
OMNI
LIFE AFTER LIFTOFF:
HOW MAN WILL EVOLVE IN SPACE
THE DAY WE BOMBED UTAH:
AMERICA'S SECRET NUCLEAR WAR
PLUS: LASER MOVIES,
FACE-LIFT PILLS, SILICON ALIENS
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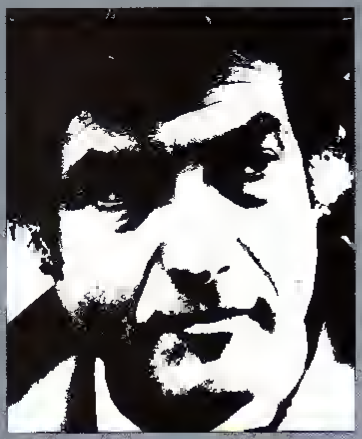
Replicas of Britain's ancient megaliths are found on a deserted planet in Stonehenge NGC2024, *a painting by Kazumasa Yamanaka, a young illustrator who lives in Tokyo. This work first appeared on the cover of the February 1983 Japanese edition of* Omni



FIRST WORD

By Daniel S Greenberg

"The Nobel Prizes are unmatched for dazzle, but in determining who's who in science, the Swedish awards are often runners-up"

Have you heard of the Fields Medal? Though cashless, unlike most major scientific awards it is the most venerated prize in mathematics. Or Israel's annual international Wolf Prizes, accompanied by awards of $100,000 for achievements in each of five scientific disciplines? Or General Motors' three $100,000 prizes annually given for distinguished work in cancer research?

Although these prizes glow in the scientific world, evoking awe and encouraging intense competition among scientists, the general press tends to ignore them. In fact, few nonscientists have ever heard of most of them. Now, let's try another.

Have you heard of the Nobel Prizes?

The answer, of course, is that each fall, when the Nobels are awarded by their Swedish and Norwegian custodians, one would have to make a concentrated effort *not* to hear of them. The prizes automatically generate front-page, prime-time treatment, and virtual sainthood is bestowed upon the annual recipients. This is especially so for the science prize winners, in such disciplines as chemistry, physics, and medicine or physiology.

What great distinction exists between the Nobels and other, less celebrated science prizes?

Less than you might think, and that's why the Nobels, first awarded at the beginning of the twentieth century, are the target of growing criticism from many scientists and the press. Zealously regarded by a hero-worshipping public as the ultimate certification of scientific and scholarly achievement, the Scandinavian prizes are now often sniped at because they mistakenly honor individuals in an era of complex team efforts and they distort science by ignoring major regions of research.

Britain's most prestigious science-research journal, *Nature*, summarized the case against the Nobels several years ago by observing editorially that many would argue that the prizes represent an outdated award system, generate a fair amount of bitterness and jealousy, and often convey a spurious air of authority, that is misinterpreted not just by the general public but even by scientists themselves, who should know better.

So, do away with them, it's been argued. On this side of the Atlantic, *The New York Times* recently encouraged, if not joined, the pack with an editorial in the form of a letter from a mythical scientist spurning the cherished award. "Most of the glory the Nobel Foundation seeks to assign to me," wrote *The Times*'s make-believe winner, is robbed from my fellow researchers and distorts the true pattern of achievement in my field."

What's odd about this line of criticism is that similar comments could be leveled against most, if not all, modern-day science prizes, but only the Nobels seem to draw that kind of irate commentary. Why is this so?

A search for the cause takes us back to the obscurity of all those other prizes contrasted with the glare of international attention that the Nobels receive. The Nobels are older than most of the other prizes. They were the first to award big money—currently about $160,000 per prize, although this is usually shared by two or three recipients. But, perhaps most important of all, the Nobels awarded by the Swedish crown come with the glitter of royal pageantry.

Let's face it—they are unmatched for pomp and dazzle. But when it actually comes to determining who is in the vanguard of science, the Nobels are often runners-up in recognizing important breakthroughs, particularly to the Wolf Prizes and Lasker medical awards. Furthermore, the Nobel accuracy in identifying the real achievers is occasionally suspect. Two years ago, for example, the Wolf Prize for physics was awarded to Kenneth G. Wilson and Michael Fisher of Cornell and Leo Kadanoff, of the University of Chicago, for developing an equation that explains the critical point at which matter changes from one phase to another—for example, water to steam. Last fall, however, Wilson alone received the Nobel Prize for *their* combined work—and immediately voiced his displeasure because his colleagues were not also cited by the prize committee.

Such oversights are not at all uncommon. Thus, science's most esteemed prize is not accurately awarded, nor is it consistently in the forefront of recognizing high achievement.

Abolish the Nobel Prize?

There's no good reason to do so, nor can the Swedes be expected to give up what, after all, is a great source of national pride and world attention. But what can be accomplished, and usefully so, would be a reduction of uncritical and extravagant veneration of the prizes and winners. The world of science has expanded at least a thousandfold since Alfred Nobel initiated the prizes. There are now a multitude of other awards for important contributions.

To glorify the Nobels and virtually ignore the others is to burden the Swedish prizes with an increasingly difficult weight. The Nobels and other prizes celebrate excellence—and that's a function not to be scoffed at. But the worship of the Nobel Prizes has gone a bit too far.

Daniel S. Greenberg is the editor and publisher of a Washington-based newsletter, Science & Government Report.

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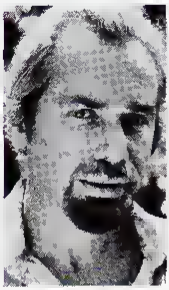
SILVERBERG


THE ENGLERS


FULLER


CADIGAN


STUCKEY

We never intended to bomb Utah, of course. In the 1950s the Atomic Energy Commission (AEC) was simply conducting above-ground nuclear tests in neighboring Nevada. But the poisonous clouds drifted eastward, toward the little Utah towns of St. George and Cedar City.

Veteran journalist *John G. Fuller* visited the scene 30 years later and found evidence of a lethal coverup. AEC officials, it appears, knew what their tests were doing to the land and its people. They just didn't want to stop. More than 1,000 victims of leukemia and other forms of cancer have reluctantly concluded that their government is to blame for their illnesses. Fuller's expose, "The Day We Bombed Utah," depicts American citizens pitted against the AEC and explains how the people are finally getting their day in court.

Fuller is the author of many nonfiction works, including such best sellers as *The Ghost of Flight 401*, *We Almost Lost Detroit*, and *Fever*.

"What happened to those two rustic Utah towns," says Fuller, "is emblematic of what could happen to similar cities all over the country. I was deeply touched by the tragedy these people had experienced. As I interviewed them on their front porches, they would sometimes count the number of relatives and friends on their street who had died from radiation exposure. With underground nuclear testing still in progress, many more Americans may suffer the same plight." The story begins on page 52.

What will happen to us when we begin taking extended space voyages or living in space stations or colonies? How will the human body adapt and evolve? These are the questions addressed by the new science of bioastronautics—the study of life in space. Writers *Nick Engler* and *Donna Cheshire Engler*, besides interviewing NASA's top experts in the field, traveled to Moscow to talk to Oleg Gazenko, director of the Soviet Institute of Biomedical Problems. Gazenko, who engineered the first life-support systems on rockets, has been dubbed the father of bioastronautics. He offered insights into how zero-g conditions influence embryology, growth, and the aging process. See "Life After Liftoff," which starts on page 108.

SF author *Robert Silverberg* has finally done it. He has brought together two of our culture's heroes in one short story. In "Amanda and the Alien" (page 60), a California girl picks up an extraterrestrial at a shopping mall. In short, it's Valley Girl vs. E.T. Our other fiction offering, "Vengeance Is Yours" (page 126), marks *Pat Cadigan*'s first appearance in *Omni*.

Finally, special kudos this month must go to award-winning political reporter and science writer *William K. Stuckey*. Besides writing a colorful profile of big science, Ozark-style, at the University of Arkansas ("Ozark Mountain High," page 72), Stuckey also succeeded in getting the *Omni* accounting department to reimburse him for over a month's worth of beers *without receipts*—an unprecedented accomplishment. Our accounting types are normally adamant about such things, but they acquiesced to the resourceful Mr. Stuckey when he produced the following letter for Dick Teresi, *Omni*'s executive editor.

Dear Mr. Teresi:

As you will note in William K. Stuckey's article on the University of Arkansas, he spent a great deal of time and interviewed a large number of professors, writers, and derelicts in my saloon, Roger's Pool Hall. He has asked me to estimate his beer consumption and expenses, since I do not give receipts.

Mr. Stuckey was first brought here on November 1. As Stuckey has come in almost every day since, I offer the following highly conservative estimate: 35 days with an average consumption of five beers each day. The beer is 80 cents per bottle, and his average tip was ten cents per bottle.

This comes to $140.00 for beer, $17.50 for tips, for a total of $157.50. Do not hesitate to contact me if you have further questions on this matter.

[Signed]
Roger Koetter, Proprietor
Roger's Pool Hall
Fayetteville, Arkansas

The article's good, too. ∞

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Debunking Claims

We of CSICOP [the Committee for the Scientific Investigation of Claims of the Paranormal] would like to thank *Omni* for the fair and accurate treatment of the Lane Starkey/Jake Rotstein story in "Psychic Gold," by Peter Rondinone [Antimatter, December 1982].

However, in the same issue, in the article "Out of the Closet" by Douglas Starr [Continuum], our committee is said to be "devoted entirely to debunking pseudoscientific claims." We would like to correct a possible misunderstanding concerning the intent of CSICOP. Although there are obviously claims and situations so glaringly debunkable that such a procedure is certainly appropriate, that is in no way our primary intent. We investigate and evaluate paranormal claims, offering alternate explanations whenever they are available, and we do so from a position of academic and technical expertise.

Paul Kurtz
Chairman, CSICOP
Buffalo, NY

Children and Pollution

Your article "Children of Disaster," by Douglas Starr [Earth, January 1983], struck a resonant chord in me. I have suffered from the less serious functional disorders of hypoglycemia and related allergies and sensitivities because of pollution. I can understand the despair that these children afflicted with much more devastating pollution-caused maladies must be experiencing. As a potential parent, I worry about the futility of trying to raise healthy children in a world bent on its own destruction.

Brek Renzelman
Bloomington, IN

Defending Defense

Phoebe Hoban's article on civil defense [Continuum, January 1983] illustrates the problem we at the local level face in dealing with the issue of nuclear preparedness.

The nearly 3,000 members of the U.S. Civil Defense Council are responsible for assisting their local citizens in dealing with all the hazards that may face their community. These hazards range from incidents as casual as a leaking acid truck to the mind-boggling problems we would face in a nuclear attack.

As local officials, we have little voice in the establishment of national policy. As an organization, the council has always attempted to put the Crisis Relocation Program into proper perspective; it is merely one of the many possible courses of action to be taken if the necessary conditions are met.

Hoban mentions the success of antinuclear forces in persuading Congress to "slash FEMA's [the Federal Emergency Management Agency's] proposed $252-million Crisis Relocation budget to about $147 million." It was not the Crisis Relocation budget that was slashed! It was funding for the activities that enable us to train our people, warn our citizens, and equip our response teams.

We cannot devote our dwindling resources and diminishing personnel to attaining our goal of providing the highest possible level of preparedness to meet any threat to citizens' life and property if we must divert our energies toward defending our programs.

William Murray
Director, Cascade County
Disaster and Emergency Services
U.S. Civil Defense Council
Great Falls, MT

I heartily applaud Phoebe Hoban for her article "Civil Defense." This ludicrous plan is at best a disgraceful waste of money and at worst a dangerous scheme. If civil defense plans manage to convince Americans that somehow the nation could survive a nuclear war, then these plans themselves make nuclear war all the more probable.

Our sole aim must be to prevent a nuclear war. All our efforts should be directed toward genuine arms-control negotiations with the Soviet Union and a peaceful coexistence with all nations.

Carol Ann Bradford
Newport Beach, CA

FORUM

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

Dolphins, Drugs, and Dr. Lilly

I am writing in reference to the interview of Dr. John Lilly, in the January 1983 issue. I cannot believe that any reputable magazine would give space to promote the ideas of such a crackpot! I thought such crap went out with Timothy Leary and the rest of those 1960s "consciousness-expansion gurus." I was apparently quite wrong, because this nonsense has survived among the idle rich of the Malibu hot-tub set. While the rest of us are barely able to make ends meet, fat cats like Lilly and his friends in Malibu spend upwards of $25,000 for so-called consciousness-expanding programs.

As for all that stuff about ECCO [Earth Coincidence Control Office] or any of the rest of that stuff about eternity and altered states of consciousness, my opinion can be summed up by a quote from the movie *Altered States*, which Lilly claims is based to some extent on his life: "I don't want to hear any more of that quantum cabalistic frigging dumb limbo mumbo jumbo!"

James Bisse
Collinsville, IL

Judith Hooper is to be congratulated for her revealing interview with John Lilly. Her questions permitted Lilly to make clear by example the distinction between the psychonaut's disciplined inner explorations and the burned-out hippie's rambling escape into the esoterica of drugs.

At least dolphins have the good sense to remain silent.

Jonathan Smith
Chicago

I found the John Lilly interview most fascinating. His journeys within appear very real, yet I cannot agree with how he begins them. Even though hallucinogenics may seem to work well for him, it is unnecessary, impractical, and very dangerous to depend on them for obtaining genuine experience.

Drugs and mind-expanding substances have no place in a balanced life.

Marc Anderson
Kokomo, IN

I am surprised and disappointed that an otherwise interesting thinker like John Lilly can dismiss the 2,000-year heritage of Catholicism by calling it multiple layers of rationality made up by clever Irish Jesuits. Apart from any damage Lilly may have sustained by his extensive use of psychoactive drugs, he is currently suffering from what has been called the Sister Mary Thumbscrew Syndrome or the Nun-with-a-Switch Complex, a disorder extremely common among persons who encountered Catholicism through the mediation of parents, priests and nuns of the pre–Vatican II triumphalistic, fortress-mentality Church. The chief symptom of this malady is that the victim

John Lilly. Psychonaut or burned-out hippie?

mistakes the errors and misunderstandings of a faulty theological education for the authentic Christian life and faith.

But after making allowances for this disease, one still wonders how it is that a scientist like Lilly can go through near-death experiences, experiment with altered states of consciousness, communicate with animals, make various journeys into philosophies of religion, and yet fail to discern this enormous blind spot of prejudicial reactivity in his own makeup. Shall we judge the value of research into altered states of consciousness by the criteria of media sensationalism and misinformation?

Likewise, a religious faith should be judged on the basis of those who truly practice it in their daily lives.

Br. William McKinley
Superior, Holy Trinity Monastery
Santa Cruz, CA

Would you please, as a public service, print the following. There is only one universe, by definition. Not even John Lilly should be permitted to use phrases like the "observable universe."

Mark Tull
Lansing, MI

Your interview with John Lilly demonstrated to me quite strongly the extent to which a person's view of the universe can undergo radical change.

Lilly was just beginning his sensory-deprivation experiments when Aldous Huxley was already far down the road to the understanding of altered states of consciousness obtained through drugs, fasting, sensory deprivation, and many other means. At that time (the early 1960s), Lilly considered Huxley a fraud and a nut.

Lilly's early experiments with isolation produced startling results, but he maintained a strictly orthodox view of these occurrences. Now, after dabbling in LSD and K, he sounds like a reincarnation of Huxley. He even admits to "exploring neurons" on his psychic voyages. What a transformation!

Rob Rogers
Dunbar, WV

NATURE AND MADNESS

EARTH

By Douglas Starr

The hills outside Florence Italy were ravaged more than 2 000 years ago when the ancient Etruscans cut the trees and brought in grazing sheep Today the city's barren hills are hostage to floods that were once held back by foliage and woods

More than 60 million buffalo once stormed the American prairie blanketing the countryside and migrating en masse Then the white man discovered what great sport they made In a butchering virtually unmatched in American history settlers and hunters slaughtered the buffalo, taking meat, fur or simply the tongues Some took nothing as they shot the animals from moving trains Now despite years of conservation, only a few thousand buffalo remain

And so it continues from ancient Rome to America from Mesopotamia to Brazil History seems a perpetual war of man against the planet that sustains him What makes human beings wreak such destruction? Are they insane?

