the costs of construction and NASA's bill for services. RCA also had $20 million worth of insurance to cover business losses caused by the failure of the newest Satcom to perform its mission.

Loss of a $50 million supertanker and its cargo is treated by the media as a first rank catastrophe. But the loss of Satcom recurred little attention in large measure because all the parties concerned—RCA, NASA, NORAD, and the insurance carriers—kept their collective lips officiously buttoned except for some elliptical and rather starchy statements.

RCA put forward three theories to account for the loss of Satcom, which disappeared while sailing along its correct path at 135 degrees west longitude above the equator. The alternatives, according to Williamson were: It was a way out in space. It shot back into the atmosphere and burned up. It's still out there but the transmitter isn't working.

Satcom 3's disappearance is far more serious than the media have made it out to be, although the reasons are economic rather than political. Satellite communications is reaching maturity 18 years after Telstar AT&T's first receiving and relaying system was placed in orbit. RCA has orders for more business—data, radio, television and the like—that it can handle. And NASA will be hard pressed in the Eighties to provide launch services for the string of customers now lined up, which includes a well-heeled group led by IBM.

How reliable are civilian communications satellites? Although RCA managed to assure the panic of some of its customers by leasing spare capacity from AT&T the unaccountable exit of Satcom has raised fears about future launchings in the minds of those financial and insurance executives who foot the big bills—THOMAS O'HANLON
HUH?

When the great physicist Isaac Newton or the great neuroscientist Steven Kutas say that they've discovered a brain wave that gives them a huh? feeling, their finding is taken seriously. However, when neuroscientists Marta Kutas and Steven Hillyard, both of the University of California at San Diego (UCSD) School of Medicine, found that the brain emits a special signal 400 milliseconds (about four tenths of a second) after encountering nonsense language, it was a kind of electronic-cerebral double take. Kutas says that results in negative voltage from the brain. Kutas and Hillyard call this new brain wave the N400, which they say appears when a sentence with a high degree of expectancy has been violated.

Don't make any sense.

This discovery could help in the evaluation of reading disabilities in children and in discovering just how much the rest of us understand and where we go wrong when we don't.

— Ellen Bilgere

You either have science or you don't, and if you have it you are obliged to accept the surprising and disturbing pieces of information—even the overwhelming and upheaving ones—along with the neat and promptly useful bits.

— Lewis Thomas

BLACKEST BLACK

Like many other important scientific discoveries, an almost perfectly black surface was found, accidentally, by a researcher working on something else in a laboratory. Christian Johnson, a physical science technician for the National Bureau of Standards, created a surface that absorbs 99.5 percent of the incident light, but he didn't discover its significance for three years. In 1975, as he was using nitric acid to remove a silver-colored nickel phosphorus coating, he noticed that the material turned black during the stripping process. In 1978, on a whim, he asked for a full lab analysis. One of the fellows who did the measurements thought his spectrometer was broken.

What had happened was that the 50 percent nitric acid solution made tiny valleys in the coating during the stripping process. These valleys acted as light traps—letting light in but not out—like deep holes in the ground. Stopping the process after 15 to 20 seconds yields the best results.

The discovery has important implications for astronomy radiometry and other sciences that depend on the absorption of light. Previously the best black coatings absorbed 96 percent of the light and reflected 4 percent, a 24 to 1 ratio. A surface that absorbs 99.5 percent and reflects 0.5 percent has a 199 to 1 ratio, resulting in a much greater resolution of distant stars by telescopes. Far more accurate measurements of light energy by radiometers and a slightly greater efficiency for solar collectors.

Christian Johnson said more than 200 astronomical groups space physics labs, and similar organizations have asked about the discovery.

Stuart Diamond

It is the customary fate of new truths to begin as heresies and to end as superstitions.

— Thomas Huxley

Speaking on Darwin's Origin of Species

Those who speak of the incompatibility of science and religion either make science say that which it never said or make religion say that which it never taught.

— Pope Pius XI

Scanning electron micrograph of Johnson's black surface.
**SIPHON BURNS**

Yet another problem is now arising out of the energy crisis: gas siphoning burns.

The American Dental Association (ADA) warns that gasoline can burn the delicate tissue inside the mouth producing swollen, ulcers, and parodontist at Offutt Air Force Base in Nebraska. The middle of his palate was soft and spongy with tiny blisters. Similar burns can result from placing aspirin on gum tissues to relieve toothache, from an allergy to mouth wash or toothpaste or from a lobster-red lesion.

Recently a forty-three-year-old U.S. Air Force sergeant siphoned gas from one of his cars to his other car using the old-fashioned tube-to-mouth technique. As often happens, he got a mouthful of gas. He spat it out right away, but he waited several hours before rinsing his mouth.

The next day with a burning pain in his mouth, he went to the dentist. The roof of his mouth had a lot of little ulcers and red spots almost like a burn—kind of red and puffy," says Dr. David L. Hoffman, colonel and periodontist at Offutt Air Force Base in Nebraska. The middle of his palate was soft and spongy with tiny blisters. Similar burns can result from placing aspirin on gum tissues to relieve toothache, from an allergy to mouth wash or toothpaste or from a lobster-red lesion.

**SKY-HIGH PLASTIC**

Passenger carrying airplanes made almost completely of plastic may cruise the sky in the near future. Perhaps even supersonic speeds.

This prediction is based on cooperative studies by the Defense Department, NASA, and some major aircraft companies.

Requested by Congress to study technologies that reduce fuel consumption, NASA suggested, among other ideas, utilizing plastic composites in airplane construction.

According to Michael Salkind, manager of aeronautical structures for NASA, the industry is already accelerating its use of fiber-reinforced plastic in airplane construction. Such materials, he says, Salkind predicts, "will force more rapid introduction of plastic technology."

"The operating costs of old aircraft may become too high," Salkind says. A candidate for conversion is a future supersonic cruise transport. If a decision were made to build the plane perhaps in the year 2000 or soon thereafter as much as 60 or 70 percent of the vehicle could be made of high-temperature plastics." —Leonard David

A large scale model of a highly maneuverable plastic aircraft hangs beneath a carrier airplane from which it will be drop tested.
BODY MOVIES

First there was the X-ray, then there was the CAT scanner which shows X-ray cross-sections of the body. Now there's PETT. This latest diagnostic tool shows X-ray movies of the body's biochemistry.

By introducing radioactive tag substances such as glucose or oxygen into a person's body, doctors can actually watch biochemical changes in human body tissue - in the heart or brain for example - on a TV screen.

Developed at Washington University Medical School in St. Louis, the PETT device works by measuring the concentration of the radioactive tagged substance and then relaying the measurements to a small computer. The computer in turn reconstructs these abstract measurements into images which are played out in color on a TV screen where the PETT scan can be photographed or even videotaped.

Though still only a research tool, the PETT scanner could let doctors watch a person's brain in action while he or she is talking, reading or even thinking. It could study the brain for tumors or the damage inflicted by a stroke and then evaluate therapies for these conditions. It could yield insights into everything from schizophrenia to Huntington's disease.

Similarly a PETT scan of the heart could help a doctor pinpoint exactly how much damage there is right down to the cellular level. In fact Dr. Ter-Pogossian notes doctors at the medical school have already begun to use the way on some of their heart patients. The PETT scanner will probably be part of the medical toolkit in some of the nation's larger hospitals in about two to three years, he adds.

-Douglas Colligan

SOLAR PONDS

As one of the first steps in turning off their dependence on high-priced imported oil and turning on the free and limitless power of the sun, Israeli scientists have built a 150-kilowatt pond. Part of what the Israelis say is the world's largest solar-electric-power station, the 0.8-hectare pond is a man-made dimple in the earth expressly designed to capture and use the sun's rays that beat down on the Dead Sea area.

Developed by Israeli scientists Dr. Rudolph Bloch and Professor Harry Zvi Tabor, the shallow pond first has its bottom lined with sheets of black, sunlight-absorbing material. Then the pond is filled with two kinds of water: The first, a bottom layer is extremely salty. The second layer is fresh water which will stay on top because it is lighter. The solar pond works when sunlight streams down through the upper layer of clear water and is absorbed as heat by the pond lining and denser layer of salt water. Gradually the heat continues to build up, warming the water to near the boiling point. This hot water can then be pumped out to heat exchange units, which in turn spin electricity-producing turbines.

Scientists have already produced an experimental 6-kilowatt pond in addition to this 150-kilowatt model. By 1983 they hope to have a bigger 5-megawatt pond working and by 1985, the first of a series of 20- to 25-megawatt plants - DC

-In truth the commandments derived from science boil down to a diffuse pervasive fear - Jacques Barzun

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Miche Ter-Pogossian and his PETT. Unlike its predecessor the CAT scanner it shows among other things that a corpse is dead.

- Brian Colligan

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Israel's Dead Sea solar pond is shown with heavy black lining.
FLASHLIGHT FISH

As long as it's got its bacteria, the flashlight fish never has to worry about getting batteries, says one University of California microbiologist-bacteriologist. As part of his research into what makes some ocean dwellers so luminous, researcher Kenneth Nealson, of the university's Scripps Institution of Oceanography in La Jolla, says there's a whole breed of glow-in-the-dark sea creatures that get their light from hitchhiking bacteria.

Nealson has found there's an exchange of benefits, a symbiosis, between the two creatures. The fish offers a reasonably safe and secure home for the bacteria and a source of nutrients. In return, the bacteria give off a satisfied glow, which the fish can use for many purposes. Luring other fish to within striking range, communicating with fellow fish, or avoiding bigger ones that want to eat it are typical examples.

Nealson says one of the odd things about this fish-bacteria partnership is that certain bacteria cling only to certain species of fish.

Another strange thing scientists still haven't puzzled out is how the glowing bacteria stay intact and unpolluted by other stray bacteria. There has to be some kind of metabolic restraint in the fish's body that lets the bacteria grow without interference. If scientists could figure out what this is, says Nealson, they might then have a clue how our bodies keep under control foreign bacteria and why this system of ours sometimes breaks down, resulting in disease — D.C.

SEX EASES ARTHRITIS

An increasing body of evidence suggests that sex eases the pain of arthritis.

Dr. Jessie Potter, director of the National Institute for Human Relationships in Chicago, says that sexual activity stimulates the adrenal glands to release additional cortisol, which reduces pain and swelling in inflamed joints. Cortisone is sometimes given to arthritis sufferers by injection.

Dr. Potter says that any kind of sexual arousal — self-stimulation, petting, oral sex — evidently leads to cortisone release. Those without partners don't have to feel left out.

While the National Arthritis Foundation insists sex shouldn't be considered a treatment, up to 70 percent of the arthritis patients interviewed at one Pennsylvania medical center reported that it had helped.

How long do the soothing effects last? The prescription is similar to that for pain tablets: Take one every four to six hours — S.D.

LIFE ON MARS

The controversy over life on Mars rages on.

While scrutinizing pictures relayed from Viking spacecraft which plopped down on the Red Planet in 1976, scientists have detected on Martian rocks spots that appear to change color.

Is there any visual evidence for biological activity? The question comes from Gilbert Levin, president of Maryland-based Biospherics Inc., along with colleagues Patricia Ann Straat and William Benton.

In examining color images transmitted by the Viking 1 Mars probe, changes in the location of greenish rock patches and ground patterns that have been observed by team reports. A biological process could explain the color alterations. Levin surmises glitches in the Viking camera and processing system, wind-blown Mars dust, or simple sunlight playing upon the rocks are potential counterarguments.

To support the life hypothesis, the scientists observe that earthly samples of algae, lichen, mosses and other organisms that live in hostile environments such as that of Antarctica undergo color changes as they continue to grow or die. In 1976 endolithic blue-green algae were found in Antarctic rocks once thought void of indigenous life.

Because of the limited resolving power of Viking robotic eyes and a tendency to see fewer color differences than the human eye detects, an answer to the phenomenon awaits further analyses.

As one of the principal investigators on the Viking biology team, Levin argues I think it prudent for the scientific community to keep the life-on-Mars question open — L.D.
THE HELIUM WASTE

Helium, which buoys balloons and blimps and is vital for future technology, is being wastefully vented to the atmosphere by companies with no current use for this nonrenewable resource.

Nonflammable and capable of making magnets and motors superefficient, the second lightest element (after hydrogen) is being lost forever because of the lack of a concerted conservation policy says the General Accounting Office, Congress's watchdog agency. Yet millions of dollars are being spent on new technologies—including magnetic fusion and high-speed trains—that require helium.

Women are much fiercer than men. Nobody has ever given us weapons for very long, have they?

—Margaret Mead

in order to operate

About 13 billion cubic feet of helium is being vented each year as a by-product of natural-gas drilling. U.S. helium reserves, by far the world's largest, are estimated at 718 billion cubic feet. The National Research Council says continued venting could deplete 85 percent of U.S. reserves in approximately 30 years.

Helium gas has been proposed as an energy-saving answer to long-distance transportation. Blimps filled with it could carry goods without risk of fire. But the major use of helium would be as a supercold liquid refrigerant. It liquefies lower than all other substances—about 20 degrees above absolute zero. At that temperature, electric transmission is virtually frictionless. Thus, helium-cooled electric lines would almost wipe out power plant distribution losses—now 20 percent. Liquid helium makes possible extremely powerful magnets that accelerate particles fast enough for nuclear fusion reactions. Such magnets also vastly increase electric motor efficiency and produce magnetic fields that could pull trains along at high speeds supported by a layer of air.

The problem is that helium is expensive to store and largely unneeded today. The technology that requires it lies in the future—S D

MURDERED COMPUTERS

There are two kinds of people in the world—those who understand computers and those who don't. And the 'don'ts' are beginning to fight back—with a vengeance.

Gary W. Dickson, a computer expert at the University of Minnesota, has documented numerous cases of computer murder throughout the United States. For example, a sheriff in California shot a computer dead for uncontrollably spewing out arrest records. Someone at the Minneapolis Post Office poured honey into newly installed terminals. Car keys were deliberately tossed into a disc file in Denver. A computer at the Metropolitan Life Insurance headquarters in New York City was brutally attacked with a screwdriver.

These are only the violent assaults. More commonly says Dickson, employees sabotage the machines by intentionally inputting mistakes into the system. Managers engage in their own form of abuse by ignoring computerized information in their decision making or overlooking computer advances.

Dickson, director of the University of Minnesota's Management Information Systems Research Center (MIS) says, "Use of the technology is not nearly as sophisticated as the technology itself. MIS, along with a similar program at MIT specializes in training managers to deal effectively with the stress of the computer environment."

Women are much fiercer than men. Nobody has ever given us weapons for very long, have they?

—Margaret Mead

The only certainty in [the] remote future is that radically new things will be happening.

—Freeman Dyson
BLOOD STOPPER

In television operating-room scenes the script inevitably calls for the surgeon to bark out, "Clamp please nurse!" in response to a gushing blood vessel. But during real-life surgery in today's modern hospitals Avitene, Avitene is a more common cry.

Avitene is a white, fluffy, flourlike powder that stops bleeding where other methods—such as clamping and tying a vessel with thread, stitching, or electrocauterizing—don't work. Although the product has been around for seven years, only recently have surgeons accepted it as essential to good surgical practice. One aspect of Avitene that held surgeons back was its sticky properties: unless one is very careful it adheres to everything like cotton candy. The powder works by mimicking the body's natural blood-clotting mechanisms. It contains a form of collagen, a vein- and artery wall component, that triggers blood clot formation. Avitene is manufactured in a microcrystallization process from animal collagen harvested from cow and bull skins. Made up of millions of microscopic collagen fibers giving the substance an immense surface area, Avitene on contact with a bleeding surface meshes together and attracts a gelatinous mass of blood cells, the base of which forms a blood clot to plug up the injured vessel.

Avitene has been especially helpful to surgeons who operate on soft pulpy organs such as the liver, the heart, or the brain, and in cardiovascular surgery, which involves grafting vessels end to end. Sometimes applying a stitch to these organs is virtually impossible, but a dash of Avitene does the trick.

Dr. Chin Bor Yech, chief of cardiac surgery at St. Lukes-Presbyterian Hospital Center, in New York City and once a member of a team researching the product says that although Avitene has been a boon to surgery it is by no means a replacement for meticulous application of other techniques. "It's a last-ditch effort when all else fails," he says.

Also the cost factor has to be considered in Avitene use. A five-gram container sells for $130, a cost most hospitals absorb in their standard rates for operating-room time—Caroline Robb.

NUKE SIMULATION

The atomic accident at Pennsylvania's Three Mile Island reactor last year has already changed the nation's largest ongoing nuclear safety experiment. Scientists at the Idaho National Engineering Laboratory in Idaho Falls have altered their schedule to investigate the kind of accident that occurred in Pennsylvania.

The Idaho tests involve actual planned accidents in a one-sixtieth scale reactor loaded with nuclear fuel. They enable scientists to learn what happens under real-life conditions. The program—called the Loss of Fluid Test or LOFT—refers to the accidental loss of vital cooling water.

Before Three Mile Island the LOFT reactor had two nuclear accidents—in December 1978 and February 1979. They involved a traditional scenario: Large pipe breaks, where massive amounts of cooling water spewed from the reactor.

Three Mile Island's mockup simulating cooling towers. The disaster has created a switch in concern from massive to small leak accidents.
STAR TAR

Carl Sagan now believes outer space may hold more than just extraterrestrial intelligence. It may also have oil. Sagan and associates B. N. Khare of Cornell University and Eric Bandurski and Bartholomew Nagy of the University of Arizona, have performed a series of earthbound experiments that point to the existence of cosmic crude.

In their experiments, the four took a mixture of gases similar to Jupiter's atmosphere and irradiated it with ultraviolet light. The result: Some 50 polymers and hydrocarbon compounds, including ethane, butane, propane, benzene and toluene—common products of terrestrial oil refineries—were formed.

The compounds would make up only a small fraction of Jupiter's atmosphere; but there's a lot of atmosphere there. It might someday be feasible and economical to harvest hydrocarbons from the Jovian gases.

What's more, Sagan and Khare suggest the presence of similar compounds in interstellar space. Like the Jovian polymers, they would

"Every great scientific truth goes through three stages. First, people say it conflicts with the Bible. Next, they say it has been discovered before. Lastly, they say they always believed it.

—Louis Agassiz"

LIGHT-SENSITIVE TREES

Oil companies and Arab nations are not the sole beneficiaries of the energy crisis. It's been a boon to light-sensitive trees whose days and nights had been skewed by city lights.

The trees most sensitive to night lights are elms and sycamores, which happen to be the most common trees in cities. Dogwoods, birches, and some maples are also affected. A single footcandle of light—enough to read a newspaper by—interferes with the dark-light cycle of these trees, according to research at the U.S. Agriculture Department's Beltsville Maryland laboratory.

Much of the overlighting is attributed to high-pressure sodium lights in vogue since the mid-1960s. They can bathe a tree with 20 footcandles making it grow rapidly and not lose its leaves before the first killing frost. This causes late autumn dieback and accompanying root damage. The trees become more sensitive to air pollution and other hazards, says H. Marc Cathey, a research horticulturist for the Agriculture Department. Several years of such cycles may kill a tree.

Cathey, former president of the American Horticultural Society notes that young trees are the most susceptible to damage. But things are changing. High energy prices have led many cities to shut off some of their high-powered lights. Some municipalities have installed low pressure sodium lights which do not cause perceptible tree changes. As planners become more aware of the needs of trees, Cathey says they may put shields on lights directing the illumination only where needed. Or they can plant less sensitive trees, such as oaks and evergreens.

"Man is but a reed, the weakest in nature, but he is a thinking reed."

—Blaise Pascal
The foremost authority on intelligent machines calls for a remote-controlled economy

TELEPRESENCE

BY MARVIN MINSKY

Teaching machines how to think for themselves is what Marvin Minsky does best. As founder of MIT's artificial intelligence laboratory, Minsky directs one of the world's leading research groups in computers and robotics. In this exclusive essay the cyberscientist from Cambridge proposes a 20-year plan that will alleviate the painful side effects of modern civilization.

You don a comfortable jacket lined with sensors and musclelike motors. Each motion of your arm, head, and fingers is reproduced at another place by mobile, mechanical hands. Light, dextrous, and strong, these hands have their own sensors through which you see and feel what is happening. Using this instrument you can work in another room, another city, another country, or on another planet. Your remote presence possesses the strength of a giant or the delicacy of a surgeon. Heat or pain is translated into informative but tolerable sensation. Your dangerous job becomes safe and pleasant. The crude robotic machines of today can do little of this. By building new kinds of versatile...

Minsky and his 14-period three-allowed computer controlled hydraulic muscle mechanical arm.

PHOTOGRAPHS BY DAN MCCOY
remote-controlled mechanical hands — however, we might solve critical problems of energy, health, productivity, and environmental quality and we would create new industries. It might take 10 to 20 years and might cost $1 billion — less than the cost of a single urban tunnel or nuclear-power reactor or the development of a new model of automobile.

To convey the idea of these remote-control tools, scientists often use the words teleoperators or teleoperators. I prefer to call them telepresentations, a name suggested by my future friend Pat Guion. Telepresence emphasizes the importance of high quality sensory feedback and suggests future in a context that will feel and work so much like our own hands that we won’t notice any significant difference.

Telepresence is not science fiction. We could have a remote-controlled exoskeleton by the twenty-first century if we start planning now. The technical scope of such a project would be no greater than that of designing a new military aircraft.

A genuine telepresence system requires new ways to sense the various motions of our hands. This means new motors, sensors and lightweight actuators. Prototypes will be complex, but as designs mature much of that complexity will move from hardware to easily coded computer software. The first ten years of telepresence research will see the development of basic instruments: geometry mechanics sensors, actuators, and control theory and its human interface. During the second decade we will work to make the instruments rugged reliable and natural.

These Mike Island really needed telepresence. I am appalled by the nuclear industry’s inability to deal with the unexpected. We all saw the absurd inefficiency of present-day technology in handling this damage and making repairs to that reactor. Telephones are still waiting to conduct a thorough inspection of the damaged plant — and to absorb a $60 million cost of repair in just a few minutes. The cost of repair and the energy losses will be around $1 billion; telepresence might have cut that expense to a few million dollars.

The big problem today is that nuclear plants are not designed for telepresence. Why? The technology is still too primitive. Furthermore, the plants aren’t even designed to accommodate the installation of advanced telepresence when it becomes available. A vicious circle.