Yes according to philosopher Paul Shepard who has come up with a new theory about our urge to destroy life Shepard says that a key event thousands of years ago rendered us permanently adolescent, with the uncontrollable desire to vent our juvenile anger on the natural world The nature of that catastrophe? The invention of agriculture, often seen as the birth of civilization

Shepard author of the new book *Nature and Madness* is one of a growing band of academics who seek to understand how the world has come to the brink of ecological destruction The movement became popular in the pre–Earth Day 1960s when scientists first realized we were poisoning the planet Several schools of thought offered ways to prevent the disaster Technologists believed that machines and pollution control could revitalize the life-support systems Economists pushed for new regulations that would make pollution too expensive Both of those solutions might work in the short run opponents argued, but only a much deeper insight would provide the key to why humans pollute Could there be something antinature deeply rooted within the human psyche? If so could we get rid of it? Those who asked such disquieting questions became known as ecophilosophers

Shepard, one of the best-known eco-philosophers was baffled by mankind's historical insistence on destroying his own ecosystem and by the extent to which nearly all civilizations shared the inclination Yet he noted that today s so-called primitive tribes—the Manus of New Guinea, the Aranda of Australia and the Crow of North America—still live in harmony with the environment Traveling in small manageable groups, these hunters and gatherers grow up surrounded by nature attuned to its sights, smells and sounds They live on the earth as its guests not its owners just as their ancestors had done for generations

This uniquely ecological attitude seemed to change for most of the human population though approximately 10 000 years ago with the inception of agriculture In Mesopotamia people began cultivating wheat and barley, in China they grew rice, in North America maize And something changed in man s relationship to the land

A strange duality of dependence on and alienation from the earth developed Nature had always been everywhere but now there were boundaries Land was divided between cropland and wilderness and whenever wilderness invaded the farm, danger was near Agriculture produced a regular food supply but it also gave rise to denser populations So whenever crops failed large-scale disaster was sure to follow

People alienated from nature claims Shepard lost the hunter s keen attention to every wild sight and sound Childhood lost its broadening experience Instead of exploring and imitating nature, children now performed menial tasks People in farming communities developed specialized skills thus learning the concept of subservience to the whole And over several thousand years humans changed from independent adults to childish creatures living on the immature plant ecosystems we know as farms

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Ravaging the earth We've been seized by the uncontrollable urge to destroy our environment

MIND MEDICINE

LIFE

By Ben Barber

The Cambodian refugee began to hyperventilate, his body shaking in a violent seizure unlike anything the American and French doctors had ever seen. Then unexpectedly, the man fell limp, like a marionette whose strings had been snapped. He was near death.

"It's spirit possession,' a relative shouted to the doctors in the medical hut of Khao-I-Dang camp, in the Thai border town of Aranyaprathet. "Call for the Krous'—native healers.

'We were willing to try anything," admits one U.S. nurse. 'even witch doctors.'

As the stunned Western medics looked on, the Krou doctors presided over a ceremony involving chanting, music, herbal tea, and massage. Thirty minutes later the stricken man, one of 30,000 displaced people confined at the camp, began to recover. The familiar sounds of his native language reached where Valium could not, healing the tormented psyche that had seen friends and family starved and brutalized during the Pol Pot Cambodian regime (1975–78), the Vietnamese invasion, and the occupation that followed.

News of the success led International Red Cross doctors to invite the Krous to treat other patients, paving the way for one of the first intimate collaborations between Western scientific medicine and centuries-old native medicine. Lizard blood, incantations, and herbal potions are now accepted along with penicillin and aspirin within the camp's four square miles of sprawling bamboo huts and vegetable gardens. The Cambodians are free to choose between the modern clinics operated by the International Rescue Committee and the Krou-run Traditional Medical Center (TMC).

'The Krous don't interfere with our treatments, and we, in return, let them have free reign—even if it means letting them spit in open wounds," explains Dr. Larry Jones, whose casually draped stethoscope and rough-and-ready manner are reminiscent of Hawkeye from the TV series *M*A*S*H*. A pediatrician from Nashville, Jones admits he's not sure that traditional remedies work 'except psychologically." But that, he feels, is reason enough to endorse Krou healing practices.

In recent years a growing body of evidence has brought to light the large role that personal faith plays in effecting a cure. Just as 30 percent of Western patients have been found to benefit from placebos, many Cambodians automatically improve when treated with the medicine they believe in. Given the power of mind over matter, International Red Cross psychiatrist Jean-Pierre Hiegel encouraged the Krous to join the efforts of the rescue committee workers. The resulting partnership embodies many principles of the holistic-health movement, which has been gaining popularity in America and Europe.

"If the sick have a body, they also have a mind," Hiegel writes in a brochure distributed by the United Nations. "Yet all too often, suffering and sickness are split from the psychological and sociological background of the person.' To provide the best care possible, he believes, it is essential to recognize how cultural attitudes can influence both the symptoms of disease and the outcome of treatment.

Traumatized Cambodians, for example, rarely develop such hysterical symptoms as limping, blindness, and deafness, which were common among shell-shocked American soldiers in Vietnam. Instead, they have changed their fears, sorrows, regrets, and guilt about the Pol Pot years of terror into a completely different syndrome of disorders, including speech impairment, headaches, memory loss, and such psychomotor disturbances as muscular rigidity and violent tremors.

'Some Cambodians diagnosed as neurotic or even schizophrenic by Western doctors," Hiegel reports, "immediately returned to normal when treated for spirit possession by the Krous. On other occasions, our medical staff thought certain refugees were only suffering mentally when, in fact, organic disease lay at the root of their problem.'

'Frequently the Krous have better success than we do," adds Dorsey Bass,

CONTINUED ON PAGE 146

Cambodian refugees can choose between Western doctors and spiritually oriented native healers

SPACE

By Owen Davies

After a winter of some discontent—marked by concern over shuttle-launch delays and frustration at the meager return from lobbying efforts—grass-roots space groups celebrated some modest rites of spring.

Even while NASA was sounding gloomy about delays in *Challenger*'s debut, one major space-activist group planned a lively spring conference on doing business in space. The L5 Society announced that its Second Annual Conference on Space Development was to be held in Houston, from April 1 to 3.

Speakers at the conference represented private attempts at space development. Former Mercury astronaut Deke Slayton is now president of Space Services, Inc., last September, his company became the first private firm to launch a space vehicle. Max Faget left NASA in 1982 after many years as director of engineering and development. It was Faget who organized the design team that built the space shuttle. He is now president of Space Industries, Inc., which is working on what could someday become the first privately funded space station. Houston architect Renaldo Petrini heads L5's lunar-base design project, begun at last year's conference. work on the plan was to continue through L5's meeting.

In the early days of spring other groups were drawing up wish lists for future space projects. One impetus for establishing priorities was the approach—this October 1—of NASA's twenty-fifth anniversary. What should the space agency do over the next quarter century?

The largest survey on the question was conducted by the National Space Institute (NSI), one of the more active space-interest groups in the past year. There was a clear winner. NSI members decreed that NASA must commit itself to building a permanent manned space station by 1990. Other high scorers in the survey were planetary exploration and a call for greater cooperation with the space programs of Western allies.

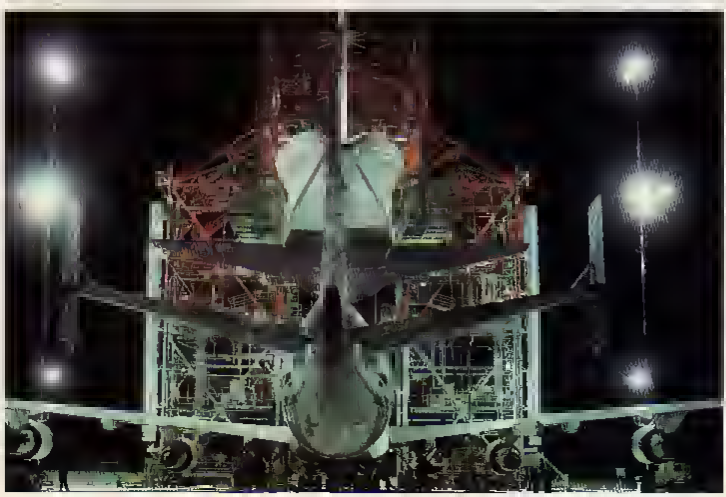
The question remains: How much political clout do the activists carry? When NSI's Mark Chartrand presented results of the survey to the House Subcommittee on Space Sciences and Applications, he was the only speaker invited to represent the popular space movement at the hearings. It seemed apparent that prospace groups still had not managed to form a large, effective lobby like the ecology and antinuclear forces.

Chartrand began work about two years ago to do something about the problem. He organized the National Coordinating Committee on Space to find common ground where the planetary-science buffs, space industrialists, and other single-issue subcultures could form alliances to promote space activities. Most activist groups sent representatives to the committee's meetings.

Yet today Chartrand is about ready to give up the project. "There are too many organizations with too many goals and approaches," he declares. "And even the small regional groups demand the same say in any collective activity as groups with thousands of members. It's impossible to act effectively under those conditions. We're planning to hold a meeting soon to review our plans, and we may just shut it down."

NSI itself will go on, however. The group has recently taken over operation of the Dial-a-Shuttle hotline, (900) 410-NASA. During shuttle missions, the public can call the number to listen in on space-to-ground talk. More than 1.5 million people did so during the STS-3 mission.

Another bright spot on the space scene: Preparations for Spaceweek '83 are well under way. The nationwide celebration, scheduled for July 16 through 24, commemorates *Apollo 11*, which in 1969 was the first mission to land men on the moon. Local Spaceweek events were held in 52 cities last year, up from only 22 in 1981, reports Dennis Stone, Spaceweek's national president. The 25 cities that recorded the number of attendees at the gatherings reported nearly 140,000 visitors. The goal for this year, Stone says, is 100 cities and a million or more visitors. Anyone wishing to help with planning in his area should contact National Spaceweek Headquarters, Box 58172, Houston, TX 77258.



After a quiet, earthbound winter for the space program, activist groups came to life

MR. AND MRS. CLEAN

MIND

By Patrick Huyghe

Does she seem to be cleaning the house every time you visit? Does he spend hours in the bathroom whenever he goes in for a shower? Does an empty can of underarm deodorant set off the equivalent of a Greek tragedy in the house?

When it comes to cleanliness, the boundary that separates the particular from the pathological can be a vague one. Cleanliness is a matter of degree, but many Americans seem so obsessed with it that their behavior approaches mania. Howard Hughes's legendary fear of germs is just one example. There are other equally strange ones. Like the man who brushed his teeth with scouring powder to get them extra clean. Or the woman seen by one psychiatrist, who insisted on spraying her husband's erection with disinfectant before having intercourse.

By all indications, we are a nation of soap-crazed cleanliness freaks. Each year we spend more than $5 billion on cleaning and bathroom items. Yet most of the cleaning and grooming practiced today is ritualistic, meant for display and sexual attraction rather than hygiene. Much of our hand washing, for instance, is done to protect our clothing and the things we handle rather than to simply clean dirt from our hands.

Every culture in the world has its own notion of what it means to be clean. To Americans, cleanliness is not a purification of the soul or the environment but a personal state defined by a lack of body odor, sparkling white teeth, and no ring around the collar.

Much of our concern with personal cleanliness, says Edward T. Hall, a world-renowned anthropologist, can be traced to the so-called sexual revolution, which has made us more aware of our bodies. But the ethnic diversity of our cities, he believes, has played an even larger role in this obsession.

"More than anything else," Hall says, "personal cleanliness is an urban phenomenon. Different diets and habits produce different odors, and when you put them together in a city, people become more aware of one another. It probably was city people who developed the notion that if wasn't right to smell, so in order not to offend anyone, Americans have adopted a common standard of cleanliness—the elimination of the body's olfactory envelope, which still surrounds many equally civilized Europeans."

Cleanliness becomes pathological when it begins to impair other daily functions. Office workers who spend ten minutes of every half hour washing their hands and housewives who fear contamination from doorknobs and TV dials have what psychiatrists call obsessive-compulsive disorders. Fortunately, less than 1 percent of the population suffer from this anxiety.

A more common problem is the simple compulsion to perform a cleaning ritual. People saddled with this habit may be irrational but they are not psychotic, insists Dr. Chet Scrignar, clinical professor of psychiatry at the Tulane University School of Medicine in New Orleans, and the author of *Stress Strategies: The Treatment of Anxiety Disorders*.

As people think of contamination, Dr. Scrignar explains, anxiety sets in. As they continue to fret, the anxiety builds until it reaches a critical point. Then the victims feel compelled to begin their ritual, such as hand washing.

"They'll tell you it's out of their control, but it's not," he says.

Once they give in to the compulsion, however, their anxiety fades quickly, and therein lies the problem. Before long, any anxiety, whether associated with a contaminant or not, can trigger the cleaning ritual.

Psychoanalysis has had little success in treating this disorder, but a form of behavior therapy known as flooding, which Scrignar performs on patients who have been hypnotized, has shown considerable promise. "Flooding means that you don't allow people to engage in the compulsion," he explains. He then helps them fight off the urge to wash. "People complain like crazy, but their anxiety goes down. It's not as quick a decline as it would be if they washed, but it works." If this therapy fails, the psychiatrist may take more drastic action—hospitalizing

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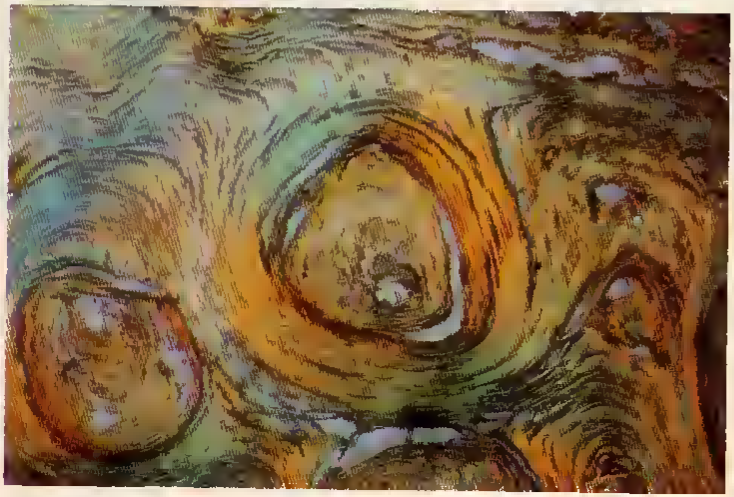

Photomicrograph of human skin. Cleanliness, unlike beauty, is not only skin deep.

THE BODY

By Shelley Ross

An operating room, the year 2000. The patient, who is having breast-reduction surgery, lies wide-awake on the table. But she feels no pain, a system of electrical probes that stimulate her brain's natural opiates takes care of that.

Nor does she fear that a scalpel's slip or a surgeon's botched sense of proportion will mar her anatomy. A sophisticated computer program, coupled to a CAT (computerized axial tomography) scan of her breasts, has churned out mathematically precise before and after pictures to guide the transformation. And her surgeon is actually a robot, with unshaking hands and perfect sangfroid.

There's no gore on twenty-first-century doctors' gowns, either. A laser makes bloodless incisions, and a revolutionary biodegradable "glue"—modeled on the natural glue with which a mollusk sticks to the sides of a dock—seals the cut without sutures. (The mollusk's secretion becomes a fibrous protein much like human connective tissue.) Postsurgical infections are just about extinct, too. Instead of scrubbing up, the doctors have passed their hands and instruments through sonication devices that kill germs with sound waves.

This forecast comes from Dr. I. Kelman Cohen, who is no misty visionary but the chairman of the plastic-surgery division of the Medical College of Virginia, in Richmond. The real revolution, however, won't involve an operating table at all. Think you'll be needing a face-lift by 1999? Forget it. If Dr. Cohen is any seer, your fountain of youth will probably come in tablet form. By instructing the cells in your face to repress some genes and amplify others, this pill—or injection or ointment—will actually do what TV face-cream commercials only promise: make your collagen tissue young again.

"Your body produces three kinds of collagen," Cohen explains. "The collagen in your face is a mixture of about eighty percent Type One collagen, the type of collagen in rigid structures like bone and tendon, and twenty percent Type Three collagen, which is more elastic. My hypothesis is that aging skin switches to a different ratio, with more Type Three and that's why you get sagging and wrinkles." The cure? That will come from the caldrons of molecular biology.

"In cell cultures, pharmacological agents can manipulate that genetic machinery," he notes. "There is no reason we can't tell your collagen cells, 'Make *x* percent of Type One,' but we have to find a way to do that without hurting the rest of the body. If the very elastic collagen of your blood vessels started making too much Type One, you would be in trouble."

But since specific cells have specific traits—abdominal fat cells transplanted to your hand, for instance, get pudgy when you gain weight—Cohen predicts that rejuvenation drugs will be custom-tailored. By 2000 you won't need any fancy "fat-suction" treatments to eradicate cellulite, either. "I think we'll know so much about the cell's enzyme systems that we'll be able to control where fat is deposited," says the surgeon.

Face-lifts, nose jobs, and tummy-tucks are only the petits fours of plastic surgery, its meat-and-potatoes is reconstructing burned faces, torn limbs, cleft palates, and other congenital deformities.

Here, say the experts, the next frontier is the immunological barrier. You can't willy-nilly wear someone else's nose or arm, because your immune system recognizes it as foreign and rejects it. This explains why organ-transplant recipients are treated with drugs that suppress their bodies' natural defenses. Currently, immunosuppressive drugs are judged too dangerous to use for anything less serious than a vital organ transplant. But what if scientists found a way to trick the immune system?

"Then we'll really be able to talk about spare parts," says Stanford University's Dr. Lars Vistnes, chief of the plastic- and reconstructive-surgery clinic. "We'll have immunosuppressants with fewer side effects, or better, we'll manipulate the transplanted part biochemically so the body recognizes it as its own." Once cell biologists learn to identify and block the antigen sites that label tissue as foreign—a feat Cohen forecasts for the next decade or two—spare fingers, ears, and skin tissue will be routine.

Sophisticated synthetic materials will mimic Mother Nature more successfully, too, making artificial skin, breast tissue, and other organs amazingly lifelike, says Cohen. And by the turn of the century, cleft palates, skull and face abnormalities, club feet, and other birth defects will be repaired before birth, with intrauterine surgery.

If you're still interested in a garden variety nose job or other cosmetic procedure by century's close, don't worry. Gone are the days of the standardized "Dr. Diamond nose," says Cohen. "Today we design a nose that goes with your face." High-tech computer imaging (already used by at least one surgeon for correcting craniofacial defects) and foolproof surgeon-robots will all but guarantee success. "If robots can build cars," asks Cohen, "why shouldn't they do the mechanical work of surgery?"