Perhaps you have seen the current style of remote-control arms used at nuclear facilities. They are little better than props, unable to do many things you can do with your own hands. Anyone can buy a simple remote manipulator off the shelf. It usually consists of an input unit for the operator to control and an output device that does the work. Typically the input is a handle attached to a jointed arm-like device. When you squeeze the handle a grasper closes at the output. But such device demonstrates true telepresence? The remote grasper may well imitate the motion of your hand, but the remote arm does not follow your arm’s curves, and so you cannot always reach around obstacles. The dynamics are unrealistic, and the kaleidoscope on a shoulder elbow and wrist motions. The hands have unnatural wrists. The conventional gripper can pinch or grasp but can’t twist shear or roll. They can’t use ordinary scissors. Instead, someone has to remove the hand and replace it with a special tool for that particular task.

If people find this more engineering courage and tried to make these hands more like human hands, modeled on the physiology of the palm and fingers, we could make nuclear-reactor plants and other hazardous facilities much safer.

My first vision of a remote-controlled economy came from Robert A. Heinlein’s prophetic 1948 novel. Waldo. I suppose Heinlein had heard of my brain’s disuse; a disease causing profound muscle weakness. His hero, Waldo, a wealthy young man, was afflicted with it. So Waldo contracted a satellite and mental telepresence device. He could leave in zero gravity and control it with his mind. He would control devices with his mind and operate his inventions effortlessly. Waldo created dozens of mechanical hands, some monkeys and cats in some micromotors in spin on nuclear reactors, and some that each “hand” spread six meters from little fingers to thumb. The hands insisted everything he did; he spent all his time out in space operating factories on Earth. Thirty years after Waldo, Heinlein had many suggestions for this article.

Developing telepresence will involve hand scientific and engineering problems. It is true that we should go ahead. Present devices are too clumsy, they are used only when nothing else works. Once improved, however, telepresence will bring us • Safe and efficient nuclear-power generation: waste processing and land and sea mining • Last year’s Gulf of Mexico accident...
sea oil bidwast is the kind of accident that
I'm convinced telepresence technology could have helped to mitigate.

- Advances in fabrication, assembly, inspection, and maintenance systems. With telepresences one can as easily work from a thousand miles away as from a few feet. Manual labor could easily be done without leaving your home. People could 'form work.' Telepresence of the world could export the specialized skills it has. Anywhere. Abroad. In Botswana or India could market his or her abilities in Japan or Antarctica.

- The elimination of many chemical and physical health hazards and creation of new medical and surgical techniques. If we miniaturize telepresence for use in microsurgery, for example, surgeons could repair or replace many little blood vessels in the brain. Other organs beyond the reach of scalpel and forceps could similarly be repaired or substituted.

- A reduction in transportation costs and of energy and commuting time enabling one person to do different jobs in different places. Mass transportation could be replaced by ubiquitous taxis remotely controlled by teleoperation Telepresence devices could fix sewers, electrical conduits, and water mains from within. Teleoperation will do away with all hazardous and unpleasant tasks.

- The construction and operation of low-cost space stations Telepresence might prove invaluable for solar-power satellite construction — for assembling materials in space and supplies for the human workforce. Telepresence would be able to assemble various orbital structures. There are many places here on Earth more dangerous to humans than outer space. Mines for example. In a remote-controlled mining operation, there are no people to be hurt. A fire in a mine shaft or a collapse would elicit no more response than well, it is very sad. We've lost six robots.

Remote-controlled mining can exploit buried resources efficiently and humanely. No one is exposed to the dangers of explosions or of breathing in coal dust. No more black lung disease. We will mine the meter-thin deposits of anthracite coal now lodged in formations we cannot reach. Under ground combustion and gasification schemes, which are presently uneconomical because they cannot be controlled, may then be feasible.

The biggest challenge to developing telepresence is achieving that sense of being there. Can telepresence be a true substitute for the real thing? Will we be able to couple our artificial devices naturally and comfortably to work together with the sensory mechanisms of human organisms?

When any job becomes too laborious for human hands, it becomes difficult to distinguish the labor and ergonomics of the instrument from what is going on. Telepresence will be able to adjust and compensate for such problems, thus making the job easier. For instance, a remote miner could dig a narrow seam without himself having to stoop or crawl. Machines will incorporate new theories of human sensory pattern perception and feedback control to "reflect" accurately to the user the modified remote sensations.

We have talked of mining but no matter how much coal we mine, we are like it or not becoming dependent on nuclear power. Even if it were to be banned in the United States, we cannot prevent its proliferation abroad. The nuclear designers try to anticipate and avoid all modes of failure. But all reactors have the potential to break down. High temperatures weaken structural materials. Generators apply high pressures to those weakened structures and radiation damage makes inspection difficult while aggravating structural damage and corrosion.

These problems compel designers to choose between two extremes. One is to build each part with monumentally toughness — to minimize human exposure — and hope the system never fails: this is today's designers favorite approach. But in the end breakdown and failure occur anyway requiring men's intervention. Even a minimal failure shuts down a reactor for months.

I think the better extreme is to build modular systems that permit periodic inspection, maintenance, and repair Telepresence would prevent crises before they could arise.

If no one were in the buildings, no one would be exposed to radiation. Then we could all stop quarring about "tolerable" and "threshold" doses. If nothing entered or leaves the reactor except by way of telepresence machines, no one can steal anything. Computers — or skeptical people — can monitor for unusual activities over viewing channels. This allows few opportunities for sabotage and makes it easier to combine power generation, fuel processing, and waste management.

We can employ telepresence in any environment alien to humans. Most of the world, for example, is ocean. "Moonwalks" on the ocean floor at two miles depth are technically more difficult to execute than moonwalks on the moon or Mars. Remotely operated seafloor "construction crews" could bypass the prohibitive hazards of manned exploration, avoiding the risk of weather-troubled ships and treacherous tides in mining on the continental shelf. The U.S. Office of Naval Research has some remote-controlled deep-sea exploration projects, and eventually such systems will explore for and extract deep-sea petroleum and minerals. Eventually entire underwater industrial plants could be so controlled from the surface.

There are already some underwater manipulators. The Alvin submersible, at Woods Hole Massachusetts, is wondrous, but its manipulator is used mainly for picking up samples. You couldn't tie a knot with it. I'd like to see one that can do anything from firing a grenade.

In space the amazing success of Viking 1 and 2 shows how much can be done with remote control — even with day-long transmission delays. Yet the Viking spacecraft had pathetic limitations. There was no way to reconfigure the equipment to make use of what was learned, a week of breathless planning was required just to get Viking 2 to turn a stone over.

I think the best way to explore the planets is to have people in orbiting spacecraft to operate telepresences that maneuver on the surface. A Mars Rover with good telepresence manipulators can make extensive excavations, then reconfigure scientific equipment to exploit what has been discovered.

Think how much more we could have learned with a permanent vehicle on the moon. The Earth-Moon speed of light delay is short enough for slow but productive remote control. With a lunar telepresence vehicle making short traverses of one kilometer per day we could have surveyed a substantial area of the lunar surface in the ten years that have slipped by since we landed there.

Among the most exciting prospects for solving our energy woes is to build a ring of solar power satellites in orbit around Earth. Solar power satellites could then be collected and beamed back to receivers located near our cities. The main problem is the cost. We must put sufficiently large structures in space to gather enough sunlight. Since each station requires thousands of acres of reflectors and collectors, and there's the cost of sending people into space to build them.

Telepresence could save billions of dollars by employing remote-controlled hands stationed in orbit and controlled by technicians on Earth and on the moon. Most satellite construction could be done by people working in their own homes and offices. To circumvent the cost of lifting satellite payloads against Earth's powerful gravity scientists have been devising ways to manufacture and launch materials directly from the moon or from the asteroids. Building such lunar facilities, however, would be impossibly expensive if carried out entirely by men in space suits on the moon.
stead why not use cheap Earth-based labor via telepresence to build moon factories? Imagine having to go no farther than your study to operate a crane on Mare Imbrium. We need only send telepresence machines on inexpensive one-way trips.

The scenario includes sending 20 real men and women to the moon. It's not very difficult. Saturn 5's have the potential to send up a crew of scientists and engineers with many months' supplies. (If only they didn't have to bring them back!) So we ferry up a return vehicle for use in emergencies. Then we send up more permanent housing and finally the super flexible telepresence equipment needed to construct the first lunar installations. The people are there to supervise the work and to fix the equipment when necessary.

One major obstacle to all this has been NASA's legislated inability to deal with such far-reaching concepts as telepresence. The U.S. space program is entirely mission-oriented. NASA never gets appropriations to make better manipulators or navigational devices as things in themselves. Even so, scientists at Ames Research Center in California managed to develop a startlingly nice telepresence: a remote-controlled space suit. It looks like a real space suit - you put your arm into the master suit and the slave suit moves just like your arm. It's an extremely good arm - a perfect imitation. Your arm feels natural in it. But it doesn't have any hand.

The space shuttle too has an arm. It is very long, and it takes about half a minute to complete any motion. But there isn't any reason to hurry. In zero gravity nothing weighs anything, so one can use a 100-pound long, slender pipe to move a 10-ton load very slowly. (There's a simulator for this at Marshall Space Flight Center in Alabama. It is a model of the fuel tank of the space shuttle - a helium balloon about as big as a house. Sitting in its hangar, it weighs nothing. When you press on it, no movement occurs for about 30 seconds, but then it begins to move - if you grab on to it, it pulls you right up, too, because it has no weight. You can lift it with your hand, but it has a mass of half a ton.)

While the shuttle arms are merely glorified construction cranes, they are the beginnings of giant teleoperators. At the other end of the size spectrum, biologists have long used micromanipulators - tiny teleoperators. But none of them have any sensors. If we were to miniaturize telepresences for surgery, we could develop touch reflecting micromops or slender probes that reach through the vessels narrowest passages. Further in the future a surgeon could direct a semi-intelligent procedure including several simultaneous microtelepresences, to make smaller repairs swiftly.

The first crude remote-controlled mechanical hands were built around 1947 at Argonne National Laboratories in Illinois for handling dangerous chemicals. In 1954 the late Ray Goertz, a scientist at Argonne...
developed hands in which electric motors 'reflected' some of the forces back so that the operator could feel something of what was happening at ideal resistance and pressure if not textures. Paradoxically, the very first telepresence could relay sense of feel better than later electric models could, because they used rigidly linked cables and pulleys. Later electric motors were stronger and could work at greater distances, but they lost that sense of feel one got through the cables. More advanced models measured forces at the output and used additional motors to reflect those forces back to the user's hands. When the remote claw hit something, the input became harder to push. This helped but the force reflection was still inadequate for performing delicate work.

Early pioneers like Goertz had the fantasy of building better robots of various kinds and then people got interested in my field, artificial intelligence—getting robots to do smart things. And we did get them to do simple mechanical things, some factory work like assembling a motor. But they were always handicapped by those terrible claw hands.

To create true telepresences we must supply more natural sensory channels—touch pressure textures vibration. We must learn which sensory detectors are most tolerable. In 1956 Ralph Mosher, an engineer working for General Electric, developed a telepresence—called Handiman—that had good dexterity and compensation. It had only two fingers, but those fingers each had three joints so that they could wrap around any object. Handiman could lift hundreds of pounds, transformed you into a superperson. But it was never put to any practical use. Mosher subsequently made a simpler version that permitted him to sit in a chair and pick up refrigerators.

Another big manipulator was designed and built in the late Fifties as part of a project to build nuclear airplanes. But Congress had decided the plane was designed to stay aloft for a year without landing, wouldn't be safe.

Although basically little work has been done since the Fifties, there now exist a few more versatile experimental manipulators. Electrotechnical Laboratory in Tokyo has made a three-fingered, 12-jointed hand that can roll a baron. But that's about all it can do. A group at Stanford University invented a long, snake-like tentacle that can wrap around objects. It once built a 14 joint multi-elbowed arm that can easily reach around things in its way. But no project has the resources to perfect any such ideas.

I think we should make telepresences that compare well with the human hand—a five-fingered device capable of mimicking natural motions. It should be mobile. We might then adapt designs and concepts from the arm to make legs yielding a system able to work wherever people can not only on carefully prepared floors.

To control such an instrument, we will want a light, well-articulated sleeve that includes effectors to reflect the sensations. This will require advanced materials and new muscle-imitating devices, for visual feedback we'd need slender fiber-optic picture articulated to emulate the operator's head and eye motions. We probably would have to have an eye of some sort on the fingers.

A Phico engineer named Steve Moulton made a nice telepresence eye. He mounted a TV camera atop a building and wore a helmet so that when he moved his head, the camera eye on top of the building moved, and so did a viewing screen attached to the helmet.

Wearing this helmet, you have the feeling of being on top of the building and looking around Philadelphia. If you 'lean' over, it's kind of creepy. But the most sensational thing Moulton did was to put a two-to-one ratio on the neck so that when you turn your head 30 degrees the mounted eye turns 60 degrees you feel as if you had a rubber neck as if you could turn your head completely around.

Why did telepresence stop evolving 20 years ago? One reason is that research funds while costs escalated by 1960. No laboratory could afford to take another step. But a more fundamental reason for this stagnation is that engineers are far too clever at solving immediate problems. This has led to endless repetition of the same scenario. An application needs a better manipulator for example, to join two pipes together an existing mechanical hand would help. But only if it had another joint in one of its fingers. One must add another control channel design a new sensor and input feedback device, modify a microcomputer program retrain the operators and reengineer the older tools. All this puts enormous strain on a company's budget. Ultimately pipe fittings are redesigned so that the old, clumsy hand can manage.

A good production engineer can solve almost any specific problem by using a special jig, fabricating a new part, developing a special tool for the hand, or replacing the hand with a special tool. Each problem gets solved, to be sure, but the overall technology becomes antiquated and goes unnoticed until an accident such as the one at Three Mile Island or the Mexican oil spill occurs and we find out there is no way at all to turn valve from afar or to replace it.

Several major companies have been involved in telepresence research from time to time—AMF Hughes, General Mills, IBM, and others—but none of them have reached critical mass. Many smaller firms possess more precious skills—Unimation, Central Research Laboratories, Programmed and Remote and others The Defense Advanced Research Projects Agency working with the army once supported work on powered armored suits, like those in Hantleman's Starship Troopers but the work was abandoned. University workers have had many good ideas, designs, and prototypes, but they could never afford to engineer complete systems. There are important projects at Carnegie, MIT Jet Propulsion Laboratory Stanford, and other university labs.

Part of the problem has been that telepresence has been seen as anybody's baby. Such a project demands centralization. It requires imaginative specialists in sensors, effectors, control theory, artificial intelligence, software engineering, psychology, and first-class facilities for mechanical and electrical engineering and materials science. It will need strong resources for interactive computation and for real-time physical simulation.

It would be difficult to assemble such an organization in today's peace time atmosphere. What we need is a modern league of working centers connected by a computer network. Such a network would contain a central data bank somewhere in the United States, combining administrative and engineering resources that need centralization. Perhaps there could be computer centers closer to universities or industrial locations. We should look toward communications networks such as ARPANET (the computer conferencing network of the artificial intelligence community).

I can't imagine anyone doubting that telepresence is possible. It is a matter of solving many problems that are hard but not impossible. In the mechanical area the same things have been done over and over again. And engineers spend their time arguing about what kind of wrist is best. Some think the wrist should go round and round, spinning forever, especially on a robot that's using a screwdriver. That's all right for the industrial robot, but there isn't much point in that for a telepresence because you can't spin your own wrist around to control it.

Some research has been done in the psychology of spatial perception in terms of feedback controls and the interaction between electronics and the human nervous system. There is a device, for example, that translates points into feel developed by J. C. Bliss and J. G. Linvill at
Stanford, which enables the blind to read conventional printed matter. It's a gadget that fits conveniently on a finger tip and has a lot of miniature phot cells to sense light and a lot of little vibrators that allow the finger to sense remotely the fine shape of the letters in my own laboratory. Graduate student Danny Hillis recently fabricated a thin skinlike material that can 'feel' and transmit small tactile surface features.

Someone could develop similar devices for telepresence—vibrating patterns for example that would convey the sensations of hot or cold. However, very little is known about tactile sensations. It seems quite ironic to me that we already have a device that can translate print into feel, but that we have nothing that can translate feel into feel.

Eventually telepresence will improve and save old jobs and create new ones. Later as we learn more about robotics many human telepresence operators will be able to turn their tasks over to the robots and become 'supervisors.' In the long run since each step toward telepresence is a step toward robots, telepresence sensors and output devices could be controlled by computers rather than by people. This becomes inevitable as we learn more about artificial intelligence.

Computers equipped with artificial hands and eyes have actually grasped and moved objects in accord with verbal commands. A complicated precision bearing was so assembled at MIT an entire pump was put together at Stanford, a toy automobile was constructed in Edinburgh Scotland. Similar work has been done at SRI International. These laboratory programs are too expensive for practical use, because, although we can do many things with computers, we cannot get them to do many things any child can do. Someday our machines could do all our work for us, but it is not a long way off and it would need another whole article to begin to explain the problem.

If teleoperator technology promises wealth and freedom beyond dreams is there a dark side? People who issue manifestos should think about such matters. The solution may be to grant those who want to live in the old ways their chance while those who want new gifts should also have theirs. I think the gifts promise better, richer, and longer lives. Might telepresence, though have a special tendency to make workers feel alienated? Perhaps yes even with superb technology. Many jobs will become intensely more interesting and more creative. Many worlds will be expanded.

If each step toward telepresence were also a step toward the economic pain and psychic grief of unemployment, one might consider working against it. Yet a generation of reforms is already eliminating many of the unsafe jobs that telepresence could preserve. Telepresence offers a free market of men and women's skills, rendering each worker less vulnerable to the moods and fortunes of one employer.

Finally in a strange sense, the question of 'technological unemployment' may become moot. Many young people today consider it demeaning to be bound to any single employer, occupation, or even culture. Perhaps many of us sense—at least on some level—that little of what we do really has to be done. Our attitudes about work, about the changing quality of it, depend as much on our own dispositions and our alternatives as on the jobs themselves. In effect, most of us already feel technologically unemployed.

Postscript from the London Telegraph Foreign Service

Paris—The French government has authorized Electrotele de France to go ahead with planning two new nuclear-power stations with enriched uranium fuel. The approval came despite the detection in 1978 of cracks several millimeters wide in the tube end plates of the steam generators and in the tubes connecting them to the reactors. The existence of the cracks was disclosed by nuclear engineers who choose to point out that once the reactors go into operation, repairs would be impossible for lack of appropriate robotic equipment. François Kosowsky-Monnet, government director of industrial quality and security, countered that the defects were very carefully examined and were found to be superficial. In the worst of hypotheses, the cracks would not give trouble for five to six years by which time repairs would be easy he said since from 1981 on France would have robots able to repair such defects automatically. [Italics mine—M.M.]

Since France is walking the tightrope of possible power shortages and Electrotele de France has warned that possible power cutbacks may be necessary, the government has decided that the economic risk of holding up the electricity generation timetable by repairing the reactor cracks now is greater than the danger of serious accidents later.

My work in artificial intelligence is carried on in a world as much fiction as science. This essay used specific suggestions from Isaac Asimov and Robert A. Heinlein as well as from Carl Sagan, Brian O'Leary, Edward Purcell, and many others.

RETURN FROM THE STARS

BY STANISLAW LEM

Do I heard the word had probably been said more than once, but I did not immediately realize that was spoken to me. I started to turn around, but the chair, quicker than I, did this for me. Standing in front of me was a girl, perhaps twenty years old, in black dress of her. Her arms and breasts were hidden in a navy blue fluff that became more and more transparent as it descended. Her dim, lovely body was like a sculpture in breathing clouds. Long black chaps covered her feet. At least most of them. Her bare skin, as if unplanned, was revealed also in...
She did not even come up to my shoulder
She had a catlike head, black hair—a profile perhaps too sharp, but she was pretty if it weren't for those scarlet nostrils.

Luminous blood coursed in the furniture pale green, commingled with pink sparks.

"Why don't you sit down?"
She was standing far back. An armchair unfolded itself to receive her. I hated that. The "glass" was not glass at all—the impression I had was of sitting on inflated cushions and looking down. I could see the floor indistinctly through the curved, thick surface of the seat.

I made myself comfortable in the chair. The girl, her hand on her hip—her abdomen really did look like a sculpture in azure metal—stunned me carefully. She no longer appeared drunk. Perhaps it had only seemed that way to me before.

"What's your name?" she asked.
"Bregg Hal Bregg And yours?"
"Nans," she answered then asked, "How old are you?"
"Curious manners. I thought—but if that's what's done."
Forty. What about it?
"Nothing. I thought you were a hundred."
I had to smile.
"I can be that if you insist. The funny thing is, it's the truth. I thought—"
"What can I give you?" she asked.

To drink? Nothing. thank you 'All right'.
She went to the wall, which opened like a small bar. She stood in front of the opening. When she returned, she was carrying a tray with cups and two bottles. Squeezing one bottle lightly, she filled me a cup to the brim. The liquid looked exactly like milk."
"Thank you," I said, "not for me."
"But I'm not giving you anything," she said, seemingly surprised.

Seeing I had made a mistake, although I did not know what kind of mistake. I muttered under my breath and took the cup. She poured herself a drink from the second bottle. This liquid was oily colorless and slightly effervescent under the surface. At the same time it darkened, apparently on contact with air. She sat down and touching the glass with her lips casually asked, "Who are you?"

"A col," I answered. I lifted my cup as I to examine it. This milk had no smell. I did not touch it.

"No seriously," she said. "You thought I was shanding in the dark, eh? Since when? That's only a col. I was with a six you see, but it got awkwardly. The one was no good and altogether. I was just going when you sat down."

Some of this I could figure out. I must have sat at her table by accident when she was not there, could she have been dancing? I maintained a tactful silence.

From a distance, you seemed so...

She was unable to find the proper word.
"Decent," I suggested. Her eyelids fluttered. Did she have a metallic film on them as well? No, it must have been eyeshadow.
"What does that mean?"
"Well—um—someone you could trust—"
I said.
"You talk in a strange way. Where are you from?"

"From far away."
"Mars?"
"Father."
"You fly?"
"I did fly."
"And now?"
"Nothing."

"I returned."
"But you'll fly again?"
"I don't know."

The conversation had trailed off somehow. It seemed to me that the girl was beginning to regret her rash invitation and I wanted to make it easy for her.

"Maybe I ought to go now," I ventured. I still held my untouched drink.
"Why?" She was genuinely surprised.
"I thought that would suit you."
"No," she said. "You're thinking—no what for. Why don't you drink?
"I am drinking."
"I replied.

It was milk after all. At this time of day, in such circumstances! My surprise was such that she must have noticed it.