THE ARTS

By Mitch Tuchman

Once with a word Ray Bradbury saved Jack Clayton's life A hostile press had panned Clayton's *The Great Gatsby* (1974) sight unseen but as Bradbury recalls he "went to see it opening night and liked it very much Some of the early reviews were mixed There may have been one or two negative ones But there had been too much publicity we all knew that I sat down and wrote to Jack that very night' 'People are going to like it It's going to make money Don't kill yourself yet

"Jack wrote back to me right away Your letter came at just the right time, I was very depressed."

Years earlier Clayton had saved Bradbury from a beating It was 1955 Bradbury had nearly completed the screenplay for John Huston's *Moby Dick* Relations between the writer and the director could not have been worse Following a London dinner during which Huston had ridiculed Bradbury's friends and Bradbury had retorted with uncharacteristic venom, Huston rose grabbed Bradbury by the lapels and threatened to punch him out "Shall I give it to him?" he cried "Shall I whip him?" Clayton hustled Bradbury out of the restaurant and into a cab

"I really was destroyed" Bradbury recalls "I was in tears"

These are the ties that bind and now, a long and sometimes painful path traversed, Bradbury the screenwriter and Clayton the director have made a film together, *Something Wicked This Way Comes* The joint effort derives ultimately from "Black Ferris," a bit of Americana written by Bradbury and originally published in 1948 in the fantasy/science-fiction magazine *Weird Tales*

Bradbury recounts the tale "Mainly it was about two boys suspecting there was something wrong with the carnival that comes to town They watch the carousel and they see a man get on and ride backward and become a little boy They follow him across town When he comes back and rides the carousel forward he gets older The boys knock down the man in charge of the carousel and as it continues to revolve the carousel man gets older and older and finally he's killed by the process"

Bringing that sketch to the screen has taken 35 years of options, scripts and heartbreak Clayton himself considered it three times and consented to direct it twice before it actually got under way

Bradbury had originally hoped to make a movie with Gene Kelly—he'd always wanted to work with him and when he saw Kelly's 1958 film *Invitation to the Dance* he started rummaging through his files and found the short story "Black Ferris" "I started playing with the idea,' Bradbury recalls "expanding the characters, working with the carnival Soon I had developed a screen treatment I called *Dark Carnival*."

But Kelly wasn't all that interested nor was anyone else *To heck with it then* Bradbury thought *I'll turn it into a novel* And he did, a brilliant but infuriating novel called *Something Wicked This Way Comes* Since its publication in 1962 it has sold almost 18 million copies in paperback worldwide But that did not get the movie made There were decades of near-offers followed by rejections

Finally, in 1980 *Something Wicked* began to roll at Disney Productions By then the simple tale of two boys and a sinister contraption had grown taking on moral and psychological dimensions Now more than buddies, Jim Nightshade and Will (as in *will*power) Holloway had become the daring id and the cautious superego that Freud claimed lurked within us all Will's father Charles Holloway (Jason Robards), the town librarian, had been added as a symbol of the sorrow of time and opportunity passing The carnival had become Hell itself, its operator Mr Dark (Jonathan Pryce) the devil, the Dust Witch (Pam Grier) chief among his minions Its barkers, freaks, and roustabouts had become the lost souls of carnivalgoers of autumns past In this new and richly embroidered version the townspeople flock to the carnival where dreams of youth restored come true Only Will and Jim are suspicious Then Jim Nightshade's guard drops

The carousel used in filming was a

A simple tale of two boys and an evil contraption takes on surprising psychological dimensions

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THE ARTS

By J. Hoberman

No one in the brief history of video art has shown greater sensitivity to the specific qualities of electronically recorded light and movement than Bill Viola. The subject of a 1982 retrospective at the Whitney Museum of American Art in New York City, Viola makes highly crafted and technically innovative tapes that analyze landscapes (and other natural imagery) with a kind of understated mysticism.

Recently Viola returned to the United States after 18 months in Japan. ("It's the equivalent of a Renaissance painter making the pilgrimage to Italy," he told me before he left in 1980.) He spent his first year there studying calligraphy and Zen. "I touched a video camera only once. Then it got intensive." After visiting various JVC, Hitachi, and Sony plants, Viola persuaded the latter corporation to accept him as an artist in residence, the first in Sony's history. "I was trying to get at the idea of an apprenticeship—the original way artists learned their craft—by going right to the source, usually by traveling long distances, and seeking out a 'master' to study with. Whether it be Zen, or video at Sony, it's all the same."

According to Viola, Japanese television manufacturers are more interested in video art—"particularly foreign video art"—than their American counterparts, but he still needed to overcome some initial resistance. "I had to convince them that my feedback would be useful," he recalls. Sony's decision to underwrite his residency came with their realization that his projects could push the limits of their technology in ways that conventional productions would not. It also helped Viola feels that Toshio Miamoto—the senior general manager who authorized the project—was a Sunday painter and former resident of the United States. In any case, Sony would have been hard pressed to find an apter candidate.

At thirty-two, the New York-born Viola has lived with electronic imagery all of his life. "I had a seven-channel childhood," he likes to say. Viola studied music and trained as a TV engineer at Syracuse University in Syracuse, New York, where he helped install a campus-wide cable TV system. Impressed by the work of structural filmmakers like Michael Snow and Ernie Gehr, Viola eschewed the sort of image-processed psychedelic *Sturm und Drang* practiced by many video artists in favor of something that was more contemplative and precise. By the late 1970s, he was mainly coaxing his special effects out of unmediated reality.

Viola's 1979 *Chott el-Djerid*, a relatively straightforward documentation of mirages in the Tunisian desert, is filled with such natural "processed imagery." This best-known of Viola's tapes—named for the dry salt lake where it was mainly shot, and subtitled *A Portrait in Heat and Light*—opens on a snowy midwestern tundra with an isolated farmhouse undulating in the cold. After a minute or so, Viola match-cuts to the middle of the Sahara and goes on to offer a half-hour fugue of fata morganas. Bleached mosques seem to flutter like flags, shimmering buses are reflected in the road, visfas melt into Jovian striations. As otherworldly as a NASA documentary, *Chott* is also extremely painterly—its images suggest an uncanny synthesis of Claude Monet's haystacks and Kenneth Noland's stripes. "If one believes that mental hallucinations are the manifestations of some chemical or biological imbalance in the brain, then mirages and desert heat distortions can be considered hallucinations of the landscape," says Viola. Taping in the Sahara "was like physically being inside someone else's dream."

There's a sense in which Viola's best tapes could be considered visionary documentaries. *Vegetable Memory*, which he shot on a brief trip to Japan in 1978, is an eerie and sensuous depiction of Tokyo's Tsukiji fish market. Fascinated by the assembly-line process in which huge frozen tunas were hacked apart and packaged for shipping, Viola repeats the same sequences over and over again, varying the speed from frantic pixilation to superslow motion. The tape was shot off the cuff using a then-new Betamax camera lent him by a sympathetic Sony

'Video treats light like water,' says Viola. "Light becomes fluid on the video tube."

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ARTIFICIAL INTELLIGENCE

By Owen Davies

That rhythmical thumping you hear is the sound of recent Osborne-1 buyers kicking themselves. Osborne's long-rumored new model—called the Executive I—has finally arrived. It is one more in a series of portable-hardware introductions that have made pack-up-and-go computing the busiest area of the micro industry.

We'd never counsel waiting to buy a computer, but in the Osborne's case those whose nearly new machines are no longer top of the line deserve sympathy. In some ways, the recently introduced Osborne (see photo below) closely resembles the old, the differences make for a far more powerful computer. The Executive I still weighs 28 pounds, and the familiar "leaning tower" case with carrying handle has been changed only by the addition of a bulbous fan housing intended to solve overheating problems common in the Southwest. Inside is the same Z-80A microprocessor—the central data-processing microchip—that was used in the original model Osborne-1 (OS-1).

But a crisp, seven-inch amber monitor showing 24 lines of 80 characters replaces the OS-1's five-inch, 16-by-52 display. Two disk drives half as thick as those in previous models each store 200,000 bytes (characters) of data. The Executive I packs 128K of main memory—twice the OS-1's capacity. And its ON/OFF switch is mounted on the front of the case instead of being hidden in a compartment at the rear, an annoying feature of Osborne's first machines.

Priced at $2,495, the new Osborne retains the OS-1's software for word processing, computer programming, and financial planning. The package includes some new programs as well. A new database-management system adapted from a minicomputer replaces the dBASE II (a sophisticated filing system) formerly offered. "Universal terminal emulation" disguises the Executive I as any of more than a dozen standard terminals, allowing it to talk over telephone lines with other computer systems. And the UCSD p-System, a combined programming language and operating system developed at the University of California, San Diego, enables users to adapt their programs easily for use in other machines.

If all this is not enough, the $3,200 Executive II should be available this month. Physically identical to the Executive I, it offers twice as much memory and an 8088 coprocessor, a second microchip that can run most programs written for the IBM Personal Computer. It will even display IBM graphics on an external color monitor. The IBM operating system, called MS-DOS when used with other computers, will either be included or be offered as an option for the Executive II.

Since July 1981 Osborne has sold more than 125,000 OS-1s, shipping them recently at a rate of over 10,000 per month. Buoyed by a promotion in which the company had included the database manager dBASE II with its machines, Osborne sold its entire January production by the tenth of the month; ten days later its February output was sold. The new models offer Osborne at least a hope of retaining its lead in the portable-computer market it founded.

Since last year, however, the company has faced growing competition. Kaypro hit the market first, offering a software package to equal the Osborne's, more disk space, and a nine-inch screen displaying 24 lines of 80 characters—all at the same $1,795 price of the basic Osborne. Recently a hard disk capable of storing 10 million bytes of data has been added—a feature Osborne has yet to match. Manufactured by Non-Linear Systems, an old-line maker of electronic test equipment, the Kaypro has been selling at a rate of 7,500 a month.

To date, at least 25 other portables have either been announced or reached the stores. Apple, IBM, DEC, and Radio Shack are all working on portables, and both Hewlett-Packard and Texas Instruments are advertising notebook-sized computers that use BASIC, a popular programming language. Among the noteworthy contenders for portable-market glory (and considerable profits)

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New Osborne portable: higher capacity, larger screen, more software, same 28-pound weight

LASER-GUN TV

BREAKTHROUGHS

By Phoebe Hoban

Ever since Advent introduced the first large-screen projection television sets nearly a decade ago, major consumer-electronics companies have been vying to create the biggest, best, and brightest video image. Now a British electronics firm claims it has come up with the ultimate technology for high-resolution, huge-screen TV: a system that projects a perfectly focused, ultrabright image all the way out to the corners of a 35-foot-diagonal screen. The secret: throwing out the cathode-ray tube (CRT) that's been the heart of the television set since its invention in 1929.

Buck Rogers would be bowled over. Instead of a trusty CRT shooting a stream of electrons at a phosphor-coated screen, the new system uses nothing less than a high-speed laser "gun" that paints the image, with a brilliant beam of light, onto any surface.

In an ordinary color set, an individual electron gun is needed to produce each of the primary colors—red, blue, and green. The electron beams are aimed at hundreds of thousands of phosphor dots on the screen, divided into three groups of colors. Deflected by magnetic coils, the beams are scanned across and down the screen in a 525-line-per-frame pattern. Dots glow when they are hit by beams. They don't look like it, but television pictures are really electronic pointillist paintings.

In the new system, two ion lasers replace the three electron-beam guns. The laser light is split by prisms into separate red, blue, and green beams which are modulated and recombined into a pencil-thin beam that contains all the necessary color components to paint the image accurately. A single moving dot creates the color picture. Replacing the electromagnetic beam-deflection system in standard TV sets is a series of electronically controlled mirrors.

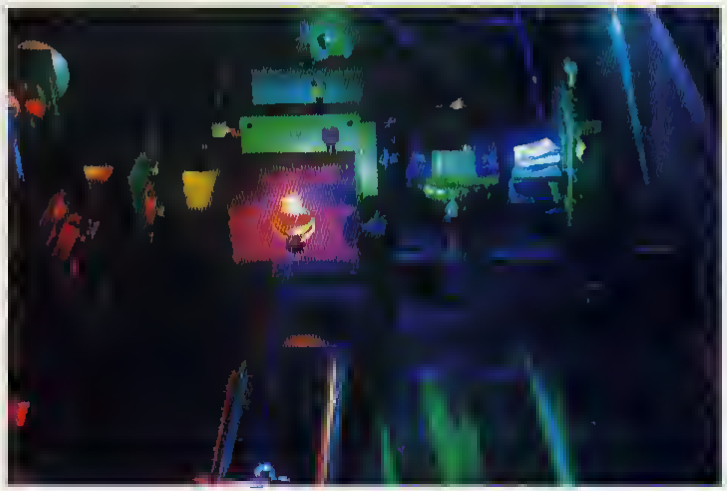
The high-contrast, laser-painted image looks vivid even in bright light. Its resolution is so great that typically fuzzy images, like computer readouts, look crystal clear when blown up to huge dimensions—or shrunk down to miniature proportions as minute as microcircuits. Says a company engineer, "It makes the quality of previous systems look sick."

The company behind the system, Transnational BV in Cheshire, England, isn't exactly broadcasting news of the new technology. The project has been cloaked in secrecy, and both its inventor and manufacturer insist on anonymity until they are geared up for mass-production and have announced marketing plans.

But company representatives say the laser projection system offers a long list of highly visible advantages. Using computer controls, it can be constantly reprogrammed to display things as different as live sports events or stock-exchange returns. Any surface, no matter what its configuration, can potentially serve as a screen without affecting image quality. The system is completely compatible with today's broadcast technology—but by simply increasing the speed of the scanning mirrors, it readily adapts to future formats like HDTV (high-definition television, which offers 1,125 lines of resolution).

This high-tech television system was hardly designed for the home, although one engineer confesses he can envision "fat cats buying it to watch weekend sports." Indeed, the display is so flexible it will be used, its designers say, for everything from laser billboards to flight simulators to teleconferencing.

But it is difficult to keep a good thing under wraps, and interested users have already inundated the company with requests. The BBC plans to use the system for monitoring their broadcast signal quality. NASA has ordered a laser projector for screening shuttle launches for the press. A coin museum in Saudi Arabia wants to use laser light to brighten up their displays of ancient currency. Says David Fishman, an analyst with Arthur D. Little in Cambridge, Massachusetts, who has seen the laser system demonstrated, "It offers great potential and a terrific range of applications. The day may come when every public place will be equipped with a laser projector to screen all sorts of visual information."



Laser beams will paint a perfectly focused, coruscating television image on any surface

THE ULTIMATE TELESCOPE

STARS

By T. A. Heppenheimer

Princeton University physicist Eric Hannah has an idea for a more powerful telescope. This one would let us peer millions of light-years out toward the edge of the universe and still let us pick out details the size of continents on distant planets. A few light-years out, we might even be able to discern objects as small as a house. With this instrument we could enjoy close-ups of such space oddities as supernovas, neutron stars, and black holes. It would be the Ultimate Telescope.

Of course, something this powerful would use the ultimate lens: the sun. Einstein was the first to appreciate that the sun can act as a gravitational lens because its powerful gravity bends light passing nearby (one of the corollaries of his theory of general relativity). In 1979 Stanford University radio astronomer Von R. Eshleman suggested such a lens might be used to build a telescope of exceptional power. And Eric Hannah, who was already experienced in grand-scale projects from having worked with colleague Gerard O'Neill on space colonies, had gone on to develop the megatelescope idea.

The Ultimate Telescope would operate somewhat like a movie projector, with the sun acting as the projector lens to focus a star's image on a target. Instead of a screen, however, we would hoist into space a large, flat array of photodetectors—for visual images—and detectors for other wavelengths as well. The immense array would be equipped with rockets to aim and focus it, and what it saw would be beamed to astronomers on Earth.

Such a telescope design would have all the features desirable in a quality instrument. For example, a good telescope should make light more intense. The Ultimate Telescope would amplify the light from a distant star some 200 billion-fold. Indeed, a star barely detectable by the Space Telescope, expected to be our premier viewing instrument when launched in 1985, would appear in the Ultimate Telescope as dazzling as Vega, the fifth-brightest star in the sky.

Telescopes should show fine detail: this one would show features 100 million times finer than the Space Telescope ever could. In viewing a star 16,000 light-years away, we could make out surface features only a few dozen kilometers in size. Even going out to the distance of the Andromeda galaxy—some 2.2 million light-years away—we could get a sharp enough image of planets to detect continents the size of North America.

What is true for visible light is equally true at X-ray wavelengths. Thus, a quasar at the very edge of the visible universe—something that would register as only a faint smear of light to the Space Telescope—would form a violent and intensely brilliant image in the Ultimate Telescope.

Nothing would be hidden from view. We could gaze 10 billion light-years away and watch whole stars and solar systems vanish into the maw of a black hole, emitting bursts of X rays as they were swallowed up. We could zoom in on rapidly rotating neutron stars and pulsars and study the fine details of their surfaces. We could peer into the very heart of a red giant as its core collapses to form a supernova. When this happens, much of its energy dissipates as neutrinos, particles so elusive that special detectors have been able to capture less than 1 in 1 quadrillion. Yet using the sun's lens we could focus on the neutrinos to such an extent that we could follow a star's collapse literally microsecond by microsecond by concentrating on the emission of neutrinos.