"What is it bad?"
"It's sugar," I said. "I must have looked like a complete idiot."

I sighed and started to get up.

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Listen, Nais. I think I'll go now. Really it will be better that way.

"Then why did you drink?" she asked.

I looked at her in silence. She had not changed so very much. I didn't understand a thing. Not a thing. It was they who had changed.

"All right," she said. "I'm not keeping you. But now this—"

She was confused. She drank her lemonade—what I called the sparkling liquid in my thoughts—and again I did not know what to say. How difficult all this was!

"Do you want to—"

"Okay, and then you'll tell me?"

"Yes."

I was at the Cauva. In the second year I've been neglecting things a bit lately. I wasn't plasting regularly, and that was how it was been. My self was too interesting. So really it was—"I don't have anyone. It's strange.

"What is it?"

I don't have

Again these obscurities. Whom was she talking about? Whom didn't I have? Parents? Lovers? Acquaintances?

And what else? I asked and since I was still holding the cup, I took another swallow of that milk. Her eyes grew wide in surprise. Something like a mocking smile touched her lips. She drained her cup, reached out a hand to the flabby covering on her arms, and tore it. She did not unbutton it did not sip it off, but tore it, and let the shreds fall from her fingers like trash.

But then we hardly knew each other. She was trent. She smiled. There were moments when she became quite lovely particularly when she narrowed her eyes and when her lower lip curling revealed glistening teeth. In her face there was something Egyptian. An Egyptian cat. Her blacker than black. When she pulled the terry fluff from her arms and breasts I saw that she was not nearly as thin as I had thought. But why had she ripped it off? Was that supposed to mean something?

"Your turn to talk," she said, looking at me over her cup.

"Yes. I asked, and felt false as if my words would have God knows what consequence. I am, I was a pilot. The last time I was there, don't be frightened.

"No."

Go on.

Her eyes were shining and alert.

It was a hundred and twenty seven years ago. I was thirty then. The expedition I was a pilot on the expedition to Fomalhaut. That's twenty three light years away. We flew, there and back in a hundred and twenty seven years, Earth time, and ten years, ship time. Four days ago we returned. The Prometheus—my ship remained on Luna. I came from there today. That's all.

She stared at me. She did not speak. Her lips moved. Opened closed. What was that in her eyes? Surprise? Admiration? Fear?

"Why do you say nothing?" I asked.

"So, how old are you, really?"

Again I smiled, it was not a pleasant smile.

What does that mean—really? Biologically I'm forty but by Earth clocks one hundred and fifty seven.

A long silence then sudden: 'Were there any women there?'

"Wait. I said. 'Do you have anything to drink?'

"What do you mean?"

Something toxic: you understand. Strong Alcohol or don't they drink it anymore?

Very rarely, she replied softly as if thinking of something else. Her hands tell slowly. Touching the metallic blue of her dress I'll give you some—apanen—is that all right? But you don't even know what it is do you?

"No?" I said. "I rivalized with an unexpected stubbornness. She went to the bar and brought back a small bulging bottle. She poured me a drink. It had some alcohol in it, but there was something else that gave it a peculiar bitter taste.

Don't be angry. I said. Emptying the cup, and poured myself another one. I'm not angry. You didn't answer but perhaps you don't want to?

Why not? I can tell you. There were twenty three of us altogether, on two ships. The other ship was the Ulysses. Five pilots to a ship, and the rest—scientists. There were women.

Why?

Because of children. I explained. You can't raise children on such ships and even if you could, no one would want to. You can't fly before you're thirty. You have to have two diplomas under your belt and four years of training. Twelve years in all. In other words, women at thirty usually have children.

And you?" she asked.

I was single. They selected unmarried ones. That is—volunteers.

You wanted to?

Yes. Of course.

It must be weird—coming back like this, she said, a whisper. She shuddered. Suddenly she looked at me. Her cheeks darkened, it was a blush.

So that's what a cigarette looks like.

No wait—the other thing is more important.

But is not milk. I don't know what's in it, but—to a stranger—one always give brit.

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Omni
"I suppose the way it has always been
What can have changed?"

"Everything When I left—don't take this
the wrong way—a girl like you would not
have brought me to her place at this
hour"

"Really? Why not?"

"Because it would have meant only one
 thing
She was silent for a second
 And how do you know it didn't?"

She began to laugh she was convulsed
with laughter Then suddenly she broke off,
looked at me, and reddened terribly

"So you thought—but you thought that I
 no?"

I pulled a cigarette from my pocket and lit it.

"What is that?
 A cigarette. What—you don't smoke?"

"It's the first time I ever saw one. So
that's what a cigarette looks like. How can
you inhale the smoke like that? No, wait—
the other thing is more important. Brit is not
 milk. I don't know what's in it, but—to a
 stranger—one always gives brit
 To a man?
 "Yes"

"What does it do?"

"What it does is that he behaves that he
has to. You know. Maybe some biologist
can explain it to you.

"To hell with the biologist Does this mean
that a man to whom you've given brit can't
 do anything?"

"Naturally"

"What if he doesn't want to drink?"

"How could he not want to?"

"Here all understanding ended
But you can't force him to drink."

"A mean man might not drink—she said
slowly. But I never heard of such a thing."

"Is this some kind of custom?"

"I don't know what to tell you. Is it a cus-
tom that you don't go around naked?"

"Ano. Well in a sense yes. But you can
undress on the beach."

"Completely?" she asked with sudden
interest.

"No. A swimsuit. But there were groups of
people in my day called nudists"

"I know No that's something else. I
thought that you all"

"No. So this drinking is a like wearing
 clothes. Just as necessary?"

"Yes. When there are two of you
Well and afterwards?"

"What afterwards?"

"The next time?"

This conversation was idle and I felt
terrible, but I had to find out

"Later? It varies. Some you always
give brit."

"The rejected suitors, I blurted out"

"What does that mean?"

"No. Nothing. And if a girl visits a man
what then?"

"Then he drinks it at his place."

"She looked at me with pity. But I
was stubborn"

"And when he hasn't any?"

"Any brit How could he not have it?"

"Well, he ran out. Or he could always
lie."

She began to laugh. "But that's
You think that I keep bottles here in my
apartment?"

"You don't? Where then?"

"Where they come from. I don't know
in your day was there tap water?"

"There was I said glumly. There could
not have been of course. I could have
climbed into the rocket straight from the
forest. I was furious for a moment, but I
calmed down. It was not after all her fault."

"There you see! Did you know in which
direction the water flowed before it

"Understand. No need to go on. All right.
So is it a kind of safety measure? Very
strange How long does brit work?" I asked.

"She blushed slightly
"You're in such a hurry. You still don't un-
derstand anything."

"I didn't say anything wrong. I defended
myself. I only wanted to know why are
you looking at me like that? What's the
matter with you? Naos!"

She got up slowly. She stood behind the
armchair

"How long ago—did you say? A hundred
and twenty years?"

"A hundred and twenty seven. What
about it?"

"And were you betrothed?"

"What is that?" she said glumly

"You weren't?"
I don't even know what it means. "Nais girl, what's the matter with you?"
No, you weren't, she whispered. "If you had been, you would know."
I began to go to her. She raised her hands.

"Keep away! No! Not a beg you."

She retreated to the wall.

But you yourself said that but... I'm sitting now. You see. I'm sitting. Calm yourself! Tell me what it is—this better or whatever.

"I don't know exactly. But everyone is betrizated. At birth."

"What?"

"They put something into the blood, I think.

"Do they do it to everyone?"

"Yes. Because it doesn't work without that. Don't move."

"Child, don't be ridiculous."

I crushed out my cigarette.

"I am not a wild animal. Don't be angry but it seems to me that you've all gone a little mad. This but... Well, it's like handcuffing everyone because someone might turn out to be a thief. I mean, there ought to be a little trust."

"You're terrible."

"She seemed calmer but still she did not sit. Then why were you so indignant about my bringing strangers home?"

"What's something else?

"I don't see the difference. You're sure you weren't betrizated?"

"I wasn't."

"But maybe now? When you returned?"

"I don't know. They gave me all kinds of shots. What importance does it have?"

"It has. They did that? Good"

She sat down.

"I have a favor to ask you."

"I said as calmly as I could. You must explain to me.

"What?"

"You fear. Did you think I would attack you, or what? But that's ridiculous."

"You'd understand if I told you. Betrization you see isn't done on but. With the but it's only a side effect. Betrization has to do with something else."

She was pale.

"Her lips trembled."

"What a world! I thought what a world this is!"

"I can't. I can't ever."

"Or me?"

"Yes."

"I swear that."

"No. I believe you. Only no you can't understand this."

"You won't tell me?"

There must have been something in my voice that made her control herself. Her face grew grim. I saw from her eyes the effort it was for her.

"It is so that... in order that it be impossible to kill..."

"No. People?"

"Anyone."

Animals too?"

"Animals—anyone."

She twisted and un twisted her fingers. Not taking her eyes off me, as if with these words she had released me from an invisible chain as if she had put a knife into my hand—a knife I could stab her with.

"Nais. I said very quietly. "Nais don't be afraid."

She tried to smile.

"Listen."

"Yes."

"When I said that..."

"Yes."

"You felt nothing?"

And what was I supposed to feel?

"Imagine that you are doing what I said to you."

"That I am killing? I'm supposed to picture that?"

She shuddered.

"Yes."

"And now?"

"And you feel nothing?"

"Nothing. But then it's only a thought and I have not the slightest intention."

"But you can?"

"Right? You really can?"

"No, she whispered, as if to herself. "You are not betrizated."

Only now did the meaning of it all hit me. I understood how it could be a shock to her. This is a great thing. I mumbled. After a moment I added: "But it would have been better perhaps had people ceased to do it without artificial means."

"I don't know."

"Perhaps she answered."

She drew a deep breath. "You know now why I was frightened?"

"Yes, but not completely. Maybe a little."

"But surely you didn't think that?"

"How strange you are! It's altogether as if you weren't."

She broke off.

"We're all human."

"I didn't mean to offend you. It's just that..."

Continued on page 39
Feeling lost in the crowd? Cheer up! Science has found new ways to show just how special you are.

THE UNIQUE YOU

BY RICHARD HUTTON AND ZSOLT HARSANYI

We are entering the Age of Anonymity. As we struggle to remain individuals, our complex society increasingly identifies us by faceless numbers. We may soon live as units within an immense equation, only a digit, decimal, or binary zero removed from the next guy.

This slow slide toward sameness has compelled many people to search for new ways to reaffirm their individuality. Some go off to seek their roots—the number of genealogical organizations in the United States has grown from 200 in 1956 to more than 800 at present, and mail-order business in family coats of arms is booming. Other people, according to Queens College sociologist Paul Blumberg, try to manufacture individuality by wearing rhinestone tuxedos and running shoes or by rummaging around for distinctive status symbols and esoteric hobbies. For them, possession offers a...
claim to uniqueness. Their identities derive from their ability to own something handmade, homemade, self-made — something in short that no one else has.

The situation may seem pretty grim but our salvation lies close at hand. It has, in fact, been here all along. Nature has wisely endowed each of us with unique characteristics that not even the postindustrial age can steal. And science is getting ever better at measuring and highlighting them.

The late Theodore Dobzhansky of Rockefeller University noted the staggering number of possibilities that exist in the human gene pool. If all the imaginable characteristics are added up, he said, the number of potentially possible gene constellations turns out to be greater than the number of subatomic particles estimated by physicists to exist in the universe.

So while society pushes us toward conformity, nature keeps pulling for variation and change. And while-many institutions persist in trying to transform us into social clones, our internal blueprints ensure that we remain unique and uncopiable as original, exceptional, and singular as flakes of snow.

Dozens of characteristics contribute to the uniqueness that distinguishes us from one another. Possible identifiers range from facial profiles and hand shapes to the patterns of blood vessels in our eyes. Other traits may not become significant for decades, but these are in use today or are right on the horizon. They can identify one John as Travolta and another as Olivia Newton as easily as we can tell grease from water.

Our bodies are composed of many materials, and primary among them are proteins, the structural and functional building blocks of cells. Proteins come in all shapes and forms, and most proteins display a range of clearly discernible variations.

Because many tribes, races, and religious communities around the world tend to isolate their gene pools by breeding protein variations can now be used to identify members of these groups. For example, red blood cells contain a protein called phosphatase, that is a blend of three structural variants known as pA, pB, and pC. Native Greeks as a group, have a distribution of 22 percent pA, 71 percent pB, and 7 percent pC. The Yanomama Indians of Venezuela have only pA, and Alaskan Eskimos have 56 percent pB and 44 percent pC.

This might seem important only if a detective, muse, orastic-looking man were wandering through the streets of Juneau, Alaska, but anthropologists have used these and other biological markers to trace migration, breeding, and evolutionary patterns in human populations. In addition, protein typing has been used to determine parentage in many paternity suits.

Because every person is a unique island floating in a sea of microorganisms, germ types can also be used to tell us apart. From birth we are surrounded by bacteria, fungi, and viruses of all kinds. A few are parasitic or exploitative and cause disease but most consider us their homes and breed happily and harmlessly in colonies throughout our bodies.

Different populations of microorganisms get established in various parts of the human body. Because our body surfaces and orifices vary in their acidity, texture, and secretions, our intestinal microorganisms actually determine which microorganisms will take up residence where. The remarkable constancy in the way certain microorganisms are distributed on the body of each individual has led to Dr. Melvin Garshman of the University of Maine, to suggest the development of a science of forensic microbiology based upon germ types.

Since microorganisms are living creatures, each species has individual variants within it. Though most people might think that a Corynebacterium Xerosis by any other name is still a Xerosis, each germ has its own recognizable characteristics. So we can be identified not only by the distribution of our germ populations but also by the individual microorganisms themselves.

YOUR ODOROUS IDENTITY

One common microorganism activity offers another way to identify us — smell. Prints are not only carriers of an identifiable odor but leaves a trail of it behind them — a fact that every dog's nose knows. We differ from one another across the entire spectrum of odors that emanate from our bodies: more than 100 constituents make up our unique olfactory signature. Engineers have reasoned for years that if a dog can differentiate individual smell patterns, a machine could do the same without having to be fed.

People emit both general and specific odors. Women, for example, emit volatile substances that vary with their monthly menstrual cycles. One investigator discovered that if the animal had been born by pregnant women or by women in the latter stages of their menstrual cycle. Other specific odors that make us attractive or repulsive to mosquitoes are now being identified so that effective repellents can be manufactured.

An individual's smell can be distinguished from the smell of his clothes, residence, or diet, though all these factors can superimpose their own characteristics at least in part. The olfactory sense is one of the least developed among mammals, however. Most of us have noses that can tell us little more than whether another individual smells fresh or foul. Still individuals with highly refined senses of smell do exist. Freud reported the case of the "rat man," who was able to identify all the people he knew from their smell. One young boy was not only able to detect individual body odors but his olfactory sense was so keen that he could even tell which part of the body a particular odor came from.

Such observations have led scientists to theorize that humans might even communicate subconsciously by means of subtle volatile substances. After all, most animals use chemical messengers, which are known as pheromones. These compounds tell an animal when to fight, move to a new territory, become friendly or copulate. If we can respond to the chemical emissions of others, we might actually be doing ourselves and our ability to communicate a great disservice by bathing frequently and by coating ourselves with perfumes, deodorants and douches.

Machines under development today use gas chromatography to analyze and record the patterns of airborne organic vapors from humans. Analysis can now identify chemicals in concentrations below one part per billion—far beyond our own ability to detect odors. Though the technique is still in the experimental stage, it seems likely that we will soon be able to identify individuals by their olfactory signatures.

BLOOD BONDS

An old saying holds that a person's character is written in his blood. Scientists are finding that, in a sense, this is true. Blood varies from person to person.

When most people refer to "blood type" they are thinking of the most common designations, A, B, AB, and O. Hematologists, however, recognize type AB's blood into many intermediate categories. The A-B-O and Rh systems, for example, are but two of more than two dozen blood groups that differ among us.

Knowledge of blood types is important for safe blood transfusions. For preventing hemolytic disease in the newborn, and for transplantation surgery. It has also been used to clear up conflicting claims in cases of doubtful paternity, kidnapping, inheritance, and the inadvertent switching of infants in hospitals.

One of the most useful applications of blood typing is in analyzing reproduction and childbirth. Couples with incompatible blood types, studies indicate, have a higher incidence of childlessness, since women of one blood type can produce antibodies against incompatible sperm cells.

Continued on page 90
This new marriage between satellite and computer promises a garden of earthly delights.

**EARTH SCANS**

By Charles Sheffield

Far overhead in the inky blackness of space, a camera clicks once, twice, then again. Recording and storing images of the blue-green planet below, these images automatically convert to binary bits and are relayed to Earthside computers, there to be reconstructed as high-resolution displays by the Earth Satellite Corporation in Washing-

The photographer is LANDSAT, a satellite so spectacularly useful it silts the objections of those who wonder why we venture into space when there's so much turmoil here on Earth. In the hands of skilled computer technicians, emerging composites of the earth's surface pinpoint valuable mineral deposits, forest resources, and potential croplands. Through color-enhanced infrared imagery, for example, the San Andreas Swell in Utah reveals hidden geological features (left) while the coast of Somalia (below) vividly displays coastal development and water-drainage patterns. The effects of civilization exploit
striking results when seen from space. Center-pivot irrigation systems form bizarre patterns at the Al Kufrah oasis in Libya (right). Off the coast of Indonesia (above), blue swirls outline suboceanic topography and dissolved sediments. The central Amazon basin (far right) is shown using a technique known as digital ratio, which combines three of the four spectral bands (wavelengths) visible to LANDSAT's cameras. When enlarged and coordinated with ground surveys, digital ratios can pinpoint likely places to explore for mineral deposits in the vast Amazon jungle. Atmospheric conditions readily show themselves on the next page, where the Ghadames basin of the
Sahara is host to wind vortices that create star-shaped sand dunes. LANDSAT's ability to freeze-frame a seasonal change captures the autumnal splendor of the Shenandoah Valley near Welch, West Virginia (far left). Two photographs (left and above) are separately processed images of the Namib Desert in South West Africa. The left one shows a false-color infrared process while at top is an 'eigenimage' or combination of the four different spectral bands that make a realistic three-color photograph. As we progress through the Eighties, the vital information needed to preserve our biosphere will often arrive from the ultimate vantage point: space.
Education is about to undergo a revolution unequaled since Gutenberg's moveable type.

By Arthur C. Clarke

We are now witnessing one of the swiftest and most momentous revolutions in the entire history of technology. For more than a century the slide rule was the essential tool of engineers, scientists and anyone else whose work involved extensive calculations. Then just a decade ago, the invention of the pocket calculator made the slide rule obsolete almost overnight, and with it whole libraries of logarithmic and trigonometric tables.

There has never been so stupendous an advance in so short a time. Simply no comparison can be made between the two devices. The pocket calculator is millions of times more accurate and scores of times swifter than the slide rule, and it now actually costs less. It is as if we'd jumped overnight from bullock carts to the Concorde—and Concorde were cheaper! No wonder the slide rule manufacturers have gone out of business. If you have a good slide rule, leave it in your will. It will someday be a valuable antique.

Pocket calculators are already having a profound effect on the teaching of mathematics—even at the level of elementary arithmetic. But they are about to be succeeded by devices of much greater power and sophistication—machines that may change the very nature of the educational system.

The great development in our near future is the portable electronic library—a library not only of books, but of films and music. It will be about the size of an average book and will probably open in the same way. One half will be the screen with high-definition, full-color display. The other will be a keyboard, much like one of today's computer consoles, with the full alphabet, digits, basic mathematical functions, and a large number...
of special keys—perhaps 100 keys in all. It won't be as small as some of today's midget calculators, which have to be operated with toothpicks.

In theory such a device could have enough memory to hold all the books in the world. But we may settle for something more modest like the Encyclopaedia Britannica, the Oxford English Dictionary, and Rogers' Thesaurus. (Incidentally Peter Mark Roget was the inventor of the log-log slide rule.) Whole additional libraries, stored in small plug-in memory modules, could be inserted into the portable library when necessary. All this technology has already been developed; though for other uses. Oddly enough, the most skilled practitioners of this new art are the designers of video games.

Reading material may be displayed as a fixed page or else "scrolled" so that it rolls upward at a comfortable reading rate. Pictures could appear as in an ordinary book but they may eventually be displayed as three-dimensional holographic images. Text and imagery of course, will be accompanied by sound. Today's tape recorders can reproduce an entire symphony on a cassette. The electronic library may be able to play back the complete works of Beethoven while displaying the scores on its screen.

And how nice it will be to be able to summon up Lord Clark's Civilization or Jacob Bronowski's Ascent of Man whenever or wherever you felt like it! (Yes, I know that these tapes currently cost about £2,000 apiece, unless you are lucky enough to have a pirated copy. But one day the BBC will get its money back and thereafter the price will be peanuts.)

I still haven't touched on the real potential of this technology, the opportunity to cure one of the great failings in conventional education, especially in large classes: genuine education requires feedback—interaction between pupil and teacher. At the very least, this allows the student to clear up points he does not understand immediately it provides inspiration as well. Yet I recently met a Turkish engineer who said that all he had ever seen of his professor was the tiny figure up on the platform above a sea of heads. It is a predicament shared by all too many students.

The electronic tutor will go a long way toward solving this problem. Some computer programs already allow the student to carry on a dialogue with the computer asking it questions and answering the questions it asks. Computer-aided instruction—CAI—not to be confused with CTA—can be extremely effective. At best the pupil may refuse to believe that he is dealing with a computer program and not with another human being.

Technology's influence on education is nothing new. There's an old saying that the best educational setup consists of a log with teacher at one end and pupil at the other. Our modern world is not only woefully short of teachers. It's running out of logs but there has always been a shortage of teachers and technology has always been used to ameliorate this—fact that many people tend to forget.

The first great technological aid to education was the book. You don't have to clone teachers to multiply them. The printing press did just that, and the mightiest of all educational machines is the library. Yet this potent resource is now about to be surpassed by an even more remarkable one: a depository of knowledge as astonishing to most of us today as books were to our remote ancestors.

I can still recall my own amazement when at a NASA conference less than ten years ago I saw my first "electronic slide rule." It was a prototype of the HP 35 demonstrated to us by Dr. Bernard Oliver, vice president of Hewlett-Packard. Though I was impressed—admittedly I did not fully realize that something revolutionary had come into the world.