Extrasolar planets would be another specialty of the Ultimate Telescope. People already are hoping that the Space Telescope will settle the question of whether Barnard's Star, six light-years away, has planets, but at best the largest of them would show up as tiny spots of light, barely discernible from the glare of nearby Barnard. The Ultimate Telescope, by comparison, could show objects the size of houses on each planet. Planets of nearby stars would seem almost uncomfortably close. As Hannah puts it, "We're talking about looking intimately a few light-years away."

On any given clear day, we can look up and see the ultimate telescope lens: the sun.

WOLF PARK

EXPLORATIONS

By Odean Cusack

Darkness settles in at the behavioral-study center of Wolf Park, and in the scientific-observation hut, a single lamp permits the occupant to continue working. Close by, the wolves, twilight creatures whose nocturnal exploits were once the stuff of legends and nightmares, flex their lean limbs and begin to prowl. With no apparent provocation, a silhouette entreats the moon with a lingering, plaintive howl. Soon other voices echo this haunting call, and the resulting chorale is a celebration of wolves and wildness that both chills and thrills the human listener. The observer pauses, stirred by ancestral memories of a time when the differences between man and beast were less distinct. Imagination soars, civilization's artifacts dissolve. Like the heralded Wolf Warrior of the Cheyenne Plains Indians, the human spectator abandons self and briefly unites with the soul of the wild.

For centuries, wolf lore has dominated our fears and fancies. Sometimes revered, but mostly reviled, the wild canine has historically been cast as a villain, the nemesis of humans, livestock, and wildlife—a misconception that has forced the species to the brink of extinction. But modern ethologists, such as Purdue University's Erich Klinghammer, the founder of Wolf Park, have now established that the wolf is a valuable predator whose complex pack life is a unique model of social interaction and cooperative effort.

Situated in the rural farming community of Battle Ground, Indiana, the 75-acre research facility, which doubles as a wildlife park, is the home of the most studied captive pack of wolves in the world. Although tame, the animals function much as their wild fellows, with a notable exception. Wolves in the wild are shy and avoid contact with people. At Wolf Park, the socialized animals nonchalantly accept human scrutiny, providing the scientist with an unprecedented research opportunity and the visitor with a rare glimpse of a wildlife heritage that has largely vanished from the United States.

Wolf-society leadership is invested in a dominant pair—the alpha male and female—and individual rank is determined and maintained through ritualized behaviors. In the body language of wolves, an elevated tail, for example, is a sign of self-confidence, and exposure of the belly or genitalia indicates submission. Wolves are opportunists and look for a chance to move up the social structure. Consequently, rank—particularly among yearlings—can change rapidly. As a trio of gangly youngsters cavort, Klinghammer explains, "During such activity, young wolves learn to judge one another's strengths and skills. This serves an important social function because, as adults, they must keep informed about the condition and disposition of other pack members."

At the onset of the breeding season, in mid-January, activity heightens, and social standing is most likely to change. Observers monitor the pack 24 hours a day, noting the hierarchy of behaviors exhibited by the animals. The alpha male courts the alpha female, and for a period of four days within her estrus cycle he allows no other male to approach her. This guarding behavior is triggered by the secretion of a pheromone by the female and may coincide with ovulation, providing the male wolf with a natural mechanism to ensure the pups' paternity. Although wolves display mate preferences irrespective of social rank, often only the dominant pair produce a litter that is reared by the entire pack.

Pack living evolved as a survival strategy, and cooperative hunting enables social carnivores to take on larger and more formidable prey. As a small crowd assembles in the observation tower overlooking the 17-acre bison enclosure, Klinghammer, below, leading a mature 80-pound wolf, informs his audience, "To properly study the wolf, you must also study his prey and his environment." Currently, Wolf Park is the only wildlife facility where one can observe dynamic predator-prey interactions. "These encounters," adds the distinguished German-born ethologist, "enrich the lives of both species by restoring an additional

Like their wild brethren, denizens of Wolf Park roam in packs governed by complex social rules

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CONTINUUM

MANUFACTURING BREAKTHROUGHS

All right. Information theory is great. You use it to send messages around the world through heavy static. It can, reportedly, even forecast the weather years in advance, foretell the death of heart patients and predict tomorrow's gold prices. But come on, can it really promote scientific breakthroughs?

Arthur Damask thinks so. A physicist at Queens College in New York City, he says that breakthroughs do not always strike unpredictably; progress is not always dependent on a physicist serendipitously sitting under the right tree and being hit with a laws-of-gravity provoking apple. Rather, you can guess which experiments will pay off and even promote major new discoveries. All it takes is a little math.

Damask developed his idea after studying the work of Yale science historian Derek de Solla Price. Science grows steadily, Price found, not in fits and starts when major breakthroughs are made. It doubles and redoubles continuously until it runs out of personnel or money—just as yeast cells in a flask grow until they run out of nutrients.

Major discoveries—ones that change the course of science and technology—follow the same predictable pattern. As scientific knowledge accumulates and more scientists and money become available, breakthroughs steadily grow more common.

Damask believes that this pattern applies to individual laboratories. The larger and wealthier the lab, the better the chance it will produce significant discoveries. To get the best results, simply throw the right number of men and the proper amount of money at problems that are likely to produce startling results. That is where information theory comes in.

Information theory was developed in the 1940s by Claude Shannon, a scientist working at Bell Laboratories. One of Shannon's key insights was that the less likely a letter is to appear in a message, the more information it carries. For example, a code is more easily cracked if unusual letters such as *Z* appear in the message than if only common letters—*E*, *T* or *A*—are found.

Science works the same way; the more surprising a discovery, the more useful it is. As one example Damask cites a new family of supertough ceramics formed by mixing chemicals with a gel and setting them at low heat. "Everybody eats Jell-O," he says, "but no one thought of mixing ceramic powders with gelatine. The first such ceramic was an astonishing breakthrough, the rest will most certainly be useful but far from earthshaking."

The best research managers intuitively back experiments that may give unexpected results, Damask believes. But information theory could turn this seat-of-the-pants art into cold, efficient methematics. Shannon's equations, after all, deal with probabilities. It makes no difference what they're used to predict. Apply them to a group of experiments and it's no longer necessary to guess which one has the best chance of yielding a breakthrough, the equations give a precise figure. That experiment should get the most money and personnel. The equations also tell just how much funding it should get.

How much will the added precision improve a lab's performance? "Three hundred percent or more," Damask estimates.

He recently offered the idea to other scientists at a seminar presented at New York University's (NYU) Center for Technology and Science Policy. The proposal received a warm welcome. Sidney Oldberg, a project manager at the Electric Power Research Institute, in Palo Alto, California, has been using information theory for about six years to predict the reliability of reactor-core materials. Using the technique to manage research programs, he says, "sounds like a fruitful approach."

Scientific research sorely needs some such management technique, Damask stresses. In conversation with a research director of a major electronics firm, Damask asked who kept track of how well the company's experiments paid off. The answer: "Nobody." At another company, he found, scientists decided how much to spend on research by reading their biggest rival's annual report.

Yet, not everyone has welcomed Damask's idea. Historian Sidney Bradford objects that "in any man's life social factors come to bear—marriage, the impact of peers, rival attractions. How well the lab is run is only part of what affects a researcher's output." And though Damask and the NYU Center have been consulting with research directors at three major corporations, not one has agreed to adopt management by equation. Herbert Fusfeld, the Center's director, speculates that lab managers do not want outsiders to evaluate their performance. "We have a hunch that they are nervous about how it will look when we examine the data."—*ANTHONY LIVERSIDGE*

CONTINUUM

One of Blough's three pigeon students in its computer-equipped learning box. Bird brains are capable of mastering the ABCs

PIGEON LITERATI

It's not exactly pigeon English, but three feathered subjects in a recent Brown University experiment have mastered the alphabet.

In individual "classrooms'—boxes equipped with Atari home computers and television screens—three male pigeons learned to distinguish all 26 letters. For about four days, each studied a target letter, and when that letter appeared on the screen in random combinations with two other letters, the bird had to peck the correct one.

A computerized record of the pigeons' four-month trials revealed that bird brains are surprisingly like human ones. At any rate, pigeons and people find the same letters easy—or difficult—to tell apart, reports psychologist Donald Blough. Take *D* and *Z*. Pigeons could tell the difference 92 percent of the time. But when it came to distinguishing *U* from *V*, look-alike letters often confused by human children, the accuracy rate sank to 34 percent.

"I wanted to find out how different creatures see the world," says Blough. "The fact that pigeons and humans perceive in similar ways suggests there is something fundamental about the pattern-recognition process."—Phoebe Hoban

"Without adventure civilization is in full decay."
—Alfred North Whitehead

CHINESE CHEATS

It was an old story. Scientists were fudging their data, gilding their credentials, and claiming false authorship of certain manuscripts. Only this time the scene of the crime was not the decadent West, but the People's Republic of China.

In recent months the Bamboo Curtain has parted slightly to reveal an unfamiliar side of Chinese science. Some scientists, reports the *Peking Review*, stoop to "deception by doctoring data and research results in their pursuit of personal fame and gain. Some even resort to plagiarism." Another journal tells of lesser misdeeds, like breaking up a paper into smaller articles to gain more publication credits.

Why the cheating? "First there is the same desire for advancement in China as here," explains Leo Orleans, a China specialist with the Library of Congress. "Then, many of the people in charge of the research institutes have no science background at all." And Chinese researchers are under great pressure to modernize their country's science and technology overnight, Orleans says.—Marcia Bartusiak

FUTURE FARMS

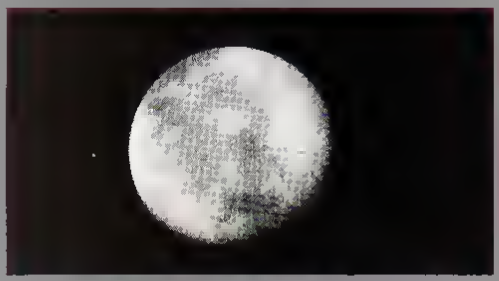
The Age of the Wheel is waning—on the farm.

By 2030 sophisticated "crop-scanning gantries," bridgelike frameworks traveling on permanent rails will probably replace the tractor, predicts one far-seeing agricultural engineer. The land will profit.

Because heavy farm vehicles chew up the soil surface and structure, notes John Matthews, head of the Tractor and Cultivation Division of England's National Institute of Agricultural Engineering, most seeds are now planted at a depth of 200 millimeters.

Not so with the farm gantries. Spanning 15 to 20 meters of crops and cruising along tracks of porous stones or synthetic materials they'll permit farmers to sow seeds only 50 millimeters deep. The new-age vehicles will also plant, fertilize, irrigate, harvest, and test trace elements in the subsoil. And their computers will automatically make adjustments for sloping fields.—Dava Sobel

Unlike present-day tractors, future farm vehicles won't chew up the soil, says one expert. Why? They'll have no wheels.



Europa. NASA researchers now believe there s more to this Jovian moon than meets the eye—notably, a vast underground sea

SEAS OF EUROPA

When the two Voyager space probes raced past Jupiter and its moons they spied neither frothy waves nor sandy shores But scientists now believe there's a vast ocean hidden beneath the frozen surface of Europa

At first glance icebound Europa one of Jupiter s major moons looks as smooth as a giant white billiard ball poised in space—quite different from her sisters Io, Ganymede and Callisto Though a network of fissures spans Europa s surface, large hills and craters are almost nonexistent But recent calculations by planetary researchers at NASAs Ames Research Center in California tell another story

Beneath Europa s icy crust propose Steven Squyres Ray Reynolds and David Colburn lies a liquid ocean some 30 miles deep Radioactive decay in the satellite's interior and the huge gravitational pull of nearby Jupiter likely keep the underground sea thawed What s more the NASA/Ames team speculates Europa's huge surface cracks should let in enough sunlight to support photosynthesis—and perhaps life

Volcanic vents on the ocean bottom and electrical surges induced by Jupiter's gravitational field might also provide energy for life forms Such a scenario has already been envisioned—by Arthur C Clarke in *2010 Odyssey Two*

' While I wouldn't bet my rent money that life came into being on Europa," says Squyres it s interesting to note that a Europan ocean would resemble a life-supporting environment on Earth ' The large masses of algae thriving beneath Antarctic lakes, for example, would probably feel right at home Meanwhile NASAs next probe *Galileo*, may bring home more evidence of the hidden alien sea

—Marcia Bartusiak

'We cannot command na ture except by obeying her '

—Francis Bacon

POLLUTION SOLUTION

Take a horseradish and mince it very fine Add hydrogen peroxide and blend Then strain the mixture through cheesecloth

Brewed by Alexander M Klibanov of the Massachusetts Institute of Technology s nutrition and food-science department the recipe reportedly detoxifies wastewater produced by chemical and coal-processing plants Its specialty is cleaning up PCBs or polychlorinated biphenyls the dread poisons that have made headlines at dump sites from Love Canal to Impenal Missouri

Horseradish? The humble root contains the enzyme peroxidase When mixed with hydrogen peroxide and added to wastewater, it triggers a chemical reaction that causes phenols and aromatic amines the two main wastewater toxins to solidify The chemicals form a long chain that can be removed as a sediment or burned as fuel What s more while current methods take days to clean up waste Klibanov s method works in just hours

While his recipe awaits a patent Klibanov is at work on another for ridding nuclear plant waste of radioactive tritium —Phoebe Hoban

"A vacuum is repugnant to reason "

—Rene Descartes

Cleaning up toxic chemical waste An MIT professor claims his horseradish recipe will do it in a few hours instead of days

CONTINUUM

RESCUE SHUTTLE

In the not-too-distant future, a space station may be imperiled by a rapidly approaching meteor shower How will the crew be rescued? Perhaps with the 'minishuttle" now being designed for the Air Force by the Boeing Aerospace Company, of Seattle

Still on the drawing board, this reusable spacecraft would be a mirror image of the NASA shuttle, but only one third the size It would have a 30-foot wingspan and a 52-foot length, and it could blast off from atop an in-flight Boeing 747

A modified 747 loaded with the minishuttle, the aerospace company says could take off from any major airport within 100 minutes of an alert When the plane reached an altitude of 37,000 feet the minishuttle would ignite its engines and catapult into orbit An external fuel tank would drop off when empty and disintegrate in the atmosphere but the craft would carry enough fuel for orbital maneuvers and reentry

As now conceived, the minishuttle is an unmanned vehicle It could ferry satellites into space or perform reconnaissance missions But Boeing says the design can be altered to accommodate crew and passengers "If the Air Force decides to build this craft ' says a company spokesperson, 'it will be ready in five years '

Engineer Dick Bornhorst, of the Rocket Propulsion Laboratory, at Edwards Air Force Base, in California, says the minishuttle is "feasible engineering-wise ' But he notes the Air Force has made no decision on the project —Eric Mishara

"Look at your watch and tell what time it is You do not know what will happen in the next five minutes of your life "

—Leopold Stokowski

To save space-station crews from extraterrestrial peril, a rescue minishuttle would take off from atop a Boeing 747 jet in flight

Immaculate contraception Silicon plugs that bar the egg from passing through the fallopian tubes may be the perfect method

BIRTH-CONTROL PLUGS

The perfect birth-control method for women would be 100 percent effective It would require only one treatment for permanent protection and could be reversed in minutes whenever children were desired Now a product that fits the bill may soon be available It consists of two small, rubbery plugs that block the fallopian tubes keeping the egg from passing through to be fertilized

The procedure has been tested in 950 women, with no reported pregnancies, according to R S P Laboratories, the Stamford, Connecticut developer Only three women developed side effects that dictated the removal of the plugs

Doctors make the plugs by injecting liquid silicon directly into the fallopian tubes' opening Once the silicon hardens, it fills two thirds of the tubes A thread embedded in the plugs facilitates their removal

The procedure can be performed with no anesthesia in a doctor s office with little if any discomfort, according to gynecologist Theodore Reed, of Philadelphia's Landenau Hospital Eliminating the hospital stay cuts the cost of sterilization to about half that of other methods, he adds

The plugs are now under review by the Food and Drug Administration, R S P officials report If all goes well, the plugs should be on the market by year's end

—Rick Boling

"A student who changes the course of history is probably taking an exam "

—Franklin P Jones

SEXY BREATH

You can determine the sex of your peers by the smell of their breath alone according to a team of scientists at the University of Pennsylvania

To sniff out its results the research group asked 19 female and 14 male college students to refrain from brushing their teeth or eating spicy foods for five consecutive days Then five male and five female judges were separated from the test subjects by a screen in a large well-ventilated room Each subject was asked to blow into a tube passing through the screen to the judges on the other side Finally the judges tried to guess the sex of each test breather while ranking his or her breath according to its intensity and pleasantness

"What we found" says researcher Samuel Yankell, "was rather surprising because the sex question really came as an afterthought

Both male and female judges correctly guessed the sex of the breath donors up to 95 percent of the time The female judges were better at identifying male breath and the male judges were slightly better at identifying female breath Apparently it's easier to identify the opposite sex" Yankell says

In general male odors were found to be more intense and less pleasant than female odors The researchers, including Richard Doty, Paul Green and Carol Ram believe this may be due to a hormonal difference between the sexes —Marc McCutcheon

"It is better of course to know useless things than to know nothing"

—Seneca

INFECTION-FIGHTING BLOOD VESSELS

Artificial blood vessels have been used to bypass arterial obstructions and clots since the 1960s The vessels, made of Dacron and other biologically neutral materials, are not rejected by the immune system But areas in contact with the synthetic vessels are vulnerable to infection, usually from staphylococcus bacteria Up to 6 percent of graft recipients develop infections despite antibiotics and more than 30 percent of these die

Researchers at the University of California at Los Angeles think they may have the solution They are binding to blood vessel materials an antibiotic that fights staphylococcus The vessel will then kill bacteria in the graft site for several weeks after surgery

Vascular surgeon Wesley S Moore, head of the project says experiments with dogs have shown the technique to be highly effective He plans to start human trials soon

The technique may eventually be used in other synthetic body parts from artificial heart valves and pacemakers to hip joints

—David L Dreier

WALLPAPER WATERLOO

Armed with tests showing arsenic in Napoleon's hair many historians have claimed that the deposed emperor was the victim of a poisoning plot

New evidence points to a less diabolical demise says British historian David Jones, of the University of Newcastle upon Tyne According to Jones it was not political intrigue, but deadly wallpaper that did the former conqueror in

The historian finds his clues in a fragment of wallpaper from the drawing room of Longwood House the St Helena retreat where Napoleon died in 1821 Tests reveal traces of arsenic, a compound widely used in late-eighteenth- and nineteenth century paints and dyes

"The wallpaper was harmless as long as it was dry," Jones explains "But when it got damp mold grew and turned the arsenic toxins into vapors, which were breathed by people in that room"

Though arsenic fumes probably didn't kill the exiled leader says Jones they no doubt contributed to his ill health Napoleon suffered for years from malaise—shivering weakness stomach pains and swollen limbs all symptoms of arsenic poisoning—and visitors often complained of the "unhealthy atmosphere" at his retreat "Now" says the historian "there is no real reason to argue with the original autopsy report which stated that Napoleon died from an ulcerated stomach" —Sherry Baker

"Heroism, the Caucasian mountaineers say, is endurance for one moment more"

—George Kennan

No snowflake in an avalanche ever feels responsible

—Stanislaw J Lec

Napoleon died with traces of arsenic in his hair Was he the victim of a poison plot or his drawing room wallpaper?

CONTINUUM

TEDDY BEAR THERAPY

The teddy bear's chest rose and fell, creating a heartbeat sound for the tiny infant beside it. The baby nuzzled the animal's pulsating fur, unaware that such rhythm might calm his own spasmodic movements and help heal his damaged nervous system.

This infant, like many premature babies, had a central-nervous system disorder that caused him to move erratically, breathe unevenly, and pass from light to heavy sleep with no regularity at all. If uncorrected, the condition could render the infant vulnerable to sudden crib death. And if the child lived, he might grow up to be hyperactive or worse, mentally retarded.

But University of Connecticut psychologist Evelyn Thoman may have a treatment. She believes that the pulsating rhythm of a mechanical teddy bear will, in [illegible] an [illegible] work. F. Eugene [illegible], director of the Cru[illegible]ute for Medical [illegible]neering at UCLA, hope that once the nervous system learns to keep pace with the bear, the devastating effects of premature birth will be significantly diminished.

In Thoman's current experiment, the bear is set so that it "breathes" at the same rate the infant does during deep sleep, when respiration is likely to be steadiest. Infant and bear are then placed on a mattress containing sensors that detect breathing patterns. Using data from the mattress, as well as a video record of the infant's movements, Thoman and Yates will evaluate the baby's progress.

Though other researchers have had some success treating premature babies with rhythmic stimulation, Thoman says the bear may prove more effective. The reason: Its rate of breathing is similar to the baby's own. In addition, the therapy may be fine-tuned by the infant himself, who has the option of either using the breathing bear or rolling away.—Madeleine Lebwohl

ROCK-EATING BEHEMOTHS

A group of gigantic extinct marine animals that coexisted with the dinosaurs had an odd propensity for eating rocks. In fact, scientists have routinely found 15- to 20-pound caches of spherical stones nestled in the animals' fossilized remains. Some say the rocks helped these great beasts, called plesiosaurs, grind up their food.

But geologists David Darby and Richard Ojakangas of the University of Minnesota disagree. After discovering about 100 rocks in a Montana skeleton, they hypothesized that the stones provided ballast for swimming.

According to Darby, the food-grinding theory is implausible because plesiosaurs simply didn't have gizzards, which aid digestion in turkeys and other birds that ingest small stones.

Furthermore, at least one contemporary reptile—the primitive African crocodile—swallows stones for balance. Even those that live in swampy areas with few rocks manage to acquire them, he explains. Young crocodiles without stones are tail-heavy, top-heavy and seem to have trouble balancing in waves.

Doubters say the plesiosaurs would not be smart enough to swallow stones to improve their swimming prowess. Darby argues that their small brains were adequate and the behavior could have been instinctual.—Dava Sobel

"In my opinion, the universe is governed by a committee; one man couldn't have made so many mistakes."
—Clifford Odets

The ancient plesiosaurs, seen here above, may have smacked on rocks in order to improve their ballast while swimming.

INSECT SQUADRONS

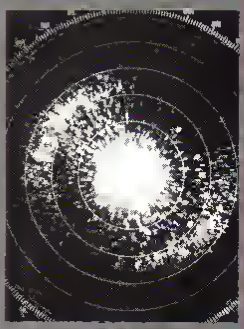
It's five miles across, ten miles long and flies through the air like a squadron of bombers in formation

No killer bees aren't on the way Department of Agriculture researchers tracking the ominous flying cloud on their radar screens are watching such plebeian farmer's foes as corn earworms and cabbage loopers Their findings could give farmers a pest early warning system

Using trailer mounted antennas and computer-controlled weather stations the team has been learning how atmospheric conditions affect insect flight patterns According to Wayne Wolf the team's agricultural engineer, they've already discovered that bugs fly in uniform layers not in shapeless swarms their squadrons are most dense after sunset And they fly as high as 7 700 feet where faster winds propel them

The radar isn't yet capable of distinguishing between different types of insects, ' says Wolf 'But it can help by estimating *how many* are aloft '

—Phoebe Hoban



Radar scan of night flying insects a farmer's dream?

We are all in the gutter but some of us are looking at the stars '

—Oscar Wilde

PLASTIC TEETH

Plastic wrap the kind that guards food from staleness might have inspired a promising dental innovation a liquid plastic that hardens to a cavity resistant surface when applied to teeth

According to dentist James Williams of the Medical College of Georgia a single application of the plastic was administered to a group of 400 elementary school children in 1976 Today 68 percent of their teeth are cavity free And without the plastic coating Williams says only 50 percent of the teeth would have escaped decay

Only the grooves and valleys in the biting surface of the tooth—the areas most liable to decay—need be coated " says Williams Routine application of the sealant to worn spots, in conjunction with fluoridation and brushing and flossing he adds would result in almost 100 percent cavity prevention And the cost of sealing a tooth is less than a filling

The dental plastic known as pit and fissure sealant " has been approved by the Food and Drug Administration and is available to dentists —Eric Mishara

Boy meets girl as a mathematical quest A psychologist has written the equation but the solution is up to the seeker

LOVE FORMULA

How long will it take you to find true love? Just solve the following equation

$$M = \frac{0.7}{O \times S \times A \times D \times I}$$

The answer is the number of months *(M)* you'll have to wait before you meet Mr or Ms Right

The formula the brainchild of psychologist Jeffrey Young of the University of Pennsylvania is a mathematical statement of the factors involved in intimacy I found that telling a patient something like You're too selective just didn't work says Young 'I had to develop something more concrete to bring home the effect of say, meeting just one new person a month

Interviewing lovers and seekers the psychologist searched for the reasons some people take two or three years to find romance while others work much more quickly Sheer attractiveness was not the answer opportunity selectivity approach desirability and intimacy were

Opportunity, the *O* of the formula means the number of eligible members of the opposite sex to whom you're exposed each month Selectivity (*S*) is the percentage of those you meet whom you find desirable, and approach (*A*) stands for the percentage of that group you actually ask for a date Desirability (*D*) is the percentage of those who agree to go out with you

Finally intimacy, or *I* is the percentage of dates that lead to an intimate relationship of at least six months duration It's based on your track record and your current rating of your ability to create intimacy As for the 0 7 it stands for the 70 percent probability that the equation's answer will come true

—Robert Deckert

CONTINUUM

PHONY PSYCHOSIS

Should you get the urge to feign insanity don't do it, advise psychiatrists at McLean Hospital, in Belmont, Massachusetts The ticket you win to the wan world of basket weaving and unseen voices may be one way because according to a new study, fake psychosis can be more dangerous than the real kind

Why? People who mimic hallucinations or other psychotic behavior usually suffer from underlying ' personality disorders ' Harrison G Pope and his McLean Hospital colleagues report The nine ersatz psychotics they studied actually fared worse than real manic-depressives and even some schizophrenics Eight of them spent months or years in mental hospitals and one committed suicide

"There is no pill to cure a personality disorder notes Pope What's more phony psychotics may suffer uncomfortable side effects from antipsychotic drugs and waste time while the real problem gets worse

Since there s no way to verify another person's hallucinations it's not easy to spot the fakers Still, the McLean psychiatrists suggest a few tip offs Does the patient confess to having control over his craziness? Are his hallucinations obviously fanciful? (One pretender 'saw' nude one-armed Africans dancing on the ceiling) And do his symptoms appear or disappear instantly, as happened to some would-be psychotics who recovered after taking a single pill?

—Rick Boling

"Stars scribble in our eyes the frosty sagas,/The gleaming cantos of unvanquished space"

—Hart Crane

Faking insanity can be dangerous to your mental health Wasted years harmful drug side effects, and even suicide may follow

Mother-child bonds The magic could be biochemical since doses of female hormones can turn male rats into good ' mothers

MOM CHEMICALS

The special emotional bond between a mother and her child is more than psychological—if the research of Harvard Medical School neuroendocrinologist Robert Bridges tells us anything about humans

Bridges and his team are testing the role of "mom chemicals in rats, whose maternal actions are fairly easy to quantify Their finding? The desire to feed and protect one's young stems to a surprising degree from the body s hormones

In one study male rats and childless females turned into model mothers following doses of estradiol and progesterone, female hormones that surge during pregnancy Within two days even the males were building nests and crouching over the young to warm them The intensity of a *human* mother's response to her newborn—especially her first—may depend greatly on such hormones, Bridges speculates

That s not all Our brains natural opiates such as beta-endorphin and the enkephalins, also influence motherhood chemistry Since beta-endorphin levels seem to increase throughout pregnancy and drop right after birth, Bridges thinks the opiate reduction may trigger maternal feelings When the researchers treated pregnant rats with morphine to artificially maintain their high opiate levels the rats behaved unmaternally When the morphine treatment ended the signs of proper rodent mothering returned

"Maybe says Bridges, "very high dosages of opiatelike painkillers during childbirth interfere with or delay the mother-child bond —Marcia Bartusiak

"People think too historically They are always living half in a cemetery."

—Aristide Briand

First the newborn lambs died, then older sheep. Then the cloud engulfed the valleys

THE DAY WE BOMBED UTAH

BY JOHN G. FULLER

The night was quiet except for the bells of the sheep. On the winter range they were restless. It was mild that March night in 1953, a soft 49°F. Still, inside the snug sheep wagon the wood stove took off the chill. Even before first light Kern Bulloch and his brother Mac would be saddling up their horses to nudge their band of nearly 2,000 Rambouillet sheep on the trail toward Utah, toward home. There was more than 100 miles to go, from north of the Lincoln Mine, in Nevada, trailing eastward along Tickaboo Valley, Dry Lake, and Panaca, and on home to Cedar City. Kern, lean, limber, and slight, loved the range with a passion. Mac Bulloch, barrel-chested, with a cherubic face, felt the same way.

The sheep traveled and grazed about six miles a day, grubbing their muzzles deep into the snow and porous rocky soil down to the roots of the black sage, saltbush, and galleta grass. The Bulloch brothers were accustomed to the silence and loneliness of the Nevada range. But they could never get accustomed to the violent spurts of the atom-bomb tests at Yucca Flat, just 40 miles away. Some of the test bombs would yield more than four times the kilotons of the bomb that had leveled Hiroshima eight years before.

The mushroom cloud, fiery and turbulent, would boil upward just before sunrise to create a false dawn. The Bulloch horses would rear up, the sheep would scatter, and the dust cloud would sweep toward them, thick with dirt and fallout.

PHOTOGRAPH BY DAN MORRILL

THE DESERT SHOOTING AND JOHN WAYNE'S DEATH

July 6, 1954, was a lusty and cheerful day in St. George, Utah. The local Elks lodge played a charity softball game against a film company on location to shoot a movie called *The Conqueror*. Several things happened.

Susan Hayward kicked off her shoes, ran the bases barefoot, and scored a run. John Wayne and Dick Powell scored two runs each and signed autographs. Agnes Moorehead cheered from the grandstand.

Now, nearly thirty years later, all four of the superstars are dead from cancer. More than 200 in the cast and film crew worked with them in the sands of the desert. Nearly 100—almost half—have come down with cancer. Half of that group have died from it.

There were no nuclear tests at the Nevada proving grounds in 1954. But the cumulative fallout of all the Upshot-Knothole tests of 1953 had covered the ground in uneven blotches, most intensely in and around St. George and nearby Snow's Canyon, where most of the footage was shot.

The Conqueror was an expensive but shoddy production about Genghis Khan and the Mongol warriors. The script called for some of the dustiest, grimiest battle scenes ever filmed. All during the shooting actors and extras rolled in the sands in mock battles. Desert winds blew incessantly. When they didn't, huge electric blowers were brought in to simulate the winds. Tongues, teeth, and gullets were coated with grime. Everything was crusted with windblown soil. So much dirt collected in the costumes that actors had to be hosed down before they took them off. Those who weren't working in front of the cameras tried wearing face masks, which were ineffective.

Since inhalation and ingestion are the most deadly forms of exposure, the danger was exacerbated. Many fission products like strontium 90 and cesium 137 decay slowly. They are driven below the surface of the soil by rain and snow. At times they percolate upward. When the soil is stirred up, the buried poisons emerge again.

Michael Wayne (at right in photo above), now in his late forties, was on location with his father, along with his brother Patrick (at left in photo). Michael has recovered from skin cancer. Patrick, now in his early forties, has had a benign tumor removed. They are concentrating on making the John Wayne Cancer Center at UCLA, the best in the country. "I think it's the best possible tribute to Dad," Michael says.

Michael is not an antinuclear activist. He is all for nuclear power. But he says, "I don't want them doing all this if it's not safe. The government just can't walk over people. The greatest crime is a coverup, whether it's Watergate or nuclear radiation."

There could be no harm, of course. Press releases from the Atomic Energy Commission (AEC) stated that the fallout "does not constitute a serious hazard to any living thing outside the test site."

For some reason the test shot that came in the predawn of March 24, 1953, seemed different to Kern Bulloch. The ground shook more. The sheep were more frenzied. Red, the sheep dog, jumped into the sheep wagon and cowered. The mushroom cloud, capped with a crest of ice crystals, soared to 40,000 feet above them. Kern covered his eyes. He thought he could see the bones through his clamped fingers.

What neither Kern nor Mac Bulloch realized at the time was that they were to become unwitting principals in a tragedy. At first the cloud of tragedy would pass over their herd. Then it would engulf hundreds of humans. The cloud would not dissipate in their lifetimes. And despite 30 years of strenuous government efforts to deny the tragedy, it hasn't ended today.

Some 20 miles to the south, thirty-one-year-old Bob Sheahan watched from the Groom Mine. He had once been an engineering student at the University of Nevada. With his father, Dan, he had already seen nearly 30 radioactive clouds pass by since the tests started two years before. He had taken photographs of many. The clouds were heavily laden and dirty. The Groom Mine, a cluster of a dozen buildings and cabins, sat on the eastern border of Nevada Proving Grounds, in the path of the winds that blew to the north and east.

As the clouds and dust from the March 24 detonation headed north from Yucca Flat and toward Bald Mountain, near the mine, Bob Sheahan went down to one of the cabins to see if William Holy, the radiation monitor from the Public Health Service, wanted to have some breakfast. Holy wanted some, but he couldn't leave his radio and telephone equipment, which he had set up for the shot. There would be messages coming in from the other monitor posts to track the fallout from nearby Tempiute, Lincoln Mine, and Control Point.

Holy was occupied with a broken generator when the phone rang in the cabin. He asked Bob Sheahan to get the message. On the phone was Holy's counterpart out near the Lincoln Mine. The radiation reading there and for the valley where the Bullochs were was very hot.

A few miles from Lincoln Mine the Bulloch brothers, on horseback, herded up the stray sheep and watched as the dusty haze closed in. According to legend, on a clear day you could see a train coming two days away. Today was nothing like that, but they could see a jeep speeding toward them on one of the few roads that cut through the desert. In the jeep were several men. They pulled up close to the Bullochs and got out, looking worried. They were wearing plastic boots. "You fellows are in a helluva hot spot," they said. "You better get out of here fast." Kern Bulloch asked, "How

can we do that? The sheep move six miles a day." The answer was "Move 'em as quick as you can, then. This is no place to hang around." Then the jeep drove away.

The Bullochs had never heard of a radiation hot spot. The herdsmen did the only thing they could. They hustled their sheep east, away from the blast, toward Utah.

Later that day Bill Holy filled in the Sheahans about his radio and phone calls. A report on a band of sheep and two sheepherders had come in. In the valley where the Bullochs were, the readings were hotter than at the Lincoln Mine. There was talk of sending a copter to get the two sheepmen out. But the Public Health Service monitors didn't want to return to the spot. The decision was made at the Proving Ground control point to get the people at Lincoln Mine under cover. Nothing could be done about the two sheepmen.