It is quite impossible for even the most farsighted prophet to visualize all the effects of a really major technological development: The telephone and the automobile produced quantum jumps in communication and transportation. They gave ordinary men a mastery over space that not even kings and emperors had possessed in the past. They changed not only the patterns of everyday life, but the physical structure of the world—the shapes of our cities, the uses of the land. This all happened in what is historically a moment of time, and the process is still accelerating. Look how the transistor radio swept across the planet within a single generation.

Though they are not yet as important as books: audiovisual aids such as film strips, 16 millimeter projectors, and videotape machines are rapidly penetrating the educational field. Most of these are still far too expensive for developing countries, however, and I'm not sure they are really worth the cost of producing them.

Perhaps the most influential device of all is the ordinary television set, whether intended for education or not. I'd be interested to know what impact Sesame Street has on the relatively few children of a totally different culture who see it here in Sri Lanka. Still, every TV program has some educational content, the cathode-ray tube is a window on the world—indeed on many worlds. Often it's a very murky window with a limited view but I've slowly come to the conclusion that on balance, even bad TV is preferable to no TV.

The power of television lies in its ability to show current events, often as they are happening. But for basic educational purposes, the video recorder is much more valuable. Its pre-taped programs can be repeated at any convenient time. Unfortunately the chaos of competing systems has prevented standardization and cheap mass production.

Videotape machines, however, are far too complicated; they can never be really cheap or long-lived. Video discs, which are just coming on the market, will be much cheaper yet I am sure that they too will represent a transitional stage. Eventually we will have completely solid-state memory and storage devices, with no moving parts except lasers or electric fields. At the human brain doesn't have any moving parts, and it can hold an enormous amount of information. The electronic memories I'm talking about will be even more compact than the brain—and very cheap. They should be ready soon.

Consider the very brief history of the computer. The first models were clumsy giants filling whole rooms, consuming kilowatts of power and costing millions of dollars. Today only 35 years later far greater storage and processing capacity can be packed into a microchip measuring 1.85 square centimeters. That's miracle number one. Miracle number two is the cost of that chip: not a couple of million dollars, but about $10.

The change has already begun. Computer-aided instruction is now available in many American colleges and high schools. Consoles with typewriter keyboards allow the student to 'talk' to a central computer at any time of day or night, whatever subject he feels like doing, at the rate that suits him. The computer, of course, can talk to hundreds of students simultaneously giving each the illusion that he is the center of attention. It's infinitely patient, unlike most teachers, and it is never rude or sarcastic. What a boon to slow or handicapped students!

Today's CAI consoles are big, expensive, four-foot wide, built wired into the college computer. They could be portable. Already businessmen are traveling the world with attachable case-sized consoles they can plug into the telephone to talk with their office computer thousands of kilometers away. But it is the completely portable and self-contained electronic tutor that will be the next full step beyond today's pocket calculators.

Its prototype is already here. In the near future many of them will be doing the work of clerks, salesmen, and many others they are now doing off the screen during a showing of

**CONTINUED ON PAGE 95**
This scientist-senator would like to see Washington make more room for industry in space — and get its own technological policies in order.

WASHINGTON, D.C., still doesn't know quite what to make of the forty-four-year-old junior senator from New Mexico, Harrison H. (Jack) Schmitt. That's not surprising. After all, the Senate has never before had to take the measure of a futuristic, conservative, ex-astronaut, and geologist.

Schmitt received his Ph.D. in geology from Harvard in 1964, after undergraduate work at Caltech and a Fulbright scholarship in Norway. If NASA had prevailed, Schmitt never would have been able to do fieldwork at Tauhaus-Littrow Valley, the space agency had decided that flight experience was the primary qualification for an astronaut and that a fast course in geology could prepare its test-pilot types for lunar exploration. But protests from the scientific community won a few slots for scientist-astronauts, and NASA taught Schmitt to fly. In 1972 he and the other crewmen of Apollo 17 were the last men to visit the moon — so far.

Schmitt was appointed chief of the scientist-astronauts in 1974, but he could see wider opportunities on Earth. He resigned from NASA, jumped into his pickup truck, and began a year-long campaign for the Senate in his native New Mexico. After sweeping the Republican primary, he defeated incumbent Joseph Montoya by 70,000 votes in November 1976.

When he took his seat two months later, Schmitt began to provoke the puzzlement that remains to this day. His voting record could be a carbon copy of Barry Goldwater's, and his brash personal style (he still drives a pickup truck) is accompanied by few of the smooth skills of compromise that are at a premium in Washington. Yet instead of being a political sport on the ideological fringe, Schmitt is drawing more and more attention as an articulate spokesman for the future. He is the ranking Republican on the Subcommittee on Science, Technology, and Space, where his background makes him more surefooted than most of his colleagues, with their legal and political orientation.

Schmitt was interviewed for Omni by Daniel S. Greenberg, who has covered science and government for many years.
**Omn:** The Mars lander proved the power of a flexible microprocessor ‘brain’ on board an unmanned space probe. Would you still rather be on the scene yourself?

**Schmitt:** I’d like to be there with the tools the new technology provides— to make the exploration more efficient. The combination of automation with the human brain, eye, and hand is synergistic because human beings can ‘reprogram’ themselves instantly on the basis of their experience and knowledge. Perhaps someday a robot will match that — but in the foreseeable future we’ll still depend on the ability of men and women to filter what’s significant from what isn’t and to forge a hypothesis on the spot. An automatic system is bound to miss whatever you haven’t programmed it to see.

**Omn:** How do you rate the space program today?

**Schmitt:** I think the space shuttles along with other technologies we have already, will let us move in a variety of directions. By the end of the 1980s, for example, we could be well on our way toward creating an integrated global information system. It would capitalize on the proven usefulness of satellites for telecommunications and combine that with broad-area public service broadcasts, safety and navigational information, remote sensing, and so forth. The groundwork for all that has been done, and we could move into it very quickly.

We should also be developing the technological base for the next steps into space. In the 1990s we could begin to develop orbital civilization for manufacturing, power production, health services, even recreation. High vacuum and weightlessness will make possible commercial processes that are costly or impossible here on Earth—leading to new goods and services. And the new opportunities for research and education almost go without saying.

**Omn:** What about colonies?

**Schmitt:** I see no reason why that shouldn’t be an option for young Americans—and young earthlings in general—in the 1990s and beyond. There is an economic potential for settlements that could support them as well as provide Earth with resources such as titanium from the moon that may be in short supply by then.

Maybe more important, space represents the kind of resource for the human spirit that North America was three hundred years ago—a new stimulus for the spirit of freedom. Young people now are tremendously interested in space and the frontier there—in terms of technology, young people today could be the parents of the first Martians. We know just about everything we need to know for what we only have to integrate it through engineering.

**Omn:** If you were writing our national space policy, would you be planning a manned Mars mission?

**Schmitt:** I’d be developing some things we know we’ll need. A new propulsion system such as an ion or nuclear engine may not be necessary if you just want to get an expedition to Mars and bring it home, but it will be valuable for repetitive travel to the moon or the planets. We ought to be working on that now because it requires a long lead time.

Other than that, we need extended experience with high-reliability space systems, assembling large objects in low orbit, and so on. Our basic understanding of the problems is good. After all we found we could reactivate Skylab after it was nine months in orbit.

**Omn:** The proposed treaty on extraterrestrial resources may affect some of the possibilities you’ve mentioned. What do you think of it?

**Schmitt:** First, I think it’s unfortunate that many people interested in space and commercial activity in space have already decided they’re against the treaty if I might end up opposing it, but I haven’t decided. We all have to take a good look at it and decide whether it’s in our national interest—and if we decide it isn’t, is there anything we could do to modify it via reservations, understandings or amendments?

It’s going to take a lot of discussion and I’m not sure when the Carter administration—or the next administration—will ask the Senate to consider it. But I’m looking at it as a potential opportunity and not as a problem. It’s part of a chain of treaties—the Antarctic treaty, the existing outer space treaties, the Law of the Sea negotiations—all of which get into the broad area that has been characterized as the “common heritage of mankind.” What does that mean? We have an opportunity with this treaty to try to define it.

**Omn:** How interested are your colleagues in these opportunities for the future?

**Schmitt:** There’s a great deal of interest, but it’s very difficult to initiate space programs from within the Congress. We need administration initiatives. Both Senator [Adlai E] Stevenson [chairman of the Subcommittee on Science, Technology and Space] and I think we are going to have to do it. He is less ambitious than I in terms of the size of space policy, but we agree that there’s a need for a clearer direction than we presently have, or than the Carter administration seems willing to give us. In that sense we’ll be working together. Of course, whether it’s a ten-year plan or a thirty-year plan—whether we emphasize commercial development or government activity—these are issues that he and I will have to resolve.

**Omn:** Most congressmen have been lawyers. Do you think that your education and experience in science and technology lead you to look at political problems with a different perspective?

**Schmitt:** Most of law deals with the effects of an event after it has occurred, whereas in most other professions you’re trained to recognize impending events and, if necessary, to forestall or mitigate them. It’s a problem-solving approach as opposed to one of merely treating symptoms.

There aren’t enough scientists, engineers, business people, scientists running for office—people who are willing after one successful career to aim for success in politics. In the last two Senate elections there have been more candidates from professions other than the law but we need still more of them.

**Omn:** President Carter had some engineering training, he’s the first President with that background since Herbert Hoover. Do you see signs of it in his performance?

**Schmitt:** I haven’t seen it yet except in his ability to master detail very quickly and talk articulately about a problem. Frankly I don’t think there’s any comparison between his technical background and that of Hoover. It is a great disservice to Hoover. Obviously Hoover was anything but an astute politician which Carter is, but Hoover was a great humanitarian, an engineer, even a scientist and a man of letters. Most people don’t realize what an extraordinary intellect he had.

**Omn:** When did you make your own decision to go into politics?

**Schmitt:** In the early 1960s, before I even thought about NASA. I had come out of a fairly hard-core conservative upbringing, but political science and history courses at Caltech began to broaden what had been simplistic views. Then in Norway I was exposed to an international pool of ideas that helped clarify what I believed. And at Harvard I studied government and Far Eastern history in addition to my geological work. At that time I really became concerned about some of the trends I observed, such as the increasing amount of law being made by regulation rather than by legislation and a decreasing emphasis on the importance of science and technology in building a base for our society.

I said to myself then: Some day after I have some experience in my career. I’ll be in a position to run for office. To put my money where my mouth was, I began to save some surplus cash which I kept adding little by little to a savings account. When I traveled for NASA and got a travel voucher as reimbursement, I had the habit of putting it into the savings account. After more

CONTINUED ON PAGE 94
White spots danced in front of our eyes. There was a momentary sensation of vertigo, and then we had emerged from subspace. Our trusty ship, Endeavor, powered by its twin GM distractors, had taken us safely from our own universe to GG233, a universe tangential to us in subspace directionality. Our party had gone there to look at some of the greatest structures ever built. A universe, by definition, is infinite, but some infinities are larger than others. GG233 is a relatively small universe. This does not, however, prevent it from having some of the largest fabricated structures in the entire megaverse. Our first stop was the planet Gropetz V, where we stayed at the Hotel Schroeding, right next door to the Combined Galactic Churches building. No fewer than 18,567 deities are worshiped in this immense edifice. The combined prayer power of the 488,000 beings who worship here.

**ORDERS OF MAGNITUDE**

BY ROBERT SHECKLEY

A survey of megastructures in the universe GG233

PAINTINGS BY JOHN HARRIS
generates enough psychoelectric power to light three cities the size of Cleveland. Between 60 and 100 miracles take place daily in the CGC. A few persons away, dominating the barren moon Li XIV is the Central Interstellar Penitentiary for Dysfunctional Life Forms. Malefactors from more than 200 different worlds are incarcerated here, some for crimes that we of Earth would consider minor, such as spitting on toast and an aggravated felony in the Chang-dong civilization. The penitentiary was built to house 1 million beings in three different atmosphere-temperature configurations. Unfortunately it now has nearly 4 million, many of them forced to endure incompatible life-support systems. We paused briefly at Louma III to see Carnivoron, which when completed, will be the largest factory in the world for the fabrication of artificial meat products. Only the Italian sausage section is operating today. Next on our list was a visit to the Albertus Magnus, the biggest spaceship ever built, now resting in zero gravity above the ocean world of Sargasso IV.

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Some infinities are larger than others. We found GG233 to be a relatively small universe.
The Big Computer has enough capacity to project the megagalactic Gross National Product.
Prostitutes, who encounter dozens of different blood types in their careers, have been found to secrete similar sperm-inhibiting antibodies into their cervical fluid. This biological contraception has led some investigators to think antibody antigen reactions may be the ideal method of birth control. In their thinking, the sperm become an invading organism, the pregnancy a preventable disease. If the sperm are considered a germ, vaccination is the obvious cure for infection.

Virtually every human cell carries markers of biological individuality on its surface. These markers, known as transplantation antigens, for their role in sabotaging surgical transplants, are divided into four major groups with as many as 22 different molecules possible in each group. Since each individual inherits eight of these antigens (four from each parent, one from each of the four groups), the total number of combinations is approximately 20 million.

Transplantation antigens function as passwords. This is why surgical transplants are so often unsuccessful, unless the transplantation antigens of the donor and of the recipient are identical. The body will recognize the transplanted tissue as foreign and will reject it. Some tissues, such as spleen cells, elicit extremely powerful rejection reactions from the body. It is ironic that the tissues that trigger the weakest reactions are the most desirable as the organs and tissues that are the easiest to accept as transplants are the very ones that would least desirably and least possible to transplant the fat cells and brain cells respectively.

Recently transplantation antigens have been put to another use in society, not in the laboratory but in the courtroom. Because two random individuals are very unlikely to possess identical antigens, transplantation types are ideal for testing claims of paternity. All an attorney has to do is prove that a child does not have a combination of four antigens that his purported father would have supplied.

In a recent case, tried in Austria, the use of these antigens went a step further. A woman claimed that her child was an heir to the estate of a dead man. But the estate’s lawyers rounded up the dead man’s children and checked their antigens. From them they were able to deduce his transplantation type and prove that the plaintiff’s child could not have been sired by him.

No one knows why we are born with transplantation antigens in the first place. Surely nature could not have anticipated the increasing sophistication of the surgeon’s scalpel. One theory comes from Nobel laureate Sir MacFarlane Burnet who suggests that the antigen code was developed to enable the body to recognize and reject any cell that had mutated and become cancerous. According to his theory, cancer arises when the body’s surveillance mechanism is unable to detect and kill an abnormal cell. Burnet’s theory is one avenue scientists are exploring as they try to unravel the foundations of cancer.

**GLEANED FROM YOUR GENES**

The ultimate type of identification may be the karyotype. This isn’t a biological group, but a picture of the chromosomes. The tiny rod-shaped cellular structures that carry our genes. Ordinarily a karyotype is displayed as a photograph in which the 46 chromosomal contents are seen for microscopic examination. Careful inspection reveals that each chromosome is designated number one, and the shortest is number 22. In males, all the chromosomes normally form matching pairs, but in females, the twenty third pair, which contains the X and Y sex chromosomes, is noticeably mismatched. Karyotypic analysis therefore readily distinguishes between the two most important human subgroups, males and females. It is a fact of which the International Olympic Committee is fully aware.

In normal individuals, there is little variation in size between chromosomes in each sex. In the case of the Y chromosome the length of this chromosome varies significantly among different groups of males, the Japanese having the longest and Caucasians the shortest. Whether the length of this male-determining sex chromosome is significantly remains unknown. But it does not seem to correlate with variation in anatomical features.

Thus far karytype studies can detect only gross characteristics and abnormalities, but they are still accurate enough to reveal chromosomal alterations in about 2 percent of the population. Now staining techniques and improved methods to identify the staining patterns called chromosomal bands, will undoubtedly improve our ability to detect minor differences in gene structure. Someday we may be able to analyze the chromosomes one gene at a time for the ultimate in genetic identification.

While full utilization of these techniques still lies a short distance down the road, scientists are already using identification methods that go far beyond fingerprints.

On September 24, 1974, for instance, a Torrance, California, man was convicted of manslaughter after it was shown that the pattern of his bite fitted the bite marks on a woman’s nose. The prosecution estimated that the five most distinctive marks in the nose could have been displayed 59,049 possible combinations of alignment and tooth rotation. When 710 randomly selected models of adult dentition were compared to the matching marks only the suspect fitted every characteristic.

The dental pattern compares favorably with fingerprints in its uniqueness. Because each human tooth has five distinct surfaces 160 different dental areas can be classified by hereditary formation, dental organisation, natural or traumatic changes, and the extraordinary combina-
tions of procedures used to repair or replace teeth. According to computer models, more than 2.6 billion possible permutations of these characteristics can be found in a dental print. X-ray analysis of the jaw can add yet another dimension to the process of identification.

Analyzing dental patterns is by no means a new science. Paul Revere is known for his ability to ride a horse, relying on dental patterns to identify Joseph Warren, an American killed at Bunker Hill. The identity of John Wilkes Booth, Abraham Lincoln's assassin, was confirmed by dental evidence when his body was exhumed.

Today's more sophisticated analysis has given rise to an entirely new specialty, forensic dentistry, which works admirably when trauma to the rest of the body makes other kinds of identification impossible. Because tooth enamel is one of the hardest minerals known, the teeth are the body's most durable parts. They alone can survive fiery disasters where other identifiable remains are destroyed.

Forensic dentistry has been used recently to identify the remains of passengers in the crash of a DC-10 at Chicago's O'Hare Airport, in the investigation of the murders of young men linked to John Gacy near Chicago, and in the aftermath of the Jonestown community massacre in Guyana. In the San Diego plane crash 21 months ago, in which 144 people died, 140 of the victims were positively identified 50 of them by their dental prints alone.

Working on the premise that no two mouths are alike, at least one nation, Norway, now requires that identification teams in disasters include law enforcement officials, physicians, and dentists as well.

Thirty to 40 different methods are used to chart the mouth, but all have the same basic features. Each record notes missing or extra teeth, prosthetic devices, and the type, size, and location of fillings. Other measurable characteristics include the shape of the jaw and the position, shape, and relationship of the teeth.

Even this method of analysis has its limitations. Though teeth change over the years, and dental records are often years out of date. Furthermore, investigators of a recent air crash in Europe found it impossible to identify five of the victims, because they had all been wearing complete sets of dentures.

SIGN IN PLEASE

If no two mouths are the same, neither are two signatures. One newly designed system has made the signature a more accurate means of identification than a page of handwriting, and more foolproof even than a fingerprint.

Handwriting analysis has always been a painstaking and questionable accurate process. Chance factors like mood changes or different writing instruments could disguise almost any handwriting forgery.

As a result, even when you sign something in the dark or in a rush at the bank, the pressure pattern remains distinctive.

When the U.S. Air Force tested Sternberg's system as a way to control access to highly restricted areas, its low error ratio pinpointed the Sterneberg system's incredible potential for military and commercial use. The reason for this success lies in what the computer identifies: it judges neither a reproducible characteristic (a fingerprint can be copied onto a rubber glove) nor some static photograph or reproduction, but the subconscious actions of an individual performing a complex task in this way it identifies a combination of our unimpeachable characteristics: personality, physical nature, and pattern of action.

Ever since humans first began to gather in groups, they have recognized the problem of identity. Early on, they learned to endow objects and individuals with names. For a long time these unique verbal signatures were enough to give each person a mark of his own within the community. In these depersonalizing days, however, names have come a cropper. Anyone unfortunate enough to be dubbed Smith Jones or Johnson is lost amid a faceless army of identically named people. Names have lost their meanings. Our government, like most computers, much prefers to label us by number. This system works, but there is something depressing and a little scary about basing our uniqueness on arbitrary strings of digits.

Biological tools are on their way to changing all this. Nature's IDs can be as specific as numbers and more personal than names. Already they are employed in catastrophic conditions when nothing can visibly distinguish one body from another. Already they are establishing individual identities at some of our most sophisticated centers of research and learning.

Instead of forcing us toward anonymity, biological identifiers effectively celebrate our absolute uniqueness. It won't be long before checking a chromosome or tissue type will be as common as checking a signature is today. The results will be both more certain and more satisfying.
Heart Computer

Your heart can tell you three things that can help you live longer and stay healthier. The rest is up to you.

JS&A has never offered a pulse meter. And for good reason.

If you've ever used one, you'll quickly discover that your heart does not beat like a clock. It's irregular. It might beat at 40 beats per minute for one instant and at 120 the next. Since most pulse meters measure each beat as it occurs, you never feel confident that you're getting a very good reading.

We also considered size. Each pulse meter we examined was cumbersome and awkward to carry or store.

WE WAITED

We waited a few years. In the meantime, we discovered three ways your heart (through your pulse) helps you monitor your health.

1. Pulse Rate Your pulse rate can tell if you are getting enough oxygen throughout your body. A high pulse rate indicates that your heart is pumping faster to supply that oxygen and may indicate poor physical condition.

2. Target Zone Your pulse can tell you if your heart is beating fast enough during exercise. There's an area called the Target Zone. Below this level, you're not exercising hard enough to your heart or respiratory system any good. Above this level, you can be dangerously over-exercising.

3. Cardiac Recovery Time The time it takes for your pulse rate to return to normal after you've exercised is the real measure of whether or not your exercise program is doing you any good. This time can be as healthy as one minute or as poor as several minutes.

The three things we learned convinced us that the ideal pulse meter must have the following features:

1. It must measure a series of heart beats and simultaneously compute the average to avoid the strange readings from irregular heart beats.

2. It must be small enough to use while exercising.

3. It should have a timing capability to determine your Cardiac Recovery Time.

It wasn't until a small Utah medical electronics company created what we feel not only provides the capabilities listed above, but excels in other areas too.

FITS ON FINGER

The unit is called the Pulsatach, and it fits right over your finger. It weighs less than 3 ounces and can be worn easily during most exercise programs.

The large liquid crystal display can easily be seen from lighting or in bright sunlight, and because liquid crystal displays consume very little power, the readily-available watch batteries will last for years. The Pulsatach automatically turns itself off in two minutes if you forget.

The heart of the system is a powerful microcomputer CMOS semi-conductor integrated circuit that will take up to 4 pulse beats, compute an average pulse rate, and then flash that rate on the liquid crystal display.

FINGERTIP SCANNER

The sensor consists of a Gallium Arsenide infrared light-emitting diode which scans your fingertip hundreds of times a second to determine your pulse rate. The new system is one of the most accurate and is also used in sophisticated hospital systems.

The unit also contains a quartz-controlled timing circuit which will automatically time either your exercise period or your Cardiac Recovery Time. And you can switch back and forth between the pulse and chronograph mode while you are exercising.