On the range the Bulloch brothers continued to trail the sheep home. The ewes were a month away from lambing now. By May the lambing sheds at Cedar City, Utah, would be full of hundreds of mother ewes. Approaching the Utah border a week after the test shot, the herd grazed every foot of the way, nibbling at the sparse vegetation, taking in mouthfuls of dirt and desert sand along with it. Mac Bulloch, circling the rear of the herd on his horse, drew up to a ewe and saw she was about to give birth to a premature lamb. He dismounted to help her. When the lamb came out, it was stunted. There was no wool. It had a strange potbelly. There were no legs.

But premature lambs on the trail were not uncommon. Mac Bulloch shrugged it off. He did the same even when eight more lambs dropped prematurely on the rough terrain of the range. The ewes ignored them. Their natural maternal instincts seemed to be gone. Bulloch had a fleeting thought. Could the long series of tests since 1951—22 of them so far—have anything to do with this? He had no way of knowing.

He was glad when they got to the lambing sheds in early April. By May there would be no more immature lambs.

The brothers stocked the feed mangers high with hay, grain, cotton cake and bone meal, a rich diet needed after the rigors of the trail. Kern Bulloch, stocking the feed manger one day, noticed one of the sheep in a peculiar position. Its head had dropped into the manger, its muzzle buried in the feed. It was motionless. He went to the sheep and tried to lift it by the wool on its back. The wool came off in his hand in an enormous clump. The sheep was dead. All around its nose and mouth, as well as on its ears, were scabby sores. Its hooves were hardened. There were running sores with large pustules on its back.

In a matter of days the scene repeated itself. Sheep would stand, as if in a stupor, then suddenly fall over dead. During shearing wool would slide off the sheep's backs with a single push of the clippers. The brothers would come to the sheds with their father in the morning to find 40 or 50 sheep lying dead by the mangers. The symptoms were always the same. The local veterinarian had never seen anything like it before. Neither had Steven Brower, the egricultural agent for Iron County.

When the lambing season peaked, the scenes were horrifying. The newborns would emerge deformed and stunted, with no wool and with flesh as pale and soft as a human's. They had tiny legs. You could see the heart beating through the flesh. The baby sheep tried to stand, and fell over. The toll mounted quickly. Hundreds lay dead. But the scenes weren't confined to the Bullochs' lambing sheds.

Some 17,000 sheep belonging to Cedar City herders had been on the Nevada range at the same time that season. Many of the herders began to experience the same trauma. Annie Corry and her fifteen-year-old daughter were covered with blood in the lambing sheds as they tried to save the lambs and ewes at birthing. Their herdsman locked himself in his sheep wagon because he couldn't face the sight of the piles of dead sheep. At the end of the long day, Mrs. Corry rushed her daughter home to clean up for the school prom.

Dee Evans, a sheepman from Parawon, Utah, cringed at the sight of the bulldozers as they raked the dead bodies of his sheep into piles and shallow graves. At the Cedar City sheds of the Clark family, young Bob Clark came home from high school to help his brother Ken stack dead lambs into piles of 300 each, then throw them on a flatbed truck. Doug Clark, the father, counted the dead and watched as the truck hauled away what he'd worked for all his life.

Preliminary count of the losses for all the Cedar City herdsmen: 4,390. That was enough to form a carpet of carcasses two

miles long Nothing like this had happened in the history of the region

The name of that test shot on March 24 1953 was Nancy It was shot number two of the series known as Upshot-Knothole Nancy packed power She was 24 kilotons about twice that of the Hiroshima bomb She was fired at Yucca Flat as she sat in a cab atop a 300-foot steel tower which was vaporized in a fraction of a second

Rain or snow had to be carefully monitored Either could bring down tightly packed fallout in a concentrated lump To fire or not to fire was never an easy decision It took the test manager test director and an advisory panel of experts to decide Though they could postpone a shot the major plans and decisions were made by the AEC in Washington The commissioners operated under uncommon pressure and a sense of urgency

Throughout the country patriotism was rampant If you were against nuclear testing it was suggested that you might possibly be a Communist War was raging on the Korean central ridges McCarthyism was spreading Ike had been inaugurated Stalin had died but the Cold War was hot The Soviet Union had just detonated its own nuclear device and the American nuclear monopoly was broken Tests in the Pacific were too expensive They took too much time and travel The sites were vulnerable to enemy attack In spite of intense debate Nevada was the tactical if not the popular choice Shots like Nancy were not popular

Nancy had considerably exceeded the estimated yield No one knew exactly why The AEC's Dr John Bugher briefing the commissioners, said that some locations had been hit with as much as 10 rads but added that only thinly populated areas had been affected But then there was a sharp rain-out from a subsequent Upshot Knothole shot on April 25, at Troy, New York creating a hot spot a day later some 2 000 miles away The commissioners talked about the chances that had to be taken to meet a tough test schedule Later reviewing the long sequence of detonations commissioner Thomas Murray summed up everything in an elegant double negative *"We must not let anything interfere with this series of tests—nothing"*

The average American was confused about the tests and about radiation What were rads? roentgens? They are practically the same in value If you were talking about boxing the roentgen would be the punch and the rad would be the impact absorbed by the body the punch landed on About 400 rads would kill half the people who were exposed from head to toe in about 30 days The longer the exposure the greater the damage The exposure (often quoted in rads per hour) comes from the fallout fission products—like strontium 90 cesium 137 or iodine 131—released at the time of the explosion When these products rain down with the fallout they emit the whole ghoulish family of alpha beta and gamma rays which have little respect for living tissues They can't be seen, heard tasted or smelled

Health physicists worry most about gamma radiation to the whole body, inhalation of the fission products, or ingestion through contaminated food crops Beta rays can cause surface burns but the real danger comes when they get to the gut Once an exuberant AEC public information man tried to soften the ugly potential of fallout by calling the radioactive poisons sunshine units

The limit for a whole body external dose is considered to be no more than 5 rads in 30 years But there are different standards in and around atomic installations One standard limits exposure to 3 9 rads over a 13-week period Several studies however have concluded that there is no safe radiation dose at all

Whether the fallout lands in Cedar City Utah or Troy New York it doesn't land in a smooth even layer It falls in unpredictable globs like paint being splattered on a Jackson Pollock canvas like summer squalls hitting in spots across a lake

"They pulled up close to the Bullochs and got out, looking worried "You fellows are in a helluva hot spot," they said "You better get out of here fast"

As the sheepmen in Cedar City were reeling under the piles of dead sheep nothing stopped the test shot on May 19 1953 called Harry—or Dirty Harry as it was later dubbed The people of St George Utah a town near the point where Arizona Nevada and Utah meet followed their custom of greeting the shots from the nearby ridges of the Utah Mountains or Sugar Loaf This was history in the making, and the AEC assured the citizens that they were very real participants

Your best action ' an AEC booklet read 'is not to be worried about fallout ' The solemn word from the AEC was that fallout had never injured anyone inside or outside the Proving Ground boundaries Teachers took their classes out in the predawn dark to watch the flash and the mushroom to listen for the boom rattling along the canyons, and to look in wonder at the power of the atom

On the morning of May 19 Elmer Pickett took his wife and children up to Sugar Loaf Like a Norman Rockwell family on the Fourth of July they watched as Dirty Harry went off at 4 05 over the test site some 120 miles to the west The flash wasn't blinding as Elmer thought it would be it simply lit up the whole sky A few minutes later he felt the rumble in the ground After daylight the cloud came over tumbling above and glowing in a strange swirling pink

Arthur Bruhn a husky outdoorsman and president of local Dixie College watched it too along with his geology class His wife Lorna fragile and feminine had seen other shots with the children sitting on the tailgate of their station wagon eating homemade cinnamon rolls and drinking hot chocolate This day she and the children stayed home as the geology group went in their place

At home Lorna Bruhn felt the shock When broad daylight arrived the cloud seeped up over the mountain range and spread out over the town It seemed to Lorna that a giant reddish black hand had obliterated the sun She was just about to go to work in the garden when her husband called from the college "Don't go out" he told her, 'and keep the children in The cloud is coming our way '

Ken Clark one of the Cedar City sheepmen had been out to his sheep camp that morning in the Escalante Valley He was driving home in his truck when the cloud engulfed him It moved along with the truck as he headed toward Cedar City The dust particles smacked against the windshield and worked their way through cracks to cover his clothes with soot Five miles out of Cedar City he came to a roadblock A small group of men from the Proving Grounds operation stopped him

They moved a Geiger counter over the truck and Clark's clothes "Radiation all over you" they said "Call your wife Have her bring some new clothes Then come back here" They gave him the name of a service station and told him to get the truck washed—at their expense—and then to return to the roadblock

He did He noticed that the attendant washed the car with his bare hands He wondered where the radiation went when it was hosed off the truck

When his wife brought new clothes the men burned the old Then they made him bathe in a watering trough Clark wondered what was going on first the horrible sights at the lambing sheds now this

Roughly five hours after the Dirty Harry detonation Frank Butrico an off-site monitor for the Proving Ground had his hands full At 7 50 AM the radio message from Control Point instructed him to set up a roadblock at the intersection of Highways 18 and 91 near St George No cars were to pass to the west A decontamination station was set up at the Utah Oil service station on Main Street By 8 45 the number of cars needing decontamination began to rise The radiation reading did the same moving from 1 8 to 3 2 rads an hour

Two Texaco stations were added as decontamination posts By 9 10 high readings were found both in and out of cars

The peak had not yet been reached The decontamination operation was stopped so was the monitoring Motorists were ordered to stand by for 20 minutes to an hour At 9:25 the Test Site Control Point radioed to tell all the people of St George to take cover Schools were ordered to keep the children inside during recess By 9 40 nearly all of St George was under cover The radiation peaked at 5 2 rads well over the permissible limit Two hundred cars sat at the roadblock Around 11 traffic was allowed to move one car at a time Dismissed from the classrooms children ran out to play in the grass More than 16 000 people had been caught in the fallout area

In the aftermath of the Dirty Harry shot Butrico gave this appraisal "The events point up the need for educating the people in a two-hundred-mile radius of the Proving Grounds" he wrote Most of them are not aware of the precautions being taken to safeguard them"

One of the safeguards Butrico took was to collect samples of milk in the area He did it quietly to avoid panic With fallout came radioiodine—iodine 131—among other deadly fission products Deposited on pastures and gardens it entered the food chain Most lethal the dose to the thyroids of infants and young children who drank fresh milk It could also attack the thyroids of the sheep and lambs that were still dying in Cedar City at the time of the Dirty Harry shot less than two months after the Nancy detonation There had been six other test shots in between

A C Johnson the elderly local vet at Cedar City could do nothing as the sheep continued to die Medication and force-feeding were useless He told Steve Brower the county agricultural agent that in all the years the sheep had trailed on the range he had never observed symptoms like the lesions around the face and head or the slippage of wool at shearing

The first team of AEC veterinarians didn't arrive until June 5 some ten weeks after Nancy and two weeks after Dirty Harry By that time only a few piles of dried bones of the stricken sheep were left The vets were concerned and solicitous

Brower joined both Dr Robert Thompsett from AEC Los Alamos and Dr Robert Veenstra from a U S Navy base in San Francisco as they went to the first sheds to examine the surviving sheep Would the survivors exhibit the same symptoms as the dead sheep—or at least provide a clue?

When the team examined the first lamb on the underside of its neck the radiation meters went off the scale "This is hotter than a pistol" Thompsett said "The needle tried to go past the post" He scraped off one of the hard scabby lesions that covered the mouth nose and head and he handed it to Brower "Just like the ones at Trinity" Thompsett said "Heavy radiation damage" He was referring to the livestock badly scarred by beta burns after the first A-bomb had been exploded in New Mexico in 1945 Veenstra took further read

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FICTION

AMANDA AND THE ALIEN

BY ROBERT SILVERBERG

Amanda spotted the alien late Friday afternoon outside the Video Center on South Main. It was trying to look cool and laid-back, but it simply came across as bewildered and uneasy. The alien was disguised as a seventeen year-old girl, maybe a Chicana, with olive toned skin and hair so black it seemed almost blue, but Amanda, who was seventeen herself, knew a phony when she saw one. She studied the alien for some moments from the other side of

PAINTING BY BOB VENOSA

the street to make absolutely certain. Then she walked over.

"You're doing it wrong," Amanda said. "Anybody with half a brain could tell what you really are."

"Bug off," the alien said.

"No. Listen to me. You want to stay out of the detention center, or don't you?"

The alien stared coldly at Amanda and said, "I don't know what the crap you're talking about."

"Sure you do. No sense trying to bluff me. Look, I want to help you," Amanda said. "I think you're getting a raw deal. You know what that means: a raw deal? Hey, look, come home with me, and I'll teach you a few things about passing for human. I've got the whole friggin' weekend now with nothing else to do anyway."

A flicker of interest came into the other girl's dark, chilly eyes. But it died quickly, and she said, "You some kind of lunatic?"

"Suit yourself, O thing from beyond the stars. *Let* them lock you up again. *Let* them stick electrodes up your ass. I tried to help. That's all I can do, is try," Amanda said, shrugging. She began to saunter away. She didn't look back. Three steps, four, five, hands in pockets, slowly heading for her car. Had she been wrong, she wondered? No. No. She could be wrong about some things, like Charley Taylor's interest in spending the weekend with her, maybe. But not this. That crinkly-haired chick was the missing alien for sure.

The whole county was buzzing about it. Deadly nonhuman life form has escaped from the detention center out by Tracy, might be anywhere, Walnut Creek, Livermore, even San Francisco, dangerous monster, capable of mimicking human forms, will engulf and digest you and disguise itself in your shape. And there it was, Amanda knew, standing outside the Video Center. Amanda kept walking.

"Wait," the alien said finally.

Amanda took another easy step or two. Then she looked back over her shoulder. "Yeah?"

"How can you tell?"

Amanda grinned. "Easy. You've got a rain-slicker on, and it's only September. Rainy season doesn't start around here for another month or two. Your pants are the old Spandex kind. People like you don't wear that stuff anymore. Your face paint is San Jose colors, but you've got the cheek chevrons puf on in the Berkeley pattern. That's just the first three things I noticed. I could find plenty more. Nothing about you fits together with anything else. It's like you did a survey to see how you ought to appear and then tried a little of everything. The closer I study you, the more I see. Look, you're wearing your headphones, and the battery light is on, but there's no cassette in the slot. What are you listening to, the music of the spheres? That model doesn't have any FM tuner, you know."

"You see? You may think that you're perfectly camouflaged, but you aren't."

"I could destroy you," the alien said.

"What? Oh, sure. Sure you could. Engulf me right here on the street, all over in thirty seconds, little trail of slime by the door, and a new Amanda walks away. But what then? What good's that going to do you? You still won't know which end is up. So there's no logic in destroying me, unless you're a total dummy. I'm on your side. I'm not going to turn you in."

"Why should I trust you?"

"Because I've been talking to you for five minutes, and I haven't yelled for the cops yet. Don't you know that half of California is out searching for you? Hey, can you read? Come over here a minute. Here," Amanda tugged the alien toward the newspaper vending box at the curb. The headline on the afternoon *Examiner* was:

BAY AREA ALIEN TERROR
MARINES TO JOIN NINE COUNTY HUNT
MAYOR, GOVERNOR CAUTION AGAINST PANIC

"You understand that?" Amanda asked.

"At the particular moment she had spotted the alien she had been unusually alert, all raw nerves. Of course it wasn't aliens she was hunting for, just a little diversion."

"That's you they're talking about. They're out there with flame guns, tranquilizer darts, web snares, and God knows what else. There's been real hysteria for a day and a half. And you standing around here with the wrong chevrons on! Christ! Christ! What's your plan, anyway? Where are you trying to go?"

"Home," the alien said. "But first I have to rendezvous at the pickup point."

"Where's that?"

"You think I'm stupid?"

"Shit," Amanda said. "If I meant to turn you in, I'd have done it five minutes ago. But, okay, I don't give a damn where your rendezvous point is. I tell you, though, you wouldn't make it as far as San Francisco rigged up the way you are. It's a miracle you've avoided getting caught until now."

"And you'll help me?"

"I've been trying to. Come on. Let's get the hell out of here. I'll take you home and fix you up a little. My car's in the lot down on the next corner."

"Okay."

"Whew!" Amanda shook her head slowly. "Christ, some people sure can't take help when you try to offer it."

As she drove out of the center of town, Amanda glanced occasionally at the alien sitting tensely to her right. Basically the disguise was very convincing, Amanda thought. Maybe all the small details were wrong, the outer stuff, the anthropological stuff, but the alien *looked* human. It *sounded* human, it even *smelled* human. Possibly it could fool ninety-nine people out of a hundred, or maybe more than that. But Amanda had always had a good eye for detail. And at the particular moment she had spotted the alien on South Main she had been unusually alert, sensitive, all raw nerves, every antenna up.

Of course it wasn't aliens she was hunting for, but just a diversion, a little excitement, something to fill the great gaping emptiness that Charley Taylor had left in her weekend.

Amanda had been planning the weekend with Charley all month. Her parents were going to go off to Lake Tahoe for three days, her kid sister had wangled permission to accompany them, and Amanda was going to have the house to herself, just her and Macavity the cat. And Charley. He was going to move in on Friday afternoon, and they'd cook dinner together and get blasted on her stash of choice powder and watch five or six of her parents' X cassettes, and Saturday they'd drive over to the city and cruise some of the kinky districts and go to that bathhouse on Folsom where everybody got naked and climbed into the giant Jacuzzi and then on Sunday—Well, none of that was going to happen. Charley had called on Thursday to cancel. "Something big came up," he said, and Amanda had a pretty good idea what that was: his hot little cousin from New Orleans, who sometimes came flying out here on no notice at all, but the inconsiderate bastard seemed to be entirely unaware of how much Amanda had been looking forward to this weekend, how much it meant to her, how painful it was to be dumped like this. She had run through the planned events of the weekend in her mind so many times that she almost felt as if she had experienced them. It was that real to her. But overnight it had become unreal.

Three whole days on her own, the house to herself, and so early in the semester that there was no homework to think about, and Charley had stood her up! What was she supposed to do now, call desperately around town to scrounge up some old lover as a playmate? Or pick up some stranger downtown? Amanda hated to fool around with strangers. She was half-tempted to go over to the city and just let things happen, but they were all weirdos and creeps over there, anyway, and she knew what she could expect from them. What a waste, not having Charley! She could kill him for robbing her of the weekend.

Now there was the alien, though. A dozen of these star people had come to Earth last year, not in a flying saucer as everybody had expected, but in little capsules that floated like milkweed seeds, and they had

landed in a wide arc between San Diego and Salt Lake City.

Their natural form, so far as anyone could tell, was something like a huge jellyfish with a row of staring purple eyes down one wavy margin, but their usual tactic was to borrow any local body they found, digest it, and turn themselves into an accurate imitation of it. One of them had made the mistake of turning itself into a brown mountain bear and another into a bobcat—maybe they thought that those were the dominant life forms on Earth—but the others had taken on human bodies at the cost of at least ten lives.

Then they went looking to make contact with government leaders, and naturally they were rounded up very swiftly and interned, some in mental hospitals and some in county jails, but eventually—as soon as the truth of what they really were sank in—they were all put in a special detention camp in northern California.

Of course a tremendous fuss was made over them, endless stuff in the papers and on the tube, speculation by this heavy thinker and that about the significance of their mission, the nature of their biochemistry, a little wild talk about the possibility that more of their kind might be waiting undetected out there and plotting to do God knows what, and all sorts of that stuff. Then came a government clamp on the entire subject, no official announcements except that "discussions" with the visitors were continuing, and after a while the whole thing degenerated into dumb alien jokes ("Why did the alien cross the road?") and Halloween invader masks. Then it moved into the background of everyone's attention and was forgotten.

And remained forgotten until the announcement that one of the creatures had slipped out of the camp somehow and was loose within a hundred-mile zone around San Francisco. Preoccupied as she was with her anguish over Charley's heartlessness, even Amanda had managed to pick up *that* news item. And now the alien was in her very car. So there'd be some weekend amusement for her after all. Amanda was entirely unafraid of the alleged deadliness of the star being. Whatever else the alien might be, it was surely no dope, not if it had been picked to come halfway across the galaxy on a mission like this, and Amanda knew that the alien could see that harming her was not going to be in its own best interests. The alien had need of her, and the alien realized that. And Amanda, in some way that she was only just beginning to work out, had need of the alien.

She pulled up outside her house, a compact split-level at the western end of town. "This is the place," she said.

Heat shimmers danced in the air, and the hills back of the house parched in the long dry summer were the color of lions.

Macavity, Amanda's old tabby, sprawled in the shade of the bottlebrush tree on the ragged front lawn. As Amanda and the alien approached, the cat sat up warily, flattened his ears, and hissed. The alien immediately moved into a defensive posture, sniffing the air.

"Just a household pet," Amanda said. "You know what that is? He isn't dangerous. He's always a little suspicious of strangers."

Which was untrue. An earthquake couldn't have brought Macavity out of his nap, and a cotillion of mice dancing minuets on his tail wouldn't have drawn a reaction from him. Amanda calmed him with some tuna, ruffling, but he wanted nothing to do with the alien and went slinking sullenly into the underbrush. The alien watched him with care until he was out of sight.

"Do you have anything like cats back on your planet?" Amanda asked as they went inside.

"We had small wild animals once. They were unnecessary."

"Oh," Amanda said, losing interest. The house had a stuffy, stagnant air. She switched on the air conditioning. "Where is your planet, anyway?"

The alien pointedly ignored the question. It padded around the living room very much like a prowling cat itself, studying the stereo, the television, the couches, the coffee table, and the vase of dried flowers.

"Is this a typical Earthian home?"

"More or less," said Amanda. "Typical for around here, at least. This is what we call a suburb. It's half an hour by freeway from here to San Francisco. That's a city. I'll take you over there tonight or tomorrow for a look, if you're interested. She got some music going, high volume. The alien didn't seem to mind, so she notched the volume up even more. "I'm going to take a shower. You could use one, too, actually."

"Shower? You mean rain?"

"I mean, body cleaning activities. We Earthlings like to wash a lot, to get rid of sweat and dirt and stuff. It's considered bad form to stink. Come on, I'll show you how to do it. You've got to do what I do if you want to keep from getting caught, you know." She led the alien to the bathroom. "Take your clothes off first."

The alien stripped. Underneath its rain slicker it wore a stained T-shirt that said FISHERMAN'S WHARF, with a picture of the San Francisco skyline, and a pair of unzipped jeans. Under that it was wearing a black brassiere, unfastened, and with the cups over its shoulderblades, and a pair of black shiny panty-briefs with a red heart on the left buttock. The alien's body was that of a lean, tough-looking girl with a scar running down the inside of one arm.

By the way, whose body is that?" Amanda asked. "Do you know?"

"She worked at the detention center. In the kitchen."

"You know her name?"

"Flores Concepción."

"The other way around, probably. Concepción Flores. I'll call you Connie, unless you want to give me your real name."

"Connie will do."

"All right, Connie. Pay attention. You turn the water on here, and you adjust the mix of hot and cold until you like it. Then you pull this knob and get underneath the spout here and wet your body and rub soap over it and wash the soap off. Afterward you dry yourself and put fresh clothes on. You have to clean your clothes from time to time, too, because otherwise *they* start to smell, and it upsets people. Watch me shower, and then you do it."

Amanda washed quickly, while plans hummed in her head. The alien wasn't going to last long wearing the body of Concepción Flores. Sooner or later someone was going to notice that one of the kitchen girls was missing, and they'd get an all-points alarm out for her. Amanda wondered whether the alien had figured that out yet. *The alien*, Amanda thought, *needs a different body in a hurry.*

But not mine, she told herself. *For sure, not mine.*

"Your turn," she said casually, shutting the water off.

The alien, fumbling a little, turned the water back on and got under the spray. Clouds of steam rose, and its skin began to look boiled, but it didn't appear troubled. No sense of pain? "Hold it," Amanda said. "Step back." She adjusted the water. "You've got it too hot. You'll damage that body that way. Look, if you can't tell the difference between hot and cold, just take cold showers, okay? It's less dangerous. This is cold, on this side."

She left the alien under the shower and went to find some clean clothes. When she came back, the alien was still showering under icy water. "Enough," Amanda said. "Here. Put these clothes on."

"I had more clothes than this before."

"A T-shirt and jeans are all you need in hot weather like this. With your kind of build you can skip the bra, and anyway I don't think you'll be able to fasten it the right way."

"Do we put the face paint on now?"

"We can skip it while we're home. It's just stupid kid stuff anyway, all that tribal crap. If we go out, we'll do it, and we'll give you Walnut Creek colors. I think Concepción wore San Jose, but we want to throw people off the track. How about some dope?"

"What?"

"Grass. Marijuana. A drug widely used by local Earthians of our age."

"I don't need no drug."

"I don't either. But I'd *like* some. You ought to learn how, just in case you find yourself in a social situation." Amanda reached for

her pack of Filfer Golds and pulled out a joint. Expertly she tweaked its lighter tip and took a deep hit. "Here," she said, passing it. "Hold it like I did. Put it to your mouth, breathe in, suck the smoke deep." The alien dragged the joint and began to cough. "Not so deep, maybe," Amanda said. "Take just a little. Hold it. Let it out. There, much better. Now give me back the joint. You've got to keep passing it back and forth. That part's important. You feel anything from it?"

"No."

"It can be subtle. Don't worry about it. Are you hungry?"

"Not yet," the alien said.

"I am. Come into the kitchen." As she assembled a sandwich—peanut butter and avocado on whole wheat with tomato and onion—she asked, "What sort of things do you guys eat?"

"Life."

"Life?"

"We never eat dead things. Only things with life."

Amanda fought back a shudder. "I see. *Anything* with life?"

"We prefer animal life. We can absorb plants if necessary."

"Ah. Yes. And when are you going to be hungry again?"

"Maybe tonight," the alien said. "Or tomorrow. The hunger comes very suddenly when it comes."

"There's not much around here that you could eat live. But I'll work on it."

"The small furry animal?"

"No. My cat is not available for dinner. Get that idea right out of your head. Likewise me. I'm your protector and guide. It wouldn't be sensible to eat me. You follow what I'm trying to tell you?"

"I said that I'm not hungry yet."

"Well, you let me know when you start feeling the pangs. I'll find you a meal." Amanda began to construct a second sandwich. The alien prowled the kitchen, examining the appliances. Perhaps making mental records. Amanda thought of sink and oven designs to copy on its home world. Amanda said, "Why did you people come here in the first place?"

"It was our mission."

"Yes. Sure. But for what purpose? What are you after? You want to take over the world? You want to steal our scientific secrets?" The alien, making no reply, began taking spices out of the spice rack. Delicately it licked its finger, touched it to the oregano, tasted it, tried the cumin. Amanda said, "Or is it that you want to keep us from going into space? You think we're a dangerous species, and so you're going to quarantine us on our own planet? Come on, you can tell *me*. I'm not a government spy." The alien sampled the tarragon, the basil, the sage. When it reached for the curry powder, its hand suddenly shook so violently that it knocked the open jars of oregano and tarragon over, making a mess.

"Hey, are you all right?" Amanda asked.

The alien said, "I think I'm getting hungry. Are these things drugs, too?"

"Spices." Amanda said. "We put them in our foods to make them taste better." The alien was looking very strange, glassy-eyed, flushed, sweaty. "Are you feeling sick or something?"

"I feel excited. These powders—"

"They're turning you on? Which one?"

"This, I think." It pointed to the oregano. "It was either the first one or the second."

"Yeah," Amanda said. "Oregano. It can really make you fly." She wondered whether the alien would get violent when zonked. Or whether the oregano would stimulate its appetite. She had to watch out for its appetite. *There are certain risks*, Amanda reflected, *in doing what I'm doing*. Deftly she cleaned up the spilled oregano and tarragon and put the caps on the spice jars. "You ought to be careful," she said. "Your metabolism isn't used to this stuff. A little can go a long way."

"Give me some more."

"Later," Amanda said. "You don't want to overdo it too early in the day."

"More!"

"Calm down. I know this planet better than you, and I don't want to see you get in trouble. Trust me. I'll let you have more oregano when it's the right time. Look at the way you're shaking. And you're sweating like crazy." Pocketing the oregano jar, she led the alien back into the living room. "Sit down. Relax."

"More? Please?"

"I appreciate your politeness. But we have important things to talk about, and then I'll give you some. Okay?" Amanda opaqued the window, through which the hot late-afternoon sun was coming. Six o'clock on Friday, and if everything had gone the right way Charley would have been showing up just about now. Well, she'd found a different diversion. The weekend stretched before her like an open road leading to Mysteryland. The alien offered all sorts of possibilities, and she might yet have some fun over the next few days if she used her head. Amanda turned to the alien and said, "You calmer now? Yes. Good. Okay, first of all, you've got to get yourself another body."

"Why is that?"

"Two reasons. One is that the authorities are probably searching for the girl you absorbed. How you got as far as you did without anybody but me spotting you is hard to understand. Number two, a teen-aged girl traveling by herself is going to get hassled too much, and you don't know how to handle yourself in a tight situation. You know what I'm saying? You're going to want to hitchhike out to Nevada, Wyoming, Utah, wherever the hell your rendezvous place is, and all along the way people are going to be coming on to you. You don't need any of that. Besides, it's very tricky trying to pass for a girl. You've got to know how to put your face paint on, how to understand challenge codes, what the way you

"He'll never amount to anything."

wear your clothing says and like that. Boys have a much simpler subculture. You get yourself a male body, a big hunk of a body, and nobody'll bother you much on the way to where you're going. You just keep to yourself, don't make eye contact, don't smile, and everyone will leave you alone."

"Makes sense," said the alien. "All right. The hunger is becoming very bad now. Where do I get a male body?"

"San Francisco. It's full of men. We'll go over there tonight and find a nice brawny one for you. With any luck we might even find one who's not gay, and then we can have a little fun with him first. And then you take his body over—which incidentally solves your food problem for a while, doesn't it? And we can have some more fun, a whole weekend of fun." Amanda winked. "Okay, Connie?"

"Okay." The alien winked, a clumsy imitation, first one eye, then the other. "You give me more oregano now?"

"Later. And when you wink, just wink *one* eye. Like this. Except I don't think you ought to do a lot of winking at people. It's a very intimate gesture that could get you in trouble. Understand?"

"There's so much to understand."

"You're on a strange planet, kid. Did you expect it to be just like home? Okay, to continue. The next thing I ought to point out is that when you leave here on Sunday, you'll have to—"

The telephone rang.

"What's that sound?" the alien asked.

"Communications device. I'll be right back." Amanda went to the hall extension, imagining the worst: her parents, say, calling to announce that they were on their way back from Tahoe tonight, some mixup in the reservations or something.

But the voice that greeted her was Charley's. She could hardly believe it, after the casual way he had shafted her this weekend. She could hardly believe what he wanted, either. He had left half a dozen of his best cassettes at her place last week: Golden Age rock, *Abbey Road* and the Hendrix one and a Joplin and such, and now he was heading off to Monterey for the festival and wanted to have them for the drive. Did she mind if he stopped off in half an hour to pick them up?

The bastard, she thought. *The absolute trashiness of him!* First to torpedo her weekend without even an apology, and then to let her know that he and what's-her-name were scooting down to Monterey for some fun, and could he bother her for his cassettes? Didn't he think she had any feelings? She looked at the telephone as if it were emitting toads and scorpions. It was tempting to hang up on him.

She resisted the temptation. "As it happens," she said, "I'm just on my way out for the weekend myself. But I've got a friend who's staying here cat-sitting for me. I'll leave the cassettes with her, okay? Her name's Connie."

"Fine. That's great," Charley said. "I really appreciate that, Amanda."

"It's nothing," she said.

The alien was back in the kitchen, nosing around the spice rack. But Amanda had the oregano. She said, "I've arranged for delivery of your next body."

"You did?"

"A large healthy adolescent male. Exactly what you're looking for. He's going to be here in a little while. I'm going to go out for a drive. You take care of him before I get back. How long does it take for you to—engulf—somebody?"

"It's very fast."

"Good." Amanda found Charley's cassettes and stacked them on the living-room table. "He's coming over here to get these six little boxes which are music-storage devices. When the doorbell rings, you let him in and introduce yourself as Connie and tell him his things are on this table. After that you're on your own. You think you can handle it?"

"Sure," the alien said.

"Tuck in your T-shirt better. When it's tight it makes your boobs stick out, and that'll distract him. Maybe he'll even make a pass at you. What happens to the Connie body after you engulf him?"

"It won't be here. What happens is I merge with him and dissolve all the Connie characteristics and take on the new ones."

"Ah. Very nifty. You're a real nightmare thing, you know? You're a walking horror show. Here, you are, have another little hit of oregano before I go."

She put a tiny pinch of spice in the alien's hand. "Just to warm up your engine a little. I'll give you more later, when you've done the job. See you in an hour, okay?"

She left the house. Macavity was sitting on the porch, scowling, whipping his tail from side to side. Amanda knelt beside him and scratched him behind the ears. The cat made a low, rough purring sound, not much like his usual purr.

Amanda said, "You aren't happy are you, fella? Well, don't worry. I've told the alien to leave you alone, and I guarantee you'll be okay. This is Amanda's fun tonight. You don't mind if Amanda has a little fun, do you?" Macavity made a glum, snuffling sound. "Listen, maybe I can get the alien to create a nice little calico cutie for you, okay? Just going into heat and ready to howl. Would you like that, guy? Would you? I'll see what I can do when I get back. But I have to clear out of here now, before Charley shows up."

She got into her car and headed for the westbound freeway ramp. Half past six, Friday night, the sun still hanging high above the Bay. Traffic was thick in the eastbound lanes, the late commuters slogging toward home, and it was beginning to build up westbound, too, as people set out for dinner in San Francisco. Amanda drove through the tunnel and turned north into Berkeley to cruise city streets. Ten minutes to seven now. Charley must have arrived.

Hubert has never tried to impose his religion on me.

She imagined Connie in her tight T-shirt, all stoned and sweaty on oregano, and Charley giving her the eye, getting ideas, thinking about grabbing a bonus quickie before taking off with his cassettes. And Connie leading him on, Charley making his moves, and then suddenly that electric moment of surprise as the alien struck and Charley found himself turning into dinner. *It could be happening right this minute,* Amanda thought placidly. *No more than the bastard deserves, isn't it?* She had felt for a long time that Charley was a big mistake in her life, and after what he had pulled yesterday she was sure of it. *No more than he deserves.*

But she wondered, *what if Charley has brought his weekend date along?* The thought chilled her. She hadn't considered that possibility at all. It could ruin everything. Connie wasn't able to engulf two at once, was she? And suppose they recognized her as the missing alien and ran out screaming to call the cops?