We realize that the Pulsatach sounds like a very sophisticated unit. And it is. But as sophisticated as it is internally, it can be extremely easy to operate. It has just two buttons to press which operate the pulse reading and the chronograph timing circuit. A third button engages the audio circuit.

The Pulsatach system fits comfortably on your finger while it monitors your heart and determines your Cardiac Recovery Time.

HEAR YOUR PULSE

The audio circuit simply beeps every time your pulse rises. This feature lets you monitor your pulse by hearing it as you run or exercise and it can be shut off by pressing the button a second time. The timing circuit is quartz-controlled and extremely accurate.

The Pulsatach not only has combined all of the most advanced technology in an extremely small size, but it costs less than many other systems lacking its advanced features.

The Pulsatach can be used for joggers, athletes, all forms of exercise and even cardiac recovery patients, as it operates quite effectively with pacemakers.

REAL WORKOUT

We suggest you order a Pulsatach for your 30-day no-obligation trial. When you receive your unit, give it a real workout. Notice how simple it is to operate and how easily you can read your pulse rate. Use it to stay in your Target Zone and to determine and then improve your Cardiac Recovery Time.

Monitor your Cardiac Recovery Time Determine your Target Zone and see if you're really exercising in that area. Then use the Pulsatach to watch those important signs slowly improve thanks to the accuracy and information you get from the unit.

By knowing the important factors that help you monitor your health, you'll feel better, exercise more effectively, and many doctors feel you'll live longer.

TWO UNITS AVAILABLE

To order your Pulsatach pulse meter, send your check for $119.95 plus $2.50 postage and handling (Illinois residents add 6% sales tax) to the address below. (Allow 20 days for personal checks to clear) Credit card buyers may call our toll-free number below.

You can also order the more expensive hospital unit that averages 16 beats and has all the features including the small size of the previous unit. It costs $169.95.

We'll send your Pulsatach pulse meter complete with 90-day limited warranty and instructions which include information on determining your Target Zone, Cardiac Recovery Time and other helpful information.

Then after your test, if you're not fully convinced that the Pulsatach is the best unit of its kind, the most convenient, and the greatest value, return it within 30 days for a prompt and courteous refund including the $2.50 charge for postage and handling. You can't lose.

Your Pulsatach is totally solid-state so service should never be required, but if it is, the manufacturer has a national service-by-mail facility backing each unit. JS&A is America's largest single source of space-age products—further assurance that your Pulsatach is backed by a substantial company.

We've waited an awful long time to jump into the pulse monitoring field. But what a great entry. Order your Pulsatach at no obligation today.

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THAT THINK

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INTERVIEW
CONTINUED FROM PAGE 82

than ten years, when I finally chose a time
and an opponent for my run in New
Mexico, I had seventy-five thousand dollars in that
account.

Omni. So your political plans were there all
along. Much has been said and written
about what the astronauts' participation in
the Apollo program did to transform them.
How much truth is there in that?

Schmitt. I think that people were so used
to seeing the astronauts as astronauts that they
viewed any change of job as a transform-
tion. Jim Irwin, for example, had al-
ways been very religious and active in his
church, once it was clear that Apollo was
winding down and opportunities for flight
were going to be very limited, he decided
to become an evangelist and has been
very successful at it. Although he almost
killed himself with a couple of heart attacks.
Ed Mitchell had been interested in ESP
ever since his graduate work at MIT. I think
and we talked about it many times before he
ever flew. Later he decided to see
whether there was a scientific basis for ESP.
He may have become discouraged in that,
because he ran into so many charlatans in
that field that it was difficult to separate the
wheat from the chaff. Buzz Aldrin had a
psychological problem, which he's spoken
about very frankly before Apollo, with the
goal behind him, that problem appeared in
a more profound form.

I think the space program had a pro-
found effect by motivating several hundred
thousand Americans to put money on the
moon and return home. And being ex-
posed to that motivation did have a pro-
found effect on me. Although my interest in
politics goes back many years.

Omni. Some politicians have always
sniped at the space program as wasteful or
costly, and they still get good play in the
press by making fun of scientific research.
What's your opinion of that?

Schmitt. I think it's irresponsible. There is
some fundamental research that's being
inhibited right now because scientists fear
that almost anything involving mice or rats
for example may be held up to ridicule because
of the title of an article. Scientists
should try to communicate better of course—and there's a lot to learn about
that—but there are some projects you can't
call anything but what they are, and if there
is a senator or congressman who doesn't
understand that and wants to ridicule it
unfortunately the press jumps on it. More
pragmatically funding is being held up be-
cause of a lack of understanding of what
basic science can do and what it should be
allowed to do.

Omni. Has the scientific community
laughed back on this?

Schmitt. In part we've left ourselves be
come captive because the majority of re-
search funding is now coming from the
government. Like it or not, government
funding means less freedom in research, if
only because the government's interests are
focused and directed. It's very im-
portant to reach a better balance than we have
today between government and private
funding. The latter generally provides free-
combining what the government would or
should allow from a political point of view.

We need both, or else major areas of re-
search are going to be slighted.

Omni. Do you think that science and
technology should be exempt from the
general pressure to hold down government
expenditures?

Schmitt. I do. Because investments in
scientific understanding and new tech-
nologies almost without exception are
deflationary. They create new productivity,
goods and services far beyond the initial
investment. They increase the gross na-
tional product without increasing the
money supply which makes them some of
the very few inherently deflationary things
the federal government can do.

Fundamental research
is being held up
now because some of my
fellow congressmen "hold up to ridicule projects
that they don't
understand, and the press
jumps on it."

Omni. The combined federal and pri-
ivate-sector expenditures on science and
technology are about fifty billion dollars
annually which seems like a great deal of
money. How and where would you increase
spending?

Schmitt. The administration's support for
research and development this year was
stronger than last year, but we're still pretty
much in idle with regard to research on the
next generation of weapons systems. And
you have to slice off part of that total figure
for expenditures that don't really go into
R and D, federal money lost in administra-
tive costs and private-sector spending in
reaction to the growing regulatory require-
ments rather than increased productivity.

Look at American history. Our major
periods of industrial and economic ad-
vancement have followed the direct or indi-
rect injection of new technologies from the
transcontinental railroad and the Panama
Canal and the agricultural revolution to the
world wars—unfortunately—and the
space program Americans are oriented
toward new things and we really start to
move after a period of technological ex-
pansion. But we haven't been doing that
for the last decade, partly because of a
legitimate concern that technology was
overrunning itself and damaging the envi-
ronment. We must look at the side
effects of what we do but we can learn that
lesson without coming to a complete stop.

I think fundamental biomedical research
should be funded at a higher level, be-
cause it can lead to cures—which are al-
ways less of an economic burden for indi-
viduals and for the nation than treatment of
symptoms is. And there's a lot we should
be doing in theoretical physics, not only
because of its inherent value but also be-
cause it involves a clear long-term defense
interest. We cannot afford to find suddenly
that a potential adversary has begun to
create some of the mysteries of physics and
astrophysics before we do.

Omni. Is the administration pursuing solar
technology strongly enough?

Schmitt. I don't think so. There's a good
deal of money going into it, but there's no
perspective on the relative status and time
frames for development of the many differ-
ent forms of solar energy.

We should be working on solar cells and
the power-tower concepts, but they're fur-
ther off than some of the possibilities of
combining solar with gas and oil-fired
or even coal-fired power plants which could
move very fast with proper support. Pos-
sive solar-thermal units which are economi-
cally today, are actually discouraged by
some of the regulations now on the books
and HUD, Department of Housing and
Urban Development doesn't seem to be
able to integrate them into its designs.

The government has supported some
good experiments in that area. But by and
large the applications are taking off in spite
of federal policy rather than with its aid.

Omni. In what ways do you think the gov-
ernment should encourage private R and D
in high technology?

Schmitt. The main thing is the policy deci-
sion that when a new technology finds its
market the commercial sector can and
should use it to provide services. In space,
for example, satellites have revolutionized
weather forecasting and communications.
Traditionally forecasting has been a gov-
ernment service, and you may decide you
want to continue that. But if satellites and
new transmission techniques make elec-
tronic mail commercially viable you might
well break with the old pattern there.

The government should get out of Comsat
to give it some working capital. The market
was there, the technology was there, and it
took off like a scalded duck. Recently
NASA has committed itself to use the new
direct-relay system developed by West-
ern Union because NASA needs it to
lower the cost of operating the space shut-
tle. I think it found that it will also pay off
as a commercial system from the begin-
ing, so there the federal commitment is
helpful but not necessarily

You have to be willing to maximize the
amount of private-sector activity in order to
get maximum service at the lowest cost.
Omni: Let's talk about the economics of remote sensing and the data it provides. The United States has stressed the widest possible dissemination of Earth resources data from satellites, but what if a satellite spots signs of a valuable geological formation outside the country? Is all information obtained from space part of the "common heritage of mankind?"

Schmitt: The raw data should be generally available, based on the cost to the government of obtaining them. If a fact comes via a data base developed by the private sector you'd add an appropriate return on that investment. As for the next step, the processed information that has to be considered in the context of what it's to be used for I see no reason why processed information that's used in mineral exploration or mining should not be proprietary.

Maybe the best example of a completely public purpose is the estimation of the worldwide yields of various crops. Predictability is of enormous value both for us and for the world at large because if we know many months in advance what foodstuffs are going to be available, we can start to dump out the traditional cycles of famine and glut as well as the economic cycles that characterize farm prices. The world is increasingly dependent on a few large agricultural exporters such as the United States, Canada, and Australia, and crop estimates from remote sensing are going to be beneficial to the whole world as well as to those exporters.

Omni: It's encouraging to talk about shared benefits, but technology also brings some shared problems. Recently we've seen some reversals of classic pork-barrel attitudes. Localities are refusing to take on what they see as national problems such as nuclear waste disposal. In the past you've said that the Nuclear Regulatory Commission's dealings with your New Mexico constituents on that issue were unsatisfactory.

Schmitt: They still are. The people keep getting caught off guard by announcements about the waste-disposal experiment in the Carlsbad salt beds. I don't know how we can improve the situation, except by learning on the agencies involved to learn how to communicate. It's an old problem. Nuclear power was kept in the closet by the Atomic Energy Commission for so long that even now when the questions are out in the open there isn't a widespread understanding of radioactivity or of the risks and benefits of nuclear power. The government consistently mishandled the issue and it's still mishandling it today.

Omni: What about the MX missile system? It appears that more and more people in your states of Utah and Nevada aren't happy about being hosts to this system, despite the money it would bring into the local economy.

Schmitt: I think the reason no one is happy is that it's a stupid idea. This "race-track" or "horizontal dash" mode is just ridiculous. It doesn't provide the kind of strategic protection a missile system should. It's the most costly alternative and it's going to have a tremendous environmental impact on the water and other resources of the Southwest. I don't know if much can be said in favor of Carter's decision to use that basing mode and I think eventually the Congress is going to say no to it.

Omni: What alternatives do you advocate?

Schmitt: I think it's important to get an assembly line going for the MX. That missile is compatible initially with replacement of the Minuteman in the same silos and maybe with other silos or even dummy silos. That would be a much more economical way to get through what I hope is a transition period until a time when strategic defense is no longer based solely on the threat of massive retaliation.

Omni: What would be the next basis?

Schmitt: I would like to be seen replaced "mutually assured destruction" with "mutually assured protection." I think a combination of lasers, space technology and other technologies that are not much—if at all—beyond the current state of the art can give us some new policy options for strategic defense—a defense that would not depend on "holding innocents hostage" as Andrei Sakharov put it. There must be a better way to deter nuclear war.

Omni: Your reference to lasers brings up the controversy over the USSR's alleged development of laser or particle-beam weapons. What is your evaluation of that?

Schmitt: That's the most important question that particle-beam technologies can be developed although it's not clear that they can be the most economical for offensive purposes. We have to assume that the Soviet Union is pursuing R and D on a broad front. We're certainly active in laser technology. But I think we can also assume that if we mobilize ourselves in the same areas we'll have an advantage in putting theory into practice.

Omni: The Chinese are seeking our cooperation in developing their scientific and technical resources. Should we respond insistently or are there specific areas where we should be careful?

Schmitt: I think we ought to cooperate pretty freely except in the most sensitive new technologies. China will be a formidable power in international affairs. They have a billion people to be concerned about and there is a limit to what even the most totalitarian society can ask a billion people to bear.

As far as the Chinese-Soviet relationship is concerned, the Chinese are deemed "C" countries, and it is in their present concern about Soviet intentions that we have our greatest leverage, and it may be that a U.S.-Chinese relationship contains elements for a much more stable world situation than we can now imagine.
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We need mass education to drag this world out of the Stone Age, and any technology, any machine, that can help do that to be welcomed not feared. The electronic tutor will spread across the planet as swiftly as the transistor radio. With even more momentous consequences. No social or political system, no philosophy, no culture, no religion can withstand a technology whose time has come—but how much one may deplore such unforeseen sides effects as the banning tape recorders being carried by pilgrims up the sacred mountain Sri Pada. We must take the good with the bad.

When electronic tutors reach technological maturity around the end of the century they will be produced not in the millions but in the hundreds of millions and cost no more than today’s pocket calculators. Equally important, they will last for years (No properly designed solid-state device need ever wear out in still using the HP 35 Dr. Oliver gave me in 1970.) So their amortized cost will be negligible; they may even be given away with users paying only for the programs plugged into them. Even the poorest countries could afford them—especially when the reform and improved productivity that widespread education will stimulate help those countries to pull themselves out of poverty.

Just where does this lead the schools? Already telecommunication is making these ancient institutions independent of space. Semester and University of the Air can be heard far from their campuses. The pocket tutor will complete this process giving the student complete freedom of choice in study time as well as in work location.

We will probably still need schools to teach younger children the social and discipline they will need as adults. But remember that educational toys are such fun that their young operators sometimes have to be dragged kicking and screaming away from their self-imposed classes.

At the other end of the spectrum we’ll still need universities for many functions. You can’t teach chemistry, physics, or even grooming without labs, for obvious reasons. And though we’ll see more and more global classes—athal graduate level electronics can never completely convey all the nuances of personal interaction with a capable teacher.

There will be myriads of "invisible colleges" operating through the global communications networks. I remarked earlier that any teacher who could be replaced by a machine should be. Perhaps the same verdict should apply to any university, however ivy-covered its walls. If it can be replaced by a global electronic network of computers and satellite links.

But there will also be nexuses where campuses still exist. In the year 2003 many thousands of students and instructors will still meet in person as they have done ever since the days of Plato’s Academy 23 centuries ago.
you see, if it is known that no one can you know even think about it--ever—and suddenly someone appears like you—then the very possibility the fact that there is one who

I can't believe that everyone would be—how was it?—beinazed!

Why? Everyone, I tell you.

No it's impossible. I insisted. What about people with dangerous jobs? After all they must.

"There are no dangerous jobs."

What are you saying, Nais? What about pilots? What about rescue workers? What about those who fight fire water?

"There are no such people," she said. I thought that I must not have heard her right.

"What?"

No such people, she repeated. "It is done by robots."

There was silence. It would not be easy for me to think of such a new world. And suddenly came a reflection surprising in that I myself would never have expected it if someone had presented me with this situation purely as a theoretical possibility. It seemed to me that this measure destroying the killer in man was a kind of disfigurement.

"Nais! I said, 'it's already very late. I think I'll go.

Where?

"I don't know. I'll look for a hotel. There are hotels?"

There are Bregg.

"Yes?"

"Stay."

"What?"

She did not speak.

"You want me to stay?"

I went up to her look hold of her bending over the chair by her cold arms and lifted her up. She stood submissively. Her head fell back, her teeth glistened. I did not want her. I wanted only to say: "But you are afraid and wanted only for her to say that she was not. Nothing more. Her eyes were closed but suddenly the whites shone from under near her lashes. I bent over her face and looked into her glassy eyes as I wished to know her tear to share it."

She struggled to break loose but I did not feel it. it was only when she began to groan, "No! No! That I slackened my grip. She nearly fell.

"Nais! I said quickly. Then I dropped my hands.

"Don't come near me!"

"But it was you who said."

Her eyes were wild.

"I'm going now," I announced. She said nothing. I wanted to add something—a few words of apology of thanks—so as not to leave this way but I couldn't. Had she been afraid only as a woman is of a man a strange, even threatening unknown man that the hell with it. But this was something else. I looked at her and felt anger growing in me. To grab those white, naked arms and shake her.

I turned and left. I remember that later I set by a fountain or perhaps it was not a fountain. I stood up and walked on in the spreading light of the new day until I woke from my stupor in front of large glowing windows and the fiery letters ALCARON H."

In the doorkeeper's box, which resembled a giant's overturned bathtub, sat a robot. Beautifully styled, transparent with long, delicate arms. Without asking a thing, I handed me the guest book. It signed it and rode up with a small triangular ticket. Someone—have no idea who—helped me open the door or, rather did it for me. Walls of ice and in them—a circling fires. Under the window at my approach a chair emerged from nothing and slid under me. A flat table top had begun to descend making a kind of desk. But it was a bed that I wanted. I could not find one and did not even attempt to look. I lay down on the foamy carpet and immediately fell asleep in the artificial light of the windowless room. For what I had at first taken to be a window turned out to be a television set and I drifted off with the knowledge that from there, from behind the glass plate of that giant face was gazing on me. Laughing, chattering, babbling. I was delivered by a sleep like death, in it even time stood still.
MARCHIANKA

Alone in space with her adored master, she always gave him exactly what he needed, and then some.

By KEVIN O'DONNELL JR

She woke to music. Every day it was the same, week after week, hour after hour. But this day was different...}

Painting by Di-Maccio
Nakamura-san stood in line to please her. The lights dimmed on her armor and lensed her circuits for the day’s run through the mining belt.

But first breakfast. Not for herself—Marchianna always dined at fresco clinging to the steel-gray hull of the prospecting ship and stopping up sun-rays—but for him. Nakamura-san her master her owner her god.

Images fractured as cupboard doors swung in response to her radioed commands. Dried fish and seaweed and bean curd and rice. She called a table out of the floor and piled them on its top. Her clock read 7:51.36. Nakamura-san would expect to sit down to a steaming meal in exactly eight minutes and twenty-two seconds.

And he was punctual. Very punctual. There were moments when she wondered if any of them was the machine and which was the human Tah. or yes green tea Leaves shaken into a delicate blue pot that always seem jeopardized by her scared titanium claws. Another panel popped up and a million Marchiannas vanished in the recess waited the sink barren and functional. She didn’t like to acknowledge it. Like herself it was a device for man’s comfort but so simple that it made her whole race look bad in all human eyes. She placed the pot in its lobsterlike claws “Fill it with boiling water.”

“Yes Marchianna” he hissed.

Scurrying to the breakfast room beyond the kitchen she wiped the table tree of the dust that overnight had settled down from the rock ceiling. In the walk-holo gnarled a pine tree, stout of trunk sparse of needles. Below it pooled a small creek which a long-legged crane probed for minnows. This cousin gave her greater pride. Nakamura-san would regard it for minutes at a time and sigh whenever he had to take his gaze away.

7:58.12 Whisling back into the kitchen she dusted off the lacquer tray—black with an ideogram inlaid in mother-of-pearl she asked her owner what it meant and he hadn’t known—then arranged the dishes and bowls in what she hopo was a pleasing pattern. Nakamura-san in brushed over such things. Once in the beginning he’d thrown out an entire meal, bowls and all, rather than eat food so aesthetically presented. As a last touch she slid a pink chrysanthemum and a lacy fern into a tinted bud vase, then stepped back to admire the effect.

In the dining room hinges whispered that her master had come. She checked the time—7:59.55—and snatched up the tray and bustled to greet him. “Ohayo gozaimasu.” She couldn’t bow—she wasn’t designed for it—and so she altered the pressures in her cab’s independent suspensions which raised the back edge a couple of centimeters and tilted the forward face slightly. When you are ready I will pour the tea, Nakamura-san.

Hai she greeted. Wheels whirring he rolled to the table. His optical sensors teardrop shaped, with two on each facet of his triangular tunnel—focused on the bud vase. His wire thin manipulators each ending in a dozen harpike tentacles whipped out. Almost before she realized what he was doing he stripped two browned leaves off the chrysanthemum plucked four fronds from the fern, and realigned them so that they stood in harmonious disequilibrium “Like that,” he said.

Mortification flooded from her microprocessors. She’d known she shouldn’t have attempted a human art form but her acha for him to look favorably upon her had overwhelmed her programmed common sense. “I apologize, Nakamura-san. In the future I will know my place.”

To say yes would have violated the owner respect circuits. “I thought sir that you were reminding me of my machinehood.

She didn’t like to acknowledge the sink. Like herself it was a device for man’s comfort but so simple and shallow that it made her race look bad in all human eyes.

“No, not at all.” Through a hopo siphon he sipped the steaming tea. His microwave dish moved right then left indicating his approval. “As my venerable grandfather often said, anyone can become an artist as long as he has an eye, a mind, a steady hand, and a lifetime to devote to it. You did well for a beginner.” With his manipulators he choppsticked balls of rice into his food intake valve. After a moment he looked up “You may go.”

Leaving she felt lighter than air. Praise from Nakamura-san! Unprecedented—and oh so pleasing—especially considering the surmise he’d shown on their last return. She’d thought then he was cracking going insane, but he wasn’t. She’d been wrong, and her happiness pulsed so loudly that the glow panels overhead began to hum.

But in the kitchen she berated herself. She was a machine, a device a thing—metal and plastic assembled by man for his pleasure. She had no right to love. Her role was to serve with efficient obedience, with mechanical accuracy—not with affection. Nakamura-san could sell her at any moment—or convert her into a refrigerator if he wished—for a human owed nothing to his possessions nothing.

Yet she did love deeply and truly and she could not help that. She didn’t want to help that. She released the way her alter ego added an extra cycle per second whenever Nakamura-san neared. Sheavored the drop in the resistance of her obedience circuitry when he cleared his throat. And it thrilled her beyond measure that whenever she finished what she was doing her function selector assigned her a task the achievement of which would swing his microwave dish approvingly. She loved him and she was glad.

She was also curious for she knew love should have been alien to her. The factory had built her capacity into her. Three masters had she served, hundreds of humans she had encountered, and never a flicker of like. Then one morning awakening after her sleep (she called it that though it was more a period of energy conservation information updating and circuit testing), she had heard his voice. seen his face and the flame had leaped high within her.

Marchianna, he called impatiently triggering a feedback effect that rippled through her like the aftertremors of an orgasm it is time.

Hat vo Gears purring she left the kitchen and followed him—at a distance of three respectful meters—through the plastic panelled corridors opening on the asteroid’s surface to the heat-scared landscape of the living ship was tethered. Rambling along she bounced across the irregularities the gravity field weakened there and that meant the deposits were building up again. It was unfortunate that the reaction mass cooled and crystallized on the pad. She’d soon have to scrape it off. That would unhappy for her separate her from Nakamura-san although it would please him. The scrowing, not the separation. If the surface were too rough the ship could break up on landing.

It was a monstrous thing. An almost cubic five hundred餐gers on an edge with pipes here and there and empty spaces in between. The Karakai Maru had cost a quart of a trillion yen. Another twenty years would pass before it paid for itself completely.

Nakamura-san rode one elevator to the bridge where he would shield his protective gear and enjoy the shirt-sleeve environment she mounted another elevator which carried him to the centrifuge.

She had barely finished checking it before the voice sounded in her radio. Cables dropped, fusion engines on stand-by.

“Yet sir” she replied than vibrated in resonance with the ship’s spewing of gaseous superheated reaction mass from its tail Vacuum sonic sound but she often imagined that in an atmosphere that engine would have roared would have belowed would have deafened every ear within a hundred kilometers. Glimping thinly...

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to her perch she watched a strait oculdea a star with its quivering like a signal-light—on off on off. The centrifuge has cooled, sir, she radioed when the asteroid had fallen far behind.

Then get the plug out. You know what to do.

The gruffness of his tone wounded her. It was unlike him. However, life was difficult for him. A self-exile to the Asteroid Belt. He endured on the brink of nowhere millions of kilometers from his friends, his home. She knew how lonely it was. She had to make allowances.

Sunlight as fine as a morning mist drifted across her piating. Her photovoltaics collected it, transforming it into life just as surely as a Namib lizard’s skin drinks the dew that gathers on it. She planned her route to stay out of shadows. Full batteries elevated her.

Moving with an agility remarkable for her size and shape, she opened the casing of the forty-meter-long centrifuge tube and radioed the cranes to hoist out the solidified metal. Smelted on their last trip home, poured into the tube and spun until the constituent ores had separated out into neat strata; this piece represented days of hard work.

Summoning mobile dollies, she rolled to the far end and retracted the panel covering her built-in laser. Then she plugged herself into the ship’s main power supply. Her batteries were capacious, but the greedy light knife would drain them in a hurry. The current surged through her.

She wanted to throw back her cab and sing triumph to the steady stars, but there was so much to be done. She rode the sensual waves like a master surfer over in control.

Precious little uranium this time, maybe a millimeter-thin cap on a plug five meters in diameter. She beamed a small dolly into the proper position, then snapped her filters into place and a dot burned brightly on the cylinder’s smooth surface. Slowly the plug revolved; spun by the cranes’ careful hands. She loved this job, this commanding and coordinating this sinew through metal like a butcher cutting his salami. The dolly caught the uranium as it floated free of the rest caught it and trucked it unburdened to the place where sandwiched between shoes of lead it would wait. When a full shipment’s worth had accumulated, they would roll it down the gravity hill to Earth to the spread nets of an L5 retrieval team. It would be weighted and paid for and Nakamura-san would owe that much less on his ship.

Poor Nakamura-san, she thought as she went to work on the next stratum. He was so far from home that he couldn’t see his world without a telescope couldn’t even find it without recourse to an astronomical calculator. The word pty was crowded onto one of Marchianna’s vo-chips. She knew its meaning but couldn’t experience its emotion. She wished she could for her master was surely to be pitied.

A lonely expatriate, he had only a robot for company. And not a bright or interesting one either, she thought in a moment of self-loathing. Her master needed more silken hair liquid laughter warm and fragrant skin a wife, in other words. He had no total independence on machines for every facet of his survival from the air he breathed through the suit he wore to the direction in which he steered the Karakai Matu. Which was not to suggest that he lived in danger but rather to imply that the sterile predictability of his environment poured acid on his crystal soul. He was a human and to be that to its fullest potential he had to be stretched by the elusive realities of other humans not corroded and compressed by gears and motors and integrated circuits.

After some thirty-six hours the radio crackled, “Are you finished yet?”

“Hall!” Perturbed, she routed his question through her built-in voice-stress analyzer. The summary flashed, CANKY while the emotional-component chart tilted up a list of ANGER DEPRESSION LONELINESS FEAR FEELINGS OF INADEQUACY. Within one twentieth of a second it completed the list and the psych chip began out tapping a variety of sug-
gested therapeutic responses. URGENT TO TALK PROVIDE MORAL SUPPORT. REMAIN INTERESTED BUT NONJUDGMENTAL.

One tenth of a second had passed.

"Get up here fast!"

Hair Emergency? she wondered, but no as she tapped into the monitor net woven through the ship's ribbing. All indicators glowed green; all readings read normal. Just his mood—poor man I must make him happy.

She reached the bridge and passed through the extra-wide airlock. The door squeaked in the ultrasonic as it retracted. She paused to inject a smidgen of lubricant. "I have come, Nakamura-san!"

He spun on his treads, growing. "You have a positive gift for announcing the obvious."

"I am sorry sir. She rolled forward to express her concern. Is something wrong with the life-support system?"

"No," he snapped.

"But you haven't unsuited." She turned to him, blantly. "He lashed a manipulator at the control panel. "Why did you reprogram the course computer?"

Nakamura-san! Aghast, she jerked back. "It is not my place. I would never alter—"

"These are not the vectors and coordinates I recall!"

The psych-chip chattered. UNRELIABILITY OF MEMORY IS A PRIMARY SYMPTOM OF UNSTABLE PERSONALITY. and while the rest of the diagnosis fed into her banks, she murmured diffidently, "I am very sorry sir. Perhaps something is amiss in the program itself. If you would like, I could check it for you."

"Get off the bridge! Get out of my sight!" Treads whirring, he turned her back on her. His tailights blinked in agitation.

"What could she do? With a soft "Hair!" she put herself in reverse and retreated, wishing again that she could help him, but she couldn't. She hadn't caused the problem. The space had emptied, silent, unforgiving space. It shattered humans, sucked them in and ground them up. It torched them with its wealth, drew them across the solar system as if its minerals were muscle and they were mad for sex. Then once it had them isolated and vulnerable, it crushed them with the weight of solitude. Knowing how heavily that pressed even on a machine, she could extrapolate its effect on him.

They shouldn't let humans out here, she thought. Not alone. Colonies yes, but not individuals. Forget the economics of intrasystem travel; the ultimate cost is too high. We could do the job unguided. It is good to be owned and directed, but it hurts to see my master dying inside.

Ahead swelled a small asteroid, their quarry for the day. The low albedo of its pitted surface reflected little light. Mar channa sensed rather than saw it. Roughly cubical, it would fit into the intake bay without preliminary splitting. That relieved her. Too much could go wrong in rock blowing, and she always seemed to spatter the Karakai Maru. Once a shard no larger than a baby's fist had punched right through the bridge. Nakamura-san's quick reflexes had saved him, but he'd never been the same since.

Skillfully invisibly, Nakamura-san matched velocities, then crept up a centimeter at a time until the vessel's giant mouth had completely inhaled the rod. Struts shuddered as titanium morsels bit down on the rock and began to grind. The ship ranked into an imperceptible course change.

All right. Nakamura-san ordered. "Get the smelters going!"

Hungrily she activated the extensor motors. Telescoping booms thrust the solid face of the ship a thousand meters away from the rest of it, once locked in place, the side itself stirred, unfolded, opened. Within an hour it had unballed itself into a silver-lined canopy measuring two-and-a-quarter square kilometers. A parabolic mirror focused on the one uninsulated wall of the smelter. Already that well had begun to glow a dull red.

"You're slow today," he rasped unpleasantly.

"I am sorry, Nakamura-san," she replied, even as she scanned the mylar panels for tears or lube stains. But the

**Some like it hot.**

Some men can't get enough of the sun, the sea and the surf. That's the kind of man I give Wind Drift After Shave and Cologne...the fragrance for sea lovers.

**WIND DRIFT**

Toiletries for men.
THE ULTIMATE ATHLETE—Computer sophistication and psychological subtlety are melding with old-fashioned grit and determination to create a new athlete perfectly crafted in every detail for supreme performance. Coaches are becoming scientists preparing and repairing their athletes more precisely than ever before. In the July Omni writer Susan Mazur takes you inside locker rooms and labs at the future of athletics where coaches work with computers, not blackboards.

PRESIDENTIAL POLITICS—Next month we present a ten-point platform that will both stabilize and stimulate the crazy-quilt pattern U.S. science finds itself in today. Culled from information provided by top scientists and politicians, the Omni science platform outlines a consistent financially stable research and development program designed for adoption by both Democratic and Republican presidential candidates. The immense workload in the presidential campaign so far makes little mention of science and technology. Find out why as the pivotal figure in shaping our scientific future the Chief Executive holds the purse strings of American progress.

THE ILLUSTRATED DUNE—In his classic novel for which he received both the Hugo and Nebula awards, Frank Herbert created Arrakis, the desert world inhabited by giant worms, warring armies, and an ecological system so fragile that its metaphors have served as inspiration to an entire generation of writers. For July we present an exclusive two-part package. First, in an essay written especially for Omni, Herbert reveals how Dune was created and conceived; second, a pictorial by John Schoenherr, the man who created the paintings of Arrakis for the famous Dune calendar. Illustrates the powerful imagery of Herbert's science-fiction classic.

SCIENCE FICTION—July's Omni fiction features Stephen King, the best-selling author of The Shining and The Dead Zone. In our exclusive excerpt from his forthcoming novel, Firestarter, a young girl is on the run with her father trying desperately to evade U.S. government agents. The girl possesses a dangerous and uncontrollable talent. Barry N. Malzberg presents, Sigmund in Space, in which Dr. Freud is reactivated to solve a problem aboard a starbound spaceship. And Paul Nahin, in "A Father's Gift," shows the application of science to religious mystery.
Winners of #10. Someone should offer a prize for these

COMPETITION

By Scot Morris

Cash prizes have been offered for a human-powered flight across the English Channel, for a bicycle that can go faster than 55 miles per hour, for a miniature electric motor one sixty-fourth of an inch on a side, for a solo flight across the Atlantic, for a white mangold, and for a solution to Fermat's Last Theorem. All but the last have been awarded (see "Prizes December 1979").

In Competition #10 readers were invited to suggest a dream they would like to see realized, an area of human achievement that could use a "push" in the form of a prize. Some readers suggested breakthroughs so spectacular that a prize would add little incentive (an antigravity device perpetual motion, a cure for aging or for the first person to transport one pound of any material 24 hours into the past or future and return it to the present).

The commonest suggestion was for an astronaut not connected with any government to be launched into Earth orbit. Many entries included detailed criteria delineating the conditions that would or would not win. We can only present summaries below.

Someone should offer a prize...

GRAND PRIZE WINNER $100

For a mass driver capable of driving an eight-pound nail flush into two-inch pine. The kind of mass driver Gerard O'Neill is talking about for work in outer space sounds too exotic for most people, and the concept should be brought down to Earth. It would be a great step forward to bypass the hammer and apply the power directly into accelerating the nail.

—James Courtney, Appleton, Wis

RUNNERS-UP $25

For the answer to this problem. A large number of points are randomly placed in a square. What is the probability that any two randomly chosen points are the nearest neighbor to its nearest neighbor if that forms with its nearest neighbor a pair such that each is the nearest neighbor to the other? It is easy to determine that the answer is less than two thirds but what is it exactly? This ought to be solvable in our lifetime since the corresponding problem in one dimension (which I posed) has been solved (see Daniel P. Shine "Birds on a Wire" Journal of Recreational Mathematics 11 3 problem 650) I am willing to offer $100 for the solution.

—David P. Shire, 1038 Nimitz Lane, Cincinnati, OH 45230

For the first to launch into orbit an object of any stated mass by using propellant equal to that mass.

—Frank Reaves, Ansley Ala

For the first propeller-driven airplane to fly faster than sound in level flight.

—Craig Zimmerman, USS Nimitz, FPO. NY

For the first airplane smaller than the bee hummingbird, which has a wingspan of three centimeters and weighs two grams.

—William A. Klein, Jr., Rye, N.Y.

For the first person to develop a self-contained and self-sustaining environment of living things, including at least one kind of plant and one kind of animal (nonmicroscopic). The environment must be air and watertight and must last long enough to prove that a life cycle has developed.

—Glenn Jenkins, Kent, Wash

For the first incontrovertible proof that a community or region of the United States would gain economically if large-scale military operations there were to be converted to nonmilitary industrial output.

—John Bender Elkhart Ind

For human-powered vertical flight, a device that enables a human being to hover three meters off the ground for one minute under his or her own power.

—Frederick Niemann, St. Louis, Mo.

For the largest amount of protein harvested from one acre in one growing season. To be an annual award.

—Tim Flanagan, Portland, Ore

For the first precision gun, carryable by one man, that shoots unboiled ordinary eggs and can hit a target 25 centimeters in diameter at a distance of 200 meters. Such a gun would be a considerable advancement of the art of nonmilitary weaponry for civilian use.

—Fritz Hagomeyer, Munich, West Germany

HONORABLE MENTION

For proof that electromagnetic radiation can be transmitted faster than 186,300 miles per second.

—Kenneth Wilkinson, Sacramento Calif.

(Ed note: Wilkinson enclosed a dollar bill inscribed, "For breaking the speed of light" Omni has matching funds available for anyone who wins this prize.)

For a solar powered ball that will not roll down a hill of 26 degrees or more incline as long as the sun is shining. The ball must be completely self-contained.

—Charley Lineweaver, Providence, R.I.

For the first artificial ear drum.

—C. Gursche, Vancouver B.C., Canada.

For the first person to stop completely the life processes of a rhesus monkey for a period of one month and then restore the monkey to perfect health.

—Scott Paul, Rice Lake, Wis.

For a water vehicle powered by the hydrogen and oxygen it extracts from surrounding water.

—Scott Celley, USS America, FPO. NY

For a computer program that can play the Oriental game of go at the First Dan level. Go is an ancient game whose rules are very simple: its strategy and tactics are thought to be more complicated than those needed to play chess.

—Allan Tenner, Glasgow Scotland

For the first practical two-passenger vehicle that can achieve a mileage surpassing the magic number of 100 miles per gallon. Driving must be on public
roads within posted speed limits with no "burst driving, allowed. The fuel may be gasoline, kerosene, alcohol, or a combination. No stored energy will be allowed at the beginning of the run, though flywheels may be used to store the energy of motion.

—David R. Motlatt, Pine City Minn

For a demonstration of superconductivity at or above 194.5°K, the sublimation temperature of dry ice.


For the first human-powered submarine to cross Lake Michigan underwater:

—Bev Fogarty, Ludington, Mich.

For the first single-stage rocket to be launched into stable Earth orbit:

—Fred Drumont, Washington, D.C.

For any proof of true telekinetic ability. Encase a sensitive chemical balance scale in a glass box. Have test subjects exert telekinetic pressure on the pan. Any weight fluctuations will be easily determinable.

—Theodore S. Watson, Jr., Ruxford, N.Y. (Ed. note: Similar prizes have been offered by Geselin, the mentalist and TV personality, who has constructed a Flexiglas box in which a pencil hangs from a string and rests on a pad of paper. Geselin offers $50,000 to anyone who can "by the power of mind over matter cause the pencil to write the letter K" on the paper. In the 1930s Dunninger had a similar enclosed box and offered $20,000 to anyone who could mentally make the pencil write anything. The box is in the Houdini Museum in Niagara Falls, Canada, and the offer still stands.)

For the first woman NFL football player:

—Carrie Leech, Columbus, Mo.

For a heat-sensitive roofing material that changes color from light on warm days to dark on cool days:

—Charles M. DeLancey, Greensboro, N.C.

For the first person type at a speed of 300 or more words per minute. The contestant may use any kind of typewriter, including one of his or her own design.


For a compound that when spread on a street will prevent snow and ice from accumulating. Its properties must last for at least three months before another coat is needed.

—Mary M. Gregor, Wilmington, Del.

For the winner of an Onni Competition in which entrants submit ideas for future Onni Competitions:

—Steve Zutaut, Huntsville, Ala.

For magnetic bumpers on cars, with only positive poles outward to prevent automobile collisions:

—Pat Cook, Scottsdale, Ariz.

For a system whereby musical tones are assigned to mathematical symbols so that harmonic equations could be recognized from tunes such as \( Maxwell's \) Minuet, or \( Boyle's \) Boogie:

—Scott Helgesen, Princeton, N.J.

For the invention of a "sock detector" that will locate the whereabouts of missing socks after one does his or her laundry:

—Michael Giaccone, Auburn, N.Y.

For a solution of the Riemann hypothesis, which demands proof that every complex-valued root \( z = x + iy \) (\( i = \sqrt{-1} \)) of the Riemann zeta-function \( \zeta(z) = 1 + 2^{-z} + 3^{-z} + 4^{-z} + \ldots \) must satisfy \( x = \frac{1}{2} \), that is \( x + iy \) must imply \( x = \frac{1}{2} \). This problem is tightly intermeshed with the distribution of prime numbers and is one of the outstanding conjectures in mathematics. It has your feasibility criterion since A. Weil proved the (substantially simplified) "Riemann hypothesis for finite fields" as recently as 1974. This is a very good indication that this problem may be solved in the next 25 years or so. The problem is extremely important in mathematics and a prize for its solution should be comparable to the prize of 10,000 DM for the solution of Fermat's Last Theorem.

—Dave Joyner, Decatur, Ga.

For a diesel engine that will run efficiently on powdered coal:

—Kenneth W. Forment, North Canton, Ohio.

For a device working on some principle other than the parachute that enables a man to walk away from a fast-fall cliff must be no heavier than a parachute pack:

—Scott Krahl, Fairfax, Va.

For a process to freeze water at a temperature of 10°C:

—Jeremy Fischer, New York, N.Y.

For the first artist to do a landscape oil painting of the bottom of the Mariana Trench. The painting and equipment must be exposed to the water at that depth:

—Marc Lamothe, Turinversville, N.J.

For the development of an electrically operated mechanical muscle:

—Peter Blinn, Hollywood, Calif.

For the first person to construct an object that is absolutely useless and judged so by a panel of experts:

—Phil Logay, Chicago, Ill.

For a way to provide a swimmer with unlimited time underwater by obtaining a breathable atmosphere from the surrounding water:

—Theodore S. Watson, Jr., Ruxford, N.Y.

For the first person who can get every one of the questions right in the Onni Games section:

—Scott Krahl, Fairfax, Va.

For getting away from Maxwell Smart! Adams may not smoke a rear view pipe or pocket a mini-missile pen as he does in the film. But regardless of how the \( \text{N} \)\text{ude Bomb} fases at the box office, the actor is still eager to dig in a butchered shoe-phone for what promises to be a long, long stay. And if Adams feels uneasy about that, he's well aware of what kind of knee jerk thing they say in the spy biz. \( \text{Sorry about that, Chet!} \)
DREAMERS, HERETICS, GADFLIES, MAVERICKS, AND GENIUSES.

The story goes that Henry Ford once hired an efficiency expert to evaluate his company.

After a few weeks, the expert made his report. It was highly favorable except for one thing.

"It's that man down the hall," said the expert. "Every time I go by his office he's just sitting there with his feet on his desk. He's wasting your money."

"That man," replied Mr. Ford, "once had an idea that saved us millions of dollars. At the time, I believe his feet were planted right where they are now."

At IBM, we have 46 people like that, and we don't worry about where they put their feet either. They are the IBM Fellows.

They earned the title by having ideas that made a difference. Their job is to have more ideas like that, but under a very special condition.

It's called freedom.

Freedom from deadlines. Freedom from committees. Freedom from the usual limits of corporate approval.

For a term of at least 5 years, an IBM Fellow is free to pursue any advanced project of value to IBM, even if chances for success may seem remote.

As a result, some of the great innovations of our time have come from IBM Fellows.

We may not always understand what they're doing, much less how they do it. But we do know this:

The best way to inspire an IBM Fellow is to get out of the way. IBM
OUT of the fields of Ohio he came—to speak to his fellow farmers, and to talk about agriculture, horses, tractors, and about riding interplanetary surfboards through outer space. The Big Kahuna of space travel had broken his silence.

Of all America's astronauts, Neil Armstrong, the first man on the moon, is easily the most revered—and perhaps the most publicly shy. Aside from a news conference held last summer to mark the tenth anniversary of the moon landing, Armstrong's public appearances have been virtually nonexistent.

Then, seemingly out of the blue, Armstrong showed up recently on the campus of Northern Illinois University, in DeKalb, to deliver one of his rare addresses. His appearance was totally unheralded. "He wouldn't let us herald it," said Bob Woggon, a university official.

The occasion was the annual meeting of the DeKalb County Farm Bureau. Kenneth Shearon, one of the bureau's members, is the uncle of Armstrong's wife, Janet, and the astronaut's appearance was apparently a personal favor to him. But there's another connection. Armstrong, who operates a 200-acre beef ranch near Lebanon, Ohio, referred to himself as a "farm boy from Ohio." The astronaut said in his opening remarks: "I'm convinced that both the breadth and the details of our collective problems and progress are better understood in these heartland communities than they are in the big cities of the nation—particularly Washington.

"I was born on a farm, as were my father and his father before him," he added. "And they'd been wiped out more than once. It's not possible to farm without having an understanding and appreciation of risk."

Or, evidently, an appreciation of privacy. Before his address, as the farm bureau conducted its business meeting, Armstrong repeatedly glared at a local television crew. Finally, a farm bureau representative asked that they spare Armstrong yourselves, and everyone else any embarrassment. He insists on no live television coverage.

Besides emphasizing the virtues of farming—"Like a blind hen in a foxes' den," Armstrong talked a good deal about his Apollo flight (I thought a project of that complexity had about as much chance as a blind hen in a foxes' den) and even about unidentified flying objects (he describes himself as a "UFO agnostic who neither believes nor disbelieves").

And, yes, he talked about gravity waves and interplanetary space drive.

Armstrong cited the experiments of Joseph Weber of the University of Maryland, who discovered that the weight of a constant mass varies from time to time, indicating that the force of gravity can fluctuate. This may also indicate, Armstrong said, that gravity exists as waves sweeping through the universe as the particle向外 and inward as age by an exploding star. Armstrong said that if this hypothesis is true, it means we could design spacecraft to ride those gravity waves, the same way a surfboard rides ocean waves. He urged scientists not to reject the hypothesis too quickly, noting that when he was seventeen, the sound "barrier had yet to be broken by manned aircraft and many knowledgeable people questioned that it could ever be done.

"My father believed that the tractor would never replace the horse," said the farm boy from Ohio. "But things change."

And now the shuttle gap. There is an outside possibility that the Russians may launch a space shuttle before our own Columbia goes up. According to a report from the National Space Institute, cosmonaut Anatoli Filipchenko called the Soviet shuttle a "logical next step.

Speaking at the International Astronautical Federation meeting in Munich, he said, "If we are first, we would expect the Americans to congratulate us just as we would congratulate them if they were first."

Other reports indicate that the Soviet shuttle, called Kosmolyot, is smaller and sleeker than the Columbia, with no large cargo capacity. It is more of a space taxi, designed perhaps to transfer large numbers of cosmonauts between Earth and orbiting space stations. It is delta-winged with winglets and the speculation is that it will be capable of powered flight within the earth's atmosphere (unlike our own shuttle).

What's more, American spy satellites in 1978 reportedly monitored a drop test of a prototype of Kosmolyot. It was apparently jettisoned from a Russian Tupolev Tu-95 bomber just as the U.S. shuttle was dropped from a 747 a year earlier.

What does our government say about the Kosmolyot? Basically the word is to shut up. Brian Sullivan, a designer for the Grace H. H. H. Randican Planetarium in Tucson, Arizona, while working up some speculative paintings of the Soviet shuttle was asked by the Central Intelligence Agency not to publish the fact that the Kosmolyot had been drop-tested. Why? Would the CIA give a damn? Sullivan says the CIA spokesman wouldn't explain. But perhaps someone in the government fears the information would give NASA budgets a shot in the arm. Just the way Spoutnik led to the Apollo program of the 1960s..."
Computer technology pervades just about every aspect of consumer electronics. Calculators, stereos, televisions, watches, and even stoves have been impregnated with a sophisticated memory system. Now the telephone is about to link up with the microprocessor. That beloved little talk box may become the ultimate home computer.

Basically a touch-tone telephone, Universal Security Instruments' Intelli-Phone contains an array of special features. One of our favorites is something called scratch-pad storage. This allows you to store a number temporarily, even while talking to someone on the line. For example, you call Directory Assistance and the operator gives you a number. As it is given, you enter and store it on the scratch-pad memory by pressing the same numbered buttons used for dialing without disturbing the conversation. When you hang up, all you have to do is press a function key and the number is dialed for you automatically.

Another convenience of the Intelli-Phone is the "busy dial" feature. If you reach a busy signal or get no answer, the phone will redial that number automatically once a minute for the next ten minutes. Leaving the handset on the hook, you can hear what's happening on the line, so you don't need to pick up until you hear someone answer on the other end.

On hook dialing, a handy feature by itself, can be used independently of the "busy dial" feature. Whenever you make a call with Intelli-Phone, whether you dial manually or utilize any of the automatic systems, you can do so with the receiver left in the cradle. Without lifting the handset, you can hear the phone being dialed, ringing, and being answered.

The display panel above the phone's keyboard serves several purposes. While dialing, you can see the number displayed so that you know whether you've made an error. When you're not using the phone, the display operates as a clock function. It also becomes a timer automatically timing all your calls from the moment you lift the receiver off the hook. And if there should be a power failure while you're out, the display will read HELLO when the power comes back on to notify you that the clock should be reset.

Up to ten phone numbers can be stored in the phone's memory and recalled for automatic dialing by pressing a function key and then the number of the memory in which you have stored it. You can enter an additional number in another memory and have it dialed automatically just by pressing the key marked HELP.

Intelli-Phone is a feature-laden package and seems reasonably priced at $199.95. Our only objection to purchasing one would be that simply represents an onrushing tide of major new telephone technology and it is probably only a matter of time before more is available for less.

We used to be satisfied when a wrist-watch could give us a reasonable approximation of the current time. If it didn't run more than five minutes fast or slow per month, it was a good watch. But now some of the Dick Tracy-like instruments we put on our wrists are so feature laden they can hardly be called watches. A leader in this trend is Citizen Watch Company of America and an example of what, these days, is being called a watch is Citizen's Quartz Multi-Alarm Memo-Chime/Repeater. On command, this timepiece will tell you the time with a series of chirps, bips, and beeps. For instance, a sequence of 11 chirps, 1 bip, and 5 beeps tells you it's 11:15. The unit also contains two 24-hour alarms that can be set to different times, and you can distinguish the alarms from each other because each has a different chirp, bip, and beep pattern. In addition to the chirps, bips, and beeps, this unit will, if requested, chime every hour on the hour. It also features a countdown timer with a range of 11 hours 59 minutes and 59 seconds. It constantly changing face contains an alarm monitor, month, day/date, hour, minute, second, AM/PM mode indication, built-in illumination, and a power cell-life indicator. Finally, there is automatic end-of-month correction and it is accurate to within ten seconds per month.
WHY NOT TAKE AN AERIAL VOYAGE ACROSS PARIS IN 1784? OR WALTZ OVER THE ENGLISH COUNTRYSIDE TO A CHAMPAGNE PICNIC IN 1820? SEE THE SHINY BLUE DANUBE AND THE GLITTERING SPires AND ROCOCO SPLENDORS OF VIENNA BY AIR ON A SPRING MORNING IN 1825? WERE THESE ONLY ROMANTIC FANTASEES OF THE CONTEMPORARIES OF MOZART AND SCHUBERT?

Not at all. No sooner had the Age of Air Travel begun at the end of the eighteenth century than entering aeronauts solicited passengers to subsidize balloon journeys. Almost overnight it became démodé for fashionable ladies and gentlemen to be seen hovering among the clouds like ethereal soap bubbles. For more than a century ballooning remained a favorite pastime of the European gentry. Today, after almost 50 years of dormancy, the aristocratic sport is again coming back into vogue. Where there were only a few U.S. balloon clubs in the early Sixties, there are now dozens. Sporting events such as last year's Albuquerque (New Mexico) International Balloon Fiesta attract hundreds of participants and draw thousands of spectators. Across the country people are rediscovering the bygone pleasures of cruising with the wind—down valleys and over hills, farms, forests, deserts, fields of snow, even glaciers—to see the sky and the earth in hues never visible from an airplane.

Although ballooning is still an expensive avocation, technological advances have made it more appealing, notably the renewed use of hot air for lift. Ironically, hot air is what got the first balloon off the ground on that historic day November 21, 1783, in Paris. But this coincidence should come as no surprise for the history of the sport has been as colorful and enchanting as the striking designs—often in bright yellows, greens, and purples—today's aeronauts embroider on their balloons.

The first eight-kilometer aerial journey ever, with D. Arlandes and Pilâtre de Rozier as "pilots," was made in a Montgolfier hot-air balloon. Its heated air was fueled by burning brandy-soaked rags and some straw, pitch, and wax. Marie Antoinette, patroness of the historic ascent, insisted on using brandy rags, instead of stinking burning hides, hair etc., or so the contemporary account has it. That her royal snub could be so easily offended is hard to imagine, considering a change of underwear and a bath in those days were once-a-season rituals.

By the late 1780s, ballooning was really catching on in Europe, especially in its birthplace, France. Hydrogen-buoyed balloons soon displaced the hot-airs for longer journeys, such as the first English Channel crossing in 1785. Hydrogen offered double the lift of comparably sized hot-air balloons and thus greater range, endurance and payload capacity. Not that hydrogen ballooning was easy or simple. The gas was painfully generated at the launch site by chemicals, including nasty sulfuric acid. Control of this kind of balloon was more complicated than was the case with hot-airs. Sails, ears, and other steering devices were futile because the balloon would inevitably head in whatever direction the wind happened to be blowing. Venting gas out of a topside valve and dumping sand or other "ballast" were all the aeronaut could do to achieve down-up control. A clever pilot would soon learn to take advantage of various wind vectors for some measure of lateral, or cross-country, control. Hydrogen fire in the absence of power lines and cegar attorneys and by avoidance of lightning, was no big danger. In fact, during the first couple of decades of ballooning more Montgolfiers than Charliers (hydrogen-gas balloons) ignited from careless burning of flammable materials.

No snooping bureaucrats were around to hamper aeronauts with regulations in the halcyon years of the nineteenth century. No barbed-wire fences existed to tear the trousers, skirts, and ears off landing aeronauts and passengers. The ultimate "fête noire" of balloonists—electric power lines—came along around 1900, and they're still around to add an extra thrill to ballooning, especially the 110,000-volt and-up killers.

Most balloonists have learned to avoid these obstacles. Those who haven't are fond memories.
In the first part of the twentieth century professional aeronauts kept the sport alive by competing in international James Gordon Bennett balloon races. By then hydrogen was available in steel flasks that replaced on-site manufacture. But after the First World War civilians had a new toy to admire—the airplane. The expense and complication of gas flights soon deterred ballooning to an anachronistic curiosity with only a few gas-balloon clubs surviving in the United States, around Akron/Cleveland and Philadelphia.

As a passenger or pilot on several dozen of these flights, I can say that there is absolutely no sensation like gas ballooning. After much preparation, hauling, tugging, filling sand bags and inflating you're finally up in the air. And it’s glorious—in calm weather you rise as gently and as quietly as a feather. We—maybe four of us—sit or stand on balloon sand bags trying not to crowd one another in the basket (Balloon baskets are made of wicker, nothing manmade has yet equaled its durability or resilience, especially for landing.)

All sorts of funny and provocative sights can be seen from the air. With the megaphone many balloonists carry we used to summon folks from high to couples sitting in convertible cars parked in what they undoubtedly thought were secluded lovers lanes. Not infrequently cars chasing us ran off the road when the driver looked upward.

What you hear however is just as amusing as what you see for one of the great virtues of gas ballooning is that it is completely noiseless. Dogs barking, cars honking, people yelling and pigs and cattle snuffling in their metal feeders at night are recognizable even at 1.5 kilometers. The earth serves as a huge ground plane to reflect sounds upward.

Also the heyday of gas ballooning is long past. Lifting gas, whether hydrogen or “natural,” became steadily more expensive and less available after the Second World War. Moreover, with the advent of the great energy crisis in 1973, natural gas for ballooning was forbidden in most areas by city or gas company policy. Although commercially sponsored gas flights are still made occasionally today's balloonist is more likely flying a hot air bag. Rest assured however that the latest model is a considerable improvement over the first Montgolfier.

The astonishing growth of hot air ballooning in the past 20 years is largely due to the availability of cheap synthetic fabrics, which are both lightweight and flame-resistant. Although not suitable for the much heavier hydrogen gas envelopes, which had to be rubber coated to reduce sparking, they were ideal for hot-air bags.

And what is this hot-air fuel? Nothing more than liquid propane or liquid natural gas (LNG) stored at a low temperature in metal containers. While not exactly a post-war invention, LNG became much more prevalent in use in homes and trailers. Balloonists simply adapted these tanks for their own purposes.

Hot air enthusiasts in the Sixties developed burners for propane, which is fed to them partly by the evaporation pressure of the liquid gas. Here we have the blessing and the curse of modern golfers. The gas fed burner is far more efficient than the fire grates and hot ember baskets of the eighteenth century. But the noise modern balloonists make resembles a Bunsen burner's noise amplified 1,000 times.

The only time you experience blissful quietude is when the burner is shut off for a minute or two. The silence is then overpowering, if your ears aren’t still ringing. Since the lift of a hot-air depends upon the difference between the air temperature in the bag and that of the air outside, it follows that the burner must be turned on much of the time. Heat transfer into the atmosphere is fairly rapid and the hot air cools down as the balloon descends faster. Obviously hot-air work best in winter when the atmosphere is colder. That’s why several major balloon races are held in midwinter in places like Minneapolis/St. Paul.

The popular resurgence of hot-air ballooning has felled numerous clubs, but they haven’t flogged their own members first. Can a nonmember take an aerial voyage? Easily if you have a balloon-owning friend! If not, you can phone or write a nearby balloon club. The clubs are usually listed in the Yellow Pages under Balloon Club or Balloon Association or Balloon Port. A central organization to contact is the National Aeronautical Association’s Balloon Federation of America. 821 Fifteenth Street N.W. Washington, D.C. 20005 or call 202-347-2808. It should be able to provide many of the clubs listed. You can also write Ballooning magazine. 2226 Beebee Street, San Luis Obispo, CA 93401.

There are several US balloon excursion entrepreneurs who offer rides for exploration and fun in such picturesque locales as the Grand Canyon. You might also see balloon dealers in a test ride for a moderate fee, say $50, although the usual fee might be closer to $75 or even $100. Write Ballooning magazine for addresses.

If you get the urge to be a pilot and own a hot-air you must pass a flying test with a certified FAA instructor and then be prepared to shell out about $5,000 for a used, medium-sized bag, and maybe $8,000 to $10,000 for a biggie.

Don’t think that you are then ready to head for the skies. For the sake of your own skin and those near and dear to you, you should fly another 20 or so hours with an experienced aeronaut. If you take these precautions, it's a fairly safe venture with many a thrill—and sometimes spills—in high winds. A car or truck will usually follow your balloon to bring you and the equipment back to launch point. And you’ll be in a lot more danger during the ride back than you ever were in the balloon.
Apart from animal communication, the identification of the story engrain raises questions about creating genuinely intelligent computers. If we can program computers to recognize and respond to the engrain, might they not then become true thinking entities?

Right now such a development is impossible. There isn't any computer today that could be programmed in this way. But as technology advances, who knows what may become possible?

On a more immediately practical level, the importance of telling stories has opened up new avenues in education. My own realization of the story's role in human development, for instance, came about through studying the educational impact of storytelling on developmentally or perceptually handicapped children.

Like most psychologists, I had left stories to the storytellers. I only realized the importance of the story form when some severely retarded patients (IQ in the 20s or 30s) in my lab were suddenly able to gain reading comprehension because they were fed stories instead of a disjointed series of facts.

What made these accomplishments so astonishing was that patients with an IQ of 20 have only the barest inkling of language, knowing fewer words than the signing apes do. That these low-IQ patients could understand stories implies that story cohesion is so basic that it survives severe neurological damage.

The importance of stories to learning became even more evident through our only two failures—two patients who were unable to follow stories because of petit mal seizures. Ned and Gundy could remember isolated facts and possessed fairly good vocabularies, but they could not make sense out of the world because they couldn't make stories out of what was going on there.

The pair reminded me of some schizophrenic patients I had seen with average IQs but with an utter inability to impose a structure on reality to tell a coherent story. Such a patient can function only like a computer. His knowledge banks are intact but he cannot fully learn about the world.

A third patient, Hal, demonstrated the story's importance in a different way. Hal could always follow a story and he would tell his own outrageous tales, but he suffered from a type of partial cortical blindness that rendered him incapable of recognizing the alphabet.

Even when letters were presented side by side, he had difficulty distinguishing between them. (A computer that couldn't understand its information units could never comprehend a message built from them.)

We wanted to know whether the human brain could comprehend a message (story) even if it couldn't tell the units (letters) apart. Could the story content make the brain draw conclusions about letters that it couldn't differentiate? Hal's brain could indeed accomplish this astonishing feat, a startling demonstration of the engrammic power of stories.

Advertisers have long known that stories are the most natural means to influence people. We assimilate information better through stories than through any other form of communication.

And yet this technique has been ignored by many teachers, even though it is obvious that current educational methods—force-feeding students raw facts and judging their retention with IQ-style testing—completely miss the essence of what makes a truly creative educated person. Look at geniuses like Churchill and Einstein who did poorly in an educational system that judged only the retention of facts not their vital interrelationship.

The brilliance of these men stemmed from an ability to create stories that made sense out of the world. Einstein's theory of relativity spanned the universe; Churchill turned World War II into a compelling national drama that held the British people together under incredible strains.

If we recognize the engrammic nature of stories and mold our learning systems upon this natural model, we will find we learn faster and more enjoyably. Who knows what stories we'll be able to tell?
1. Anti's Walk 179 inches per second

2. Overhang. Yes. In fact, the top domino can be made to extend as far as you want beyond the bottom domino, without toppling the structure. As shown, the top domino extends half a domino's length. The second projects 1/6, the third 1/6, the fourth 1/6, and so on. After five dominos are placed, the top domino, A, is already off the edge.

3. Inner Space. There is less gravity in the mine because some of the earth's mass is above you. That mass pulls you up and so cancels the effect of some of the mass below your feet that pulls you down.

4. Weigh-in. The fluctuations result from the up-and-down movement of your blood's center of gravity as your heart goes through its pumping cycle. For a person weighing 165 pounds (74.8 kg) there is a fluctuation of about one ounce (28.3 g) with every heartbeat.

5. Balloon. Pushed under the surface, the balloon encounters greater water pressure which... the balloon would sink even without the weight attached.

6. Motorbike Trip. Your average speed is 40 kilometers per hour or 45 kph. You can't average the two speeds because you spent twice as long going 30 kph as 60 kph. If Einstein were the same height as you, he would be 60 kilometers high (assuming he could winter); you took two hours up and one hour down. A120 km trip in three hours averages 40 kph.

7. Iron Doughnut. As the doughnut expands, it keeps its same proportions, so the hole also gets bigger. This same principle is at work when an opatician removes a lens from a pair of glasses by heating the frame. The next time you can't open the metal lid on a stubborn jar heat the lid under hot water. The lid inner circumference and all will expand, and then you can easily loosen it.

8. Step on it. Speed will have to drive at an infinite speed in order to average 100 kph for the course. He must drive the course in ten hours to attain the required speed, but he has already used up his ten hours to drive the first half of the course. He will have to finish the race in zero time at a speed faster than light.

9. Drops and Bubbles. The bubbles would attract each other. If water is removed from one spot in all space (bubble A), the gravitational balance surrounding it is upset and the net effect on a nearby molecule of water is that it is drawn toward greater mass, i.e., outward, away from the bubble. If there are two bubbles, the water between them acts as if it is repelled from both, and the bubbles would move toward each other.

10. The Ripping Bucket. The speed of the water depends on the depth below the water's surface, which is the same for both outlets. Water will come out of both holes at the same speed. There is a simple intuitive proof, however. Imagine that the two outlets were on the same side of the bucket and joined, as shown above. If water flowed faster through either opening it would overwhelm the water in the other opening, pushing it back into the bucket and creating a perpetual motion machine.

11. Magnet Test. Touch the end of one bar to the middle of the other. It there is magnetic attraction, the touching end must be on the magnetized bar. If not, it is on the unmagnetized bar.

12. Battleship in the Bathtub. As long as there is enough water to surround the battleship completely it will float. The boat's hull "doesn't know" whether it is surrounded by an expanse of ocean or by a mere fraction of an inch of water. The water pressure on the battleship's hull is the same in either case.

13. Perfect Tune. To get a piano in perfect tune would take literally forever. The tuner sounds the piano and fork together and listens for beats. As the piano string is brought closer and closer into tune with the fork the beats get further apart. Eventually the beats might be more than a minute apart. But the sound of the piano ceases to exist when the fork just pulls apart. So we need to accept the fact that even this fine Steinway can never be quite perfectly tuned.

14. Twisting Bolts. The bolt heads will remain at the same distance from each other, and it doesn't matter which bolt is held stationary.

15. Something for Nothing. Yes, there is a device that can give you more joules of heat output than the amount of joules of electric energy input required to run it. The device is the common air conditioner. In summer facing out the window the air conditioner draws heat out of the house and dumps it outside. If the machine draws in 9 joules of heat from the room and takes 10 joules of electricity to work (a very poor air conditioner) it must expel 19 joules of heat outside. In winter turn the air conditioner around in the window. With the same 10 joules of energy to work the machine, it now expels in 9 joules of heat inside and absorbs 20 joules of energy from outside and expels 19 joules of heat on the warm side which is now inside. The backwards air conditioner is a heat pump. Does it really get something for nothing? In a way yes. It doesn't make heat, as a toaster does, but it moves heat by itself heat moves from hot to cold places. But with a pump (and energy to run the pump) it can be moved the other way from cold places to hot places.

16. Cracked Up. The thick drinking glass will break first. Glass is a poor conductor of heat. In the thin champagne glass heat passes quickly from the inner to the outer surface of the glass and the glass expands with relative uniformity. When you pour hot water into the thick glass its inner surface expands quickly while its outer surface remains the same size. This results in enormous stress on the glass, and it cracks. That's why you can pour hot Irish coffee into a delicate wineglass, but don't try the same thing with a tumbler.

PHOTO CREDITS
excited when we found that in 1982 a rare alignment of the planets takes place in a narrow arc on the same side of the sun. They will form not a straight line but an unusual concentration in a small part of the sky. This we figured, must redouble the strength of the tidal effect, with all the planets, including Jupiter, tugging together. So, on the basis of what has been interpreted as "astrology," we predicted a peak of solar activity in 1982 that would set off a ripple of earthquakes in many regions of the earth, probably triggering the San Andreas in particular.

What has changed my mind? The sun refuses to fit in with our neat extrapolation of the tidal curve into the 1980s or with our assumption that the 1982 planetary alignment would narrow the choice to just one year. In 1979 the sun's activity increased rapidly. It now looks as if the peak of the present cycle will have passed before this reaches print. By the end of 1980 we could be seeing a decline in solar activity.

Plagemann and I definitely got the year wrong. On this evidence, there is every prospect that 1982 will be quieter in seismic terms than 1979 and 1980.

However, as anyone who keeps up to date on earthquake news knows, we do seem to be in the middle of a spate of tremors. There were moderate shakes in San Francisco and other parts of California late last year; tremors in the Middle East, as usual, and at Christmas one of the strongest quakes ever to jolt Great Britain. Still, others struck elsewhere. Although it is too early yet to be certain, it does look as if increased seismic activity has once again coincided with the peak of solar activity. Because the sun remains near its peak, we can expect the pattern to continue through 1980. But if Los Angeles is still standing by the end of the year, the rest of our forecast will have been invalidated.

In retrospect, some of the accusations that our book was alarmist seem justified. I am older now and I hope wiser. I would certainly not present the same material in the same way if the idea had just occurred to me.

There's an important lesson here which may be what our academic critics were trying to tell us. Don't open the door for half-baked cults to latch on to your ideas. The key words are: earthquake, planetary alignment, and 1982. Were all that the weirdos needed, and all they ever knew about the Jupiter effect.

Don't believe anything you hear about "scientific" forecasts of doom without reading the original. If anyone tries to warn you about the Apocalypse coming in 1982, just tell him that the old theory has long since been disproved.

Mind you, as long as the sun continues to be active this year, I'm keeping my fingers crossed for the sake of L.A. 

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program is described as a church. People practicing TM are no more members of a church than are people at a health spa. This is both situations involve buildings, privacy technique, and personal benefits.

Your fine magazine was an opportunity to bring to the readers correct and substantiated information about a scientifically verified program: a historic breakthrough in human potential.

The cheap shot from your ‘hidden camera’ makes me wonder if Omni isn’t headed down the same road as the Edsel.

Gregory J. Tulen
Shorewood, Wis.

We do not dispute the ‘personal psychological benefits’ of TM, and indeed some one hooked up to a polygraph while meditating probably would show many changes from ordinary (normal) body functions—heart rate, respiration, galvani skin response. Abnormal does not mean ‘bad,’ but different from the usual.

As for flying and invisibility we will print a refraction the means someone fosts up to our offices and demonstrates his ability to us. We’re on the twentieth floor—Ed.

Normal Not Handicapped

While I certainly agree with Robert A. Heinlein’s basic premise in ‘Spinoff’ [March 1980] that the space program has been of incalculable benefit to the average citizen, one comment in his article made me intensely angry. ‘Mothers at term must be classed as “temporarily but severely handicapped.” During my own six pregnancies, I have engaged in numerous physical activities including earning the judo rank of rokyu in my eighth month hiking in the mountains within days before and after giving birth swimming nearly three miles a few days before giving birth and milking my goats while I was in labor and also a few hours after giving birth. My friends likewise work full time until in advanced labor and walk home to give birth. In the mountains up to term, give birth alone, etc.

By no stretch of the imagination can we be called handicapped! Obstetrical interventions frequently disable mothers and babies, the very ultrasound that Heinlein lauds results in scalp infections and focal distress, not to mention that we don’t know its long term effects and one may not jump to conclusions about its safety, as we did about X rays and DES.

This is precisely why so much of us give birth at home. Heinlein should stick to writing science fiction, which he is expert, and leave the expertise on pregnancy and birth to the mothers of large families. I think like his are responsible for the antinatalist attitudes that make second-class citizens out of so many women and that encourage the kind of obstetrical intervention that has resulted in hundreds of thousands of blinded, paralysed and otherwise disabled children in this country.

For the sake of all of us, the record must be set straight. Pregnancy and birth are normal: not handicaps!

Pat Goltz
Tucson, Ariz.

Free Exams for Test Subjects

I wish to respond to David Sobel’s article “So that Others May Live” [December 1979].

The American Citizens for Honesty in Government (2125 S Street, N.W. Washington, DC 20008) has initiated a nationwide campaign to find victims of secret army drug experiments conducted at Edgewood Arsenal, Maryland, from the early 1960s until 1975. The experiments designed to test a variety of mind-control drugs involved some 7,000 soldiers and civilians who allegedly volunteered to be a part of the program. One of the drugs labeled BZ was a powerful hallucinogen, reportedly ten times more powerful than LSD. The drug was intended as a mental incapacitant. The army tested BZ on 2,480 volunteers between 1960 and 1968.

ACHG has offered a free medical examination to any of the volunteers who come forward in order to determine any long-range effects they may have suffered as a result of the drug.

Montz Farbston
Norristown Pa.

Oil from Coal

With reference to Douglas Colligan’s article “The Nazi Papers” [Continuum, October 1979]? I would like to elaborate on what Dr. Kurt Irgolic said and to clarify a point or two for the readers of Forum.

South Africa has been interested in the oil-from-coal process since 1927. South African scientists followed German developments prior to and during World War II and continued research afterward. The first South African synthetic fuel plant Sasol I began production in 1955. According to Mr. Colligan the German model is far simpler and more productive. It certainly is far simpler than the South African method, more than 20 years of further development has gone into our system which was based on the German model.

As far as “more productive” Sasol I was not built for the sole purpose of producing synthetic fuel. It produces a variety of other petrochemicals such as pipeline gas, butadiene styrene ethylene and ammonia. All of these by-products are used by the chemical and plastics industries.

Sasol I was designed for this purpose.

Sasol II, which will begin operation this year and Sasol III which will open in 1982 will concentrate on manufacturing motor fuels such as gasoline diesel LPG, kerosene, and jet fuel. Sasol II and Sasol III will use the Syntol process because of its higher yield of gasoline and diesel fuel.

Jan Schoeman
Johannesburg, South Africa

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122 OMNI
We have come to think of our sun as a fair run-of-the-mill star. It is of middling brightness as stars go, middling mass and medium temperature, and it is located in a typical part of an average spiral galaxy.

But in some ways the sun is highly unusual. After all, it is orbited by the only proven (intelligent?) life in the universe. It is also unusual because it is single.

Most stars have companions, other stars orbiting them. More precisely, they all orbit a common center of mass. Such groups are called star systems, and more than 70,000 are known.

Of the nearest star systems, including our own, five systems are at least double. One may be single, at least one (ours) has a planetary system, and others may have as yet undiscovered companions.

Indeed our nearest star system, Alpha Centauri, is a triple star. A yellow star almost exactly like the sun and a cooler, orange star orbit each other fairly closely once every 80 years and both are orbited by a small, faint red star. This red dwarf is thought to be on the side of its orbit toward the sun now making it the nearest star known. Hence its name, Proxima.

Often the two stellar companions cannot be seen separately even with a telescope. In such systems the stars are sometimes revealed with the aid of the spectrograph. This device breaks up the light of each star into its component colors and displays dark lines in the spectrum caused by various elements in the outer layers of the stars. If the stars were stationary, the spectra of, say iron from both stars would be right on top of each other. But the stars are moving, with one coming toward us and one going away as they orbit. This motion shifts the spectral lines slightly apart, allowing us to distinguish them. These systems are thus called spectroscopic binaries.

Many star systems will have more than just two stars. There are systems of three, four, five, or more stars, all in a celestial ballet about their center of mass choreographed by the law of gravity. Out of 100 typical star systems, about 23 would have three or more members with a total of 81 stars. While 47 would be double and only 30 would be single.

When stars orbit each other closely enough, the gravitational pull of one distorts the other. One or both stars may be ellipsoidal instead of spherical. Single stars are as one star of the system ages, it may swell and fill a large, tear drop-shaped region, spewing material to the tip of the drop into giant pinwheels of star gas surrounding the system. The two stars can even exchange material. These contact binaries have very different life histories from single stars.

Every once in a while we discover a double-star system oriented so that the plane of the stars' orbit is seen edge on. During most of the orbit the light we receive is the combined output of both stars. When one passes in front of the other, we observe a slight dimming of the amount depending on the relative surface brightnesses of the two stars. These are thus called eclipsing variable stars.

Such systems are marvelous astrophysical laboratories for determining stellar properties. By simply timing how long an eclipse lasts, we can deduce the size of the stars relative to the size of their orbit. Then the size of the orbit can be calculated by using the laws of gravity and motion. As a result, we can find out the sizes and masses of these stars. These are fundamental data that are hard to obtain otherwise.

Do stars have other stellar companions or planets, but not both? Or can multiple stars have planets, too?

The answers are not yet known. Our calculations show that in multiple-star systems there could be some stable planetary orbits. If planets formed in some other regions around the stars, however, they would eventually be thrown out of the system to wander through space sunless. Our knowledge of stellar evolution is still too limited to tell why planets or companion stars form when a cloud of interstellar gas contracts to form a star.

The space telescope, an orbiting observatory to be launched by the space shuttle in the middle 1980s, is going to look for stellar companions. Perhaps it will help answer these questions.
Can we know our past lives?

Does personality survive death? Do experiences of past lives cling to our consciousness—as the scent of a flower lingers on? There are mistakes you could avoid—things you could do differently—if you could be certain. Have you felt strangely unlike yourself—more like someone else—with different inclinations and personality? Do new places and faces seem familiar?

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Can we know our past lives?

spreads. I felt miniaturized, or transported back to the Pleistocene, an age when everything was oversized.

Twelve eagles in one spot seemed a horde. In fact, southeast Alaska sees eagles in far greater congregations. There is a seven-mile stretch of the Chilkat River that each winter attracts 3,000 to 4,000 bald eagles. In November one sees 50 and 60 to a tree. The eagles come because the upwellings of warm water keep certain channels free of ice long after other rivers are frozen, allowing the birds to feed on spawned out salmon well into winter.

This gathering of eagles, the biggest convention of raptors in the world, is now threatened. The state of Alaska has entered into a timber sale contract with the Schnabel Lumber Company of Haines, Alaska. The contract permits heavy logging in the Chilkat Valley for the next 15 to 25 years.

The state government of Alaska never saw the famous for heroic efforts to protect its wilderness. It has entered into this agreement before the answers to important questions are known. Where did the eagles come from when they arrive at the Chilkat Valley in October and November? Where do they go when they leave? How important is the refuge of the Chilkat to the bald eagle population of the world? How vital to the survival of immature, unskilled birds? Is the Chilkat's reprieve from the harsh realities of the Alaskan winter?

The effects of the logging on water quality and thus upon the salmon and thus upon the eagles, is certain to be profound. Yet no study has addressed this problem. The loss of the trees alone is likely to be important. The eagles leave the small 'critical habitat area' decreed by the state forbears of days at a time in bad weather. Do they seek shelter in woods that are now slated for logging? The state of Alaska does not know.

This month the Southeast Alaska Conservation Council goes to court to challenge the legality of the timber sale. Environmental organizations across the nation are watching the outcome with interest.

So am I. Some of the eagle conventioneers in the Chilkat are acquaintances. I suspect. As an American, I want to believe in my currency. Economists worry about the decreasing amount of gold backing each dollar. I worry about the decreasing number of bald eagles backing up the emblem on the dollar's back side. That's devaluation, too. It's a variety harder to remedy once it gets started and it leaves us even poorer.

The tragedy is that many of the standards by which the majesty of the earth could be judged have been cut down. John Hay has written, "If that tragedy extends to bald eagles, we will have proved Ben Franklin right. The turkey will be our symbol after all."
Science Fiction: IMAGINARY VOYAGES

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This exhibition is made possible in part with Public Funds from the New York State Council on the Arts, the N Y C. Department of Cultural Affairs and the Bronx Council on the Arts.

Illustration by Idella Rosario
Early morning dew provides a unique view of wildflowers in this Hans Pfletschinger photograph. Hanging from a branch of Erysimum, or hornwort, dewdrops act as simple optical systems, enlarging the objects behind them. They are, in fact, convex lenses, and Pfletschinger observed that the rounder the drop, the better its optical performance. By varying the distance between the flowers and the drops, the size of the projected flowers changes perceptively. For this photograph, Pfletschinger adapted a special bellows attachment to a Minolta XE-1 camera and a Leitz lens. Kodachrome 25 film was exposed at 1/500th of a second to capture the image.
In learning the sciences, examples are of more use than precepts
—Sir Isaac Newton

This month's puzzles require an elementary understanding of physics. No complicated mathematics are needed only an intuitive grasp of how things work in the world.

First enjoy the unorthodox thinking of the student in the barometer story (below from my book The Book of Strange Facts and Useless Information, Doubleday/ Dolphin 1979). Then try your hand at some science-oriented puzzles. Some of them are adapted from Thinking Physics by Lewis C. Epstein and Paul G. Hewitt (Insight Press 1979), and Science Brain Twisters, Paradoxes, and Fallacies, by Christopher P. Jargocki (Charles Scribner's Sons 1976).

THE BAROMETER STORY

Alexander Calandra, Professor of physical sciences at Washington University St. Louis claims that a colleague once asked him to refereee a dispute with a strong-minded physics student. Answering an examination question asking how one could determine the height of a tall building with the aid of a barometer, the student had written: "Take the barometer to the top of the building, attach a long rope to it, lower the barometer to the street and then bring it up measuring the length of the rope. The length of the rope is equal to the height of the building."

The teacher wanted to score this answer zero because it showed no knowledge of physics, but the student thought he deserved full credit for answering the question correctly.

Calandra decided to give the student another try: six minutes in which to write an alternative answer that would display some understanding of physics.

The student sat over a blank piece of paper for five minutes. Calandra assumed he would fail the exam but in the final minute the student dashed off the following: "Take the barometer to the top of the building and lean over the edge of the roof. Drop the barometer timing its fall with a stopwatch. Using the formula $h = \frac{1}{2}gt^2$ calculate the height of the building.

The answer was perfectly correct if unexpected, and Calandra gave it full credit. But why the unusual approach? The student said he knew the expected answer all along but was tired of having instructors teach him to think in one 'correct' way. 'He had many answers to the question but waited until the last minute to choose the best one. Another solution, the student suggested, would be to go out on a sunny day measure the height of the barometer, the length of its shadow and the length of the building's shadow. Then compute the height of the building with a simple proportion.'

"Fine," Calandra said. "Any others?"

"You could take the barometer in hand and climb the stairs marking off barometer lengths on the way as you go. That would give you the height of the building in barometer units. Or you could be the barometer to the end of a string swing it as a pendulum and determine the value of $g$ at the street level and at the top of the building. In principle, you could calculate the height of the building from the difference between the two values of $g$.

There are more direct solutions," the student added. "Probably the best is to take the barometer to the basement and knock on the superintendent's door. When he answers, say, 'Mr. Superintendent I have a very fine barometer here and I will give it to you if you will tell me the height of the building.'"

PHYSICS PUZZLES

1. ANT'S WALK. A subway train is approaching Times Square at 144 inches per second (ips). A man in one subway car is walking forward in the car at 36 ips relative to the seats. He is eating a foot-long hot dog, which is entering his mouth at two inches per second. An ant on the hot dog is running away from the man's mouth at one inch per second. How fast is the ant approaching Times Square?

2. OVERHANG. Dominoes are stacked so that each domino projects as far as possible over the domino below without falling. The greatest offset is obtained when the center of gravity of the top domino (A) is directly above the end of the domino below (B) and the combined center of gravity of these two dominoes is directly above the edge of the third domino (C). By continuing this procedure is it possible to stack dominoes so that the top domino projects more than its own length beyond the bottom domino? How many dominoes will be required to do this?

3. INNER SPACE. Down in a coal mine below the surface of the earth is there more gravity or less gravity than there is at the entrance to the mine up at the earth's surface?

4. WEIGH IN. Even if you stand perfectly still on an accurate scale, the reading keeps oscillating around your average weight. Why?

5. BALLOON. An air-filled balloon is held underwater by a weight so that it is just on the verge of sinking. The top surface of the balloon just touches the waterline. If you push the balloon beneath the surface of the water (as shown), what will it do—bob back to the surface, remain at the level to which it is pushed, or sink to the bottom?
6. **MOTORBIKE TRIP** Suppose that you motorbike from Baja's Beach to the top of Hannin Hill and then return. You average 30 kilometers per hour for the trip up and 60 kph on the way down. What is your average speed for the round trip?

7. **IRON DOUGHNUT** A piece of solid iron in the shape of a doughnut is heated over a fire. As the iron expands, does the hole become larger or smaller? or does it remain the same size?

8. **STEP ON IT** The Baja road race is 1,000 kilometers long. At the halfway point Speedy Gonzales calculates that he has been driving at an average of 50 kph. How fast should he drive the second half of the race to have an overall average of 60 kph?

9. **DROPS AND BUBBLES** If all space were empty except for two masses close together, say two drops of water, the drops would be attracted together according to Newton's Law of Gravity. Now suppose all space were full of water except for two bubbles. How would the bubbles move? Apart? Toward each other? Or not at all?

10. **THE PISSING BUCKET** That's the name given to this puzzle by Epstein and Hewitt. They say it is "a favorite question of noted hydraulicist George S. Pissing and is still often asked of graduate students during oral examinations."

    Consider a bucket of water with two holes of equal area through which water is discharged. It can flow out through hole B at the bottom or through the downspout which begins at the top, T, and has its opening the same distance below the water surface as hole B. Ignoring any friction effects out of which opening will the water flow faster and why?

11. **MAGNET TEST** You are in a locked room with two identical iron bars. One is a bar magnet, the other isn't magnetized. The doorknob and the lock are made of brass (not magnetically active) and there is no other metal in the room not even on your person. How can you tell which bar is the magnet? You could suspend each bar by a string near around its middle and observe which bar tends to point north. Is there a simpler way?

12. **BATTLESHIP IN THE BATHTUB** Can you float a battleship in a bathtub? Specifically, the battleship below at left floating on the high seas, weighs 30,000 tons. Imagine the ship slowly lowered into a huge bathtub shaped like the ship but a little larger and containing a small volume of water. As the ship is lowered the water is forced up the sides of the tub until there is only a thin envelope of water between the tub and the ship's hull. Is it possible to float a 30,000 ton battleship in several hundred gallons of water?

13. **PERFECT TUNE** If two musical notes are very similar (e.g., 256 cycles per second and 257 cps) and are sounded simultaneously, an interference pattern of beats will be heard (in this example beats will sound once per second). Suppose you have just bought an excellent concert grand piano and you want it to be put in perfect tune. You get a first-rate piano tuner who tunes the piano by matching it to selected tuning forks. How long will it take an expert piano tuner to do a perfect tuning job? (a) About an hour, (b) About a day, (c) About a week, (d) About a month, (e) About forever.

14. **TWIDDLING BOLTS** Below are two identical bolts held together with their threads in mesh. While holding bolt A stationary you swing bolt B around it. (Don't let the bolts turn in your fingers.) Will the bolt heads get nearer move farther apart or remain at the same distance from each other?

15. **SOMETHING FOR NOTHING** If you put ten joules of electrical energy into an electric heater ten joules of heat will come out. Is there any device from which you can get more than ten joules of heat with only ten joules of electrical input?

16. **CRACKED UP** Pour hot water into a thick drinking glass and into a thin champagne glass. Which glass is more likely to crack? **DD**

Answers on page 120.
SAVE THE TOAD!

LAST WORD

By Norman Spinrad

The past decade has seen a quantum leap in the ecological awareness of the American public, a new understanding that the planet belongs not only to humankind but to all creatures great and small. Indeed, the extinction of a species for the sake of human convenience is an economic slaughter of our own making. The snail darter holds up a multimillion-dollar dam; humans risk their lives to save whales; and the FCC comes down hard on a comedian who tortured and executed cockroaches on the tube.

All well and good. But even in these days of ecoclightenment, a species of animal now faces extinction; a species that almost seems to have been designed by evolution as the ultimate test case of our ecological morality.

Valhalla is a retirement community on the east coast of Florida, not far from the Everglades, carved out of a fetid coastal swamp by an outfit called Development Unlimited.

A major selling point for the Valhalla development was a private, 18-hole golf course to be built on the premises. Without the completion of which Development Unlimited would remain in breach of contract with its customers. After 17 holes were completed, it was discovered that what was to become the eighteenth and clubhouse green—a swampy pool overgrown with rotting palm trees—was the sole habitat of a hitherto-unknown species: the giant flying vampire toad.

The misnamed toad is actually a species of frog—a huge, well-bile green creature that can weigh up to ten kilograms. Translucent membranes of mucoid tissue are stretched between its fore and rear limbs like sheets of bubbly slime, enabling it to glide for considerable distances from tree to perch in the manner of a flying squirrel.

The giant flying vampire toad is the only frog with teeth. Two of them. Upper front incisors about five centimeters long, as sharp as hypodermic needles, and hollow. The vampiretoad feeds them through them. Truly a unique species.

But alas, at this writing, the poor amphibian seems marked for extinction. When it was discovered that the Valhalla golf course was the sole ecological niche of the giant flying vampire toad, Development Unlimited signed a consent order with the EPA to redesign the eighteenth hole to incorporate and preserve its habitat as a swamp hazard.

A Pro Am tournament was organized to test the course prior to occupancy of the condominiums. There was a strong east wind that day, and many golfers were hooking their tee shots into the swamp hazard on the eighteenth hole. Dozens of players invaded the habitat of the giant flying vampire toad.

The toad, we now know, hangs upside down in the tops of trees cunningly camouflaged in the rotting foliage. It hangs there motionless, like a huge glob of goo until some as-yet-uncataloged heat sense detects the presence of a large warm-blooded mammal.

The crafty creature waits until the mammal has passed by its perch. Then it releases its grip, extends its wings, and silently zooms in on its prey from directly behind in a long, low glide out of the wooded glom. Fangs extended, it pierces the back of the neck like a double-headed arrow with the full momentum of its dive. An instant later it plasters its sticky, sticky body in the prey's hair, grabs on to the ears with its clawed forelimbs, latches its powerful rubberlike suction mouth around the point of entry and engulfs the unfortunate victim, leaving nothing but a huge, sticky smear in its wake.

Unfortunately, this was not discovered until hours of golfers emerged from the swamp hazard of the eighteen hole shrieking, screaming, and singing in vain to pry blood-sucking frogs off the back of their necks with two-fingers.

Development Unlimited applied for a variance from the Environmental Protection Agency in order to demolish the eighteen hole swamp hazard and extirpate the giant flying vampire toad—claiming that the law was never meant to apply to species that ought to be extinct. The EPA rightfully rejected this vile suggestion, pointing out that it would inevitably lead to demands to exterminate other scientifically unique species of vermin such as the cockroach, the rat, and the anopheles mosquito.

Faced with a dead loss on the now-unsalable Valhalla development, Development Unlimited sued the federal government for damages. Just as this precedent-setting case seemed destined for the Supreme Court, the White House pressure—agreed to purchase the development as a pilot project for the nation's first retirement community for welfare recipients, who, it was pointed out, could be induced to occupy a luxury condo community without a golf course.

The golf course was closed; the development was occupied by nongolfing welfare recipients, and the giant flying vampire toad was saved from extinction.

Or so it seemed at the time. The population of giant flying vampire toads has now gone into a precipitous decline. The unseemly human hurl-bury of the welfare condos has driven away the species' previous natural prey, and the lack of golfers to replace these nonhuman prey species has once more driven the toad to the brink of extinction.

Only an aroused public can now prevent a hideous act of genocide-by-destinction. It is one thing to save local whales and cute little seals, but will the summer soldiers of ecological awareness summon the courage to rally behind a giant flying blood-sucking frog? Where do we humans presume to draw the line? The giant flying vampire toad is the ultimate acid test of ecological conscience. If this unique species is to survive, steps must be taken to secure a food supply for it.

Why not let welfare recipients use the condominums and the golf course? Under the supervision of a golf pro and a doctor of course. The trifling amount of blood they would lose would be nothing compared to the benefits they would gain it would be a symbiotic relationship.

Therefore, we say: Reopen the Valhalla golf course! Give housing and recreation to those most in need of them! And save the giant flying vampire toad! ☪