No, she thought. Not even Charley would be so tacky as to bring his date over to Amanda's house tonight. And Charley never watched the news or read a paper.

He wouldn't have a clue as to what Connie really was until it was too late for him to run.

Seven o'clock. Time to head for home.

The sun was sinking behind her as she turned onto the freeway. By quarter past she was approaching her house. Charley's old red Honda was parked outside.

Amanda parked across the street and cautiously let herself in, pausing just inside the front door to listen.

Silence.

"Connie?"

"In here," said Charley's voice.

Amanda entered the living room. Charley was sprawled out comfortably on the couch. There was no sign of Connie.

"Well?" Amanda said. "How did it go?"

"Easiest thing in the world," the alien said. "He was sliding his hands under my T-shirt when I let him have the nullifier jolt."

"Ah. The nullifier jolt."

"And then I completed the engulfment and cleaned up the carpet. God, it feels good not to be hungry again. You can't imagine how tough it was to resist engulfing you, Amanda. For the past hour I kept thinking of food, food, food—"

"Very thoughtful of you to resist."

"I knew you were out to help me. It's logical not to engulf one's allies."

"That goes without saying. So you feel well fed now? He was good stuff?"

"Robust, healthy, nourishing—yes."

"I'm glad Charley turned out to be good for something. How long before you get hungry again?"

The alien shrugged. "A day or two. Maybe three. Give me more oregano, Amanda?"

"Sure," she said. "Sure." She felt a little let down. Not that she was remorseful about Charley exactly, but it all seemed so casual, so offhanded—there was something anticlimactic about it, in a way. She sus-

pected she should have stayed and watched while it was happening. Too late for that now, though.

She took the oregano from her purse and dangled the jar teasingly. "Here it is, babe. But you've got to earn it first."

"What do you mean?"

"I mean that I was looking forward to a big weekend with Charley, and the weekend is here. Charley's here, too, more or less, and I'm ready for fun. Come show me some fun, big boy."

She slipped Charley's Hendrix cassette into the tape deck and turned the volume all the way up.

The alien looked puzzled. Amanda began to peel off her clothes.

"You, too," Amanda said. "Come on. You won't have to dig deep into Charley's mind to figure out what to do. You're going to be my Charley for me this weekend, you follow? You and I are going to do all the things that he and I were going to do. Okay? Come on. Come on." She beckoned.

The alien shrugged again and slipped out of Charley's clothes, tumbling with the unfamiliarities of his zipper and buttons. Amanda, grinning, drew the alien close against her and down to the living-room floor. She took its hands and put them where she wanted them to be. She whispered instructions. The alien, docile, obedient, did what she wanted.

It felt like Charley. It smelled like Charley. And after her instructions, it even moved pretty much the way Charley moved.

But it wasn't Charley, it wasn't Charley at all, and after the first few seconds Amanda knew that she had goofed things up very badly. You couldn't just ring in an imitation like this. Making love with this alien was like making love with a very clever machine, or with her own mirror image. It was empty and meaningless and dumb.

Grimly she went on to the finish. They rolled apart, panting, sweating.

"Well?" The alien said. "Did the earth move for you?"

"Yeah. Yeah. It was terrific—Charley."

"Oregano?"

"Sure." Amanda said. She handed the spice jar across. "I always keep my promises, babe. Go to it. Have yourself a blast. Just remember that that's strong stuff for guys from your planet, okay? If you pass out, I'm going to leave you right there on the floor."

"Don't worry about me."

"Okay. You have your fun. I'm going to clean up, and then maybe we'll go over to San Francisco for the nightlife. Does that interest you?"

"You bet, Amanda." The alien winked—one eye, then the other—and gulped a huge pinch of oregano. "That sounds terrific."

Amanda gathered up her clothes, went upstairs for a quick shower and dressed. When she came down, the alien was more than half blown away on the oregano, goggle-eyed, loll-headed, propped up against the couch and crooning to itself in a weird atonal way. *Fine,* Amanda thought. *You just get yourself all spiced up, love.* She took the portable phone from the kitchen, carried it with her into the bathroom, locked the door, and quietly dialed the police emergency number.

She was bored with the alien. The game had worn thin very quickly. And it was crazy, she thought, to spend the whole weekend cooped up with a dangerous extraterrestrial creature when there wasn't going to be any fun in it for her. She knew now that there couldn't be any fun at all. And besides, in a day or two the alien was going to get hungry again.

"I've got your alien," she said. "Sitting in my living room, stoned out of its head on oregano. Yes, I'm absolutely certain. It was disguised as a Chicana girl first. Concepción Flores, but then it attacked my boyfriend, Charley Taylor, and—yes, yes, I'm safe. I'm locked in the john. Just get somebody over here fast—okay. I'll stay on the line—what happened was, I spotted it downtown outside the video center, and it insisted on coming home with me—"

The actual capture took only a few minutes. But there was no peace for hours after the police tactical squad hauled the alien away because the media were in on the act right away, first a team from Channel 2 in Oakland, and then some of the network guys, and then the *Chronicle,* and finally a whole army of reporters from as far away as Sacramento, and phone calls from Los Angeles and San Diego and—about three that morning—New York.

Amanda told the story again and again until she was sick of it, and just as dawn was breaking, she threw the last of them out and barred the door.

She wasn't sleepy at all. She felt wired up, speedy, and depressed all at once. The alien was gone. Charley was gone, and she was all alone. She was going to be famous for the next couple of days, but that wouldn't help. She'd still be alone. For a time she wandered around the house, looking at it the way an alien might, as if she had never seen a stereo cassette before, or a television set, or a rack of spices. The smell of oregano was everywhere. There were little trails of it on the floor.

Amanda switched on the radio and there she was on the SIX A.M. news: "—the emergency is over, thanks to the courageous Walnut Creek High School girl who trapped and outsmarted the most dangerous life form in the known universe—"

She shook her head. "You think that's true?" she asked the cat. "Most dangerous life form in the universe? I don't think so, Macavity. I think I know of at least one that's a lot deadlier. Eh, kid?" She winked. "If they only knew, eh? If they only knew." She scooped the cat up and hugged it, and it began to purr. Maybe trying to get a little sleep would be a good idea. Then she had to figure out what she was going to do about the rest of the weekend. ∞

"Gentlemen, there's one last important matter we should discuss before you begin your long journey into the deep void of space. Does anyone have to go potty?"

Forget MIT. The new science mecca is Roger's Pool Hall

OZARK MOUNTAIN HIGH

BY WILLIAM K. STUCKEY

The Ozark Mountain city of Fayetteville, Arkansas is the place to be when the bomb drops. Consider. There are no Titan missile silos within a radius of 130 miles (as far as we know). There's plenty of cheap land, water, and wood. And there's even a vast radiation-proof cave system, the same one used by the James brothers to dodge Ozark lawmen. Add to this the presence of a good, public-land-grant university, and you also have the brains to pick when the rest of society has turned to dust.

Doomsday thoughts aside, there are other reasons to inspect academically obscure places like the University of Arkansas. If you

PHOTOGRAPHS BY BILL SUMNER

agree that food and water are likely to be more critical than black holes and space colonies in the short-term future then the earthy U of Arkansas should exceed the Harvards and Berkeleys in importance It is Fayetteville, after all, that is the world center for weed studies its down-home campus is a hub of expertise on computerized farms solar homes, and gasohol Yet the U of A offers enough high-quality 'impractical' liberal arts and sciences to keep you entertained provoked and satisfied for the rest of your natural-born life

When I left for Arkansas this past fall friends in New York told me to expect mules moonshine and eleven-year-old brides in sunbonnets smoking corncob pipes on the porch They painted a dread (and it turns out, somewhat accurate) picture of hillbilly hermits like the ornery farmer with the shotgun and the frontyard tombstone reading TRESPASSERS WELCOME I also recalled the tale of the state university's football team Before World War I the team had been named the Cardinals During one murderous football game, however, the players were so thoroughly mean and determined that the coach said they fought like razorbacks—the wild tusked boar allegedly abandoned in Florida by sixteenth century explorer Hernando de Soto Real razorbacks are bony and sharp enough to cut through wood The team took a shine to the name and it stuck

I was still fixed on images of razorback rage when, at four in the morning, my Trailways bus pulled into town I caught a cab to a nearby motel collapsed in exhaustion and slept till ten

But when I finally got out in the Fayetteville sun I was stunned to discover the most livable city in the USA Instead of dirt and dingy wood huts I found towering maples and rows of Victorian homes The hilly road to Arkansas U was lined with first-rate book and magazine stores (where I later learned one may buy the Sunday *New York Times* no later than noon on Monday) And the campus itself (where I'd been given a room for the duration) had incredible numbers of attractive young women with GO TO HELL T-shirts and spray-on jeans

Then of course, there was Roger's Pool Hall the finest down-and-out beer joint I ever did see It was there, amid the echo of pool balls and cavernous tile walls that I convened with Fayetteville's soul Leaning over the Art Deco bar I met and retained just in case Harvard-trained trial lawyer Matthew Horan I chatted with the brilliant quirko-humorist James Twiggs author of the novel *Billy and Betty* and former editor of Cornell University Press discussed the physics of Nobel Prize winner Julian Schwinger with Michael Lieber a former Harvard Ph D candidate of his bargained over the price of five acres—including a three-bedroom house trees wells and a creek—on sale for the astrophysically vast sum of $21 000 at 8 percent heard broiler-chicken-tycoon Don Tyson, a University of Arkansas alumnus say it would take him two years to provide poultry sandwiches for all of India three years for China ten years for the world, and listened to the exotic travel stories of Roy Reed, the former London bureau chief of *The New York Times*, now a member of the University's journalism department a resident of nearby Hog Eye and yet another chronicler of Roger's Pool Hall Watching the local hillbilly types (hook-nosed and chinless) spit into tins on the floor, I congratulated myself for being in the city where the university's chancellor studied music with the most prolific Cherokee Indian composer in the world

The University of Arkansas was built from the ashes of the Civil War It came into existence on the heels of the Land Grant Act passed by Abe Lincoln to provide acreage for that great educational equalizer the land-grant school Up until the passage of the act, colleges catered mostly to wealthy genteel lads who feasted on Latin and Greek before dinner—and after dinner too But the land-grant university aimed to change all that teaching the agricultural and mechanical classes to dabble in the classics while cultivating their practical skills

> *"We're developing a machine that can catch chickens and throw them, unbruised, into a crate You try chicken catching and see how long it takes you"*

Three Arkansas cities—Batesville Little Rock and Fayetteville—bid for the university and Fayetteville won So in the reconstruction year of 1871 nine students including a black headed for a ramshackle old hut on the town's old McIlroy farm There they studied until 1874, when the school's first building—a stately Victorian structure called Old Main—was ready to educate a burgeoning student population now nearly 100 strong

Through the years the university grew spurred to regional prominence by two major congressional acts the Hatch Act which funded research-oriented agricultural experimental stations and the Smith-Lever Act which helped farmers use the research to improve their farms As thousands of students flocked, the school broadened its areas of expertise adding divisions for the performing arts the sciences, business administration engineering law and architecture

Then at the start of World War II long-time U of A president John Futrall was killed in a car crash He was succeeded by J William Fulbright—the founder of the famed Fulbright Educational Exchange Program Fulbright became president of the university in 1939 was fired by an Arkansas governor with connections to the Ku Klux Klan in 1941 and went on to defeat that same governor in the 1944 race for the U S Senate

Fulbright who played a role in the founding of the United Nations returned to the University of Arkansas every so often to give a speech or endow a chair But while the folks back home are proud, they admit that Fulbright (the son of a wealthy newspaper publisher) isn't quite consonant with the character of a boondock state so dirt-poor that it has one of the lowest median family incomes in the country To help educate the Arkansans (who spend less money on education and have fewer college degrees than the residents of any other state) the university now has a new president ole Jim Martin a scientist with dirt on his hands

At first glance Martin looks like he might be a bouncer at Roger's He can put his eyeball two inches away from yours and body-language you ("Now pay attention dammit") into submission When it comes to raising money for his Ozark mountain school he can politick like Lyndon Baines Johnson himself

Big Jim came by his manner—and his career—in the heart of the South His father was a hard-driving Alabama businessman with two companies—one specializing in agricultural equipment the other in industrial goods When the will was being drawn Jim and his brother flipped a coin to see who would inherit the glamorous industrial firm and who would get stuck in agriculture Jim lost so when he started Auburn University on a basketball scholarship in 1950 he decided to study agricultural administration

Then while Jim was doing a two-year stint in the service his daddy sold the firms Though Jim's responsibility to agriculture was gone he decided to stay in the field entering Iowa State (the land grant Princeton) for a Ph D in agricultural economics There and in professorships at the University of Maryland Oklahoma State and Virginia Tech he mastered the gamut of agricultural science researching everything from grain elevators to anaerobic bacteria to the impact of railroad rates

Finally in 1975 Martin came to Arkansas For the first five years he administered agricultural programs In 1980 he was promoted to president of the state university's five-campus system

Overleaf, large photo: Roger Koetter (big man in foreground) presides over his famous Art Deco bar in Fayetteville. Small photo at right, overleaf: George Henry Ernert, ethanol expert and former Green Beret "pacifier."

Ever since Martin says, he's been working to augment the state's basic art-and-science program. At the Fayetteville campus that means putting most of the money into departments where quality is already high. The Southern-history department, where distinguished professors write on outstanding blacks, the creationism-evolution controversy and Southern religious cults; the English department with its extraordinary creative-writing program (its director, William Harrison, produced the book from which the political SF movie *Rollerball* was made), and the internationally acclaimed chemistry department, whose professors have been trained at such prestigious institutions as Columbia, Berkeley, University College of London and the Max Planck Institute.

Perhaps most important, educator Martin has been helping the agriculture department promote an understanding of the nation's fragile food and fiber system—the system we need for survival. For those who wouldn't be caught dead near a land-grant school, Martin's random reflections bring the flavor of the U. of A. home.

- "Only three percent of the country's population have a true agricultural background. Never have so many depended on so few. Food and fiber. The rest of you think food comes from the supermarket. If you think industrial labor is a problem, just let the American farmer start speaking with one voice and it will be worse than any railroad, steel, or auto strike you've ever seen."
- "We know how to produce food without 2,4,5-T, the agent orange stuff, and all the other chemicals. If that's the way we want to go. All we have to decide is which fifty percent of the American population are going to get on the back end of a hoe. We did without chemicals up to about 1920 and we can do it again."
- "The American farmer is a highly skilled technician who knows genetics, breeding, veterinary medicine, agronomy, agriculture, entomology, meteorology, economics, you name it, but he can't set his price as General Motors can. So the better he farms and the more he grows, the bigger the crop surplus and the lower the price. How long would *you* stay in a job like that?"
- "People don't know that this state, with a whole lot of help from its agricultural colleges, is the nation's number one producer of broiler chickens. Did you know that Don Tyson's operation gets a pound of chicken meat from each 1.6 pounds of chicken feed? It takes four pounds of feed for one pound of pork, eight for a pound of beef. That's what agricultural research gets you."
- "If there were a Nobel Prize for agriculture, our top candidate would be George Templeton, of plant pathology. He was the first to discover a fungus that kills Northern Joint-Vetch, a weed that chokes off our rice crops. Before that, rice farmers had to use the polluting components of agent orange. It's the first natural herbicide cleared by the Environmental Protection Agency."
- "We're number one in rice and fish, number two in spinach, after California, fourth or fifth in soybeans, and ninth in tomatoes—we developed the Arkansas Traveler Pink Tomato right here. There'd be *no* tomatoes in Arkansas without this university. Do you know we're developing a machine that can catch chickens and throw them, completely unbruised, into a crate? You try chicken catching and see how long it takes *you*."

President Martin didn't have much to say about small-time agriculture the kind you'd need if society collapsed. Still, if you had to get by without computers or pesticides, you could do that in Fayetteville, too.

To learn how, just take the following one-year crash course drafted especially for avid survivalists by one Nolan Arthur, associate dean.

- *Fundamentals of agricultural construction 1072 and 1082*: tools, woodworking, plumbing, materials, concrete and sheet metal; ought to teach you enough skills to build a house and barn inside of a year.
- *Agronomy 1103*: growing basic field crops like wheat, corn and protein-rich soybeans.
- *Agronomy 2203*: soil chemistry and testing.
- *Animal Science 1001, 2143, 2612, and 1004*: everything from selecting the right feed to slaughtering and curing meat; to deciding whether your two-bit, five-acre operation would be better off with rabbits, goats, or cows.
- *Entomology 2013*: holding off the bugs.
- *Horticulture 1003 and 1102*: growing fruits and vegetables.
- *Plant Pathology 2003*: fighting plant disease, the survivalist's bitter enemy.

> *"George's daddy was a "runner," trucking shine by Model-A Ford to secret markets, selling it under the noses of the suited-and-tied still-busters. He passed the moonshine bug to his son."*

It you really want to save ass in hard times, such an investment—$780 for two semesters, not including schoolbooks—will go a long way.

Whether you use big- or small-time farming to wait out the holocaust, you'll need fuel to run your equipment. And if you're in Fayetteville, you'll have an abundant supply, thanks to George Henry Emert, tenured professor of biochemistry and agronomy, and head of the university's Biomass Center. The center's goal: converting biomass, like wood or thrown-out food, into ethanol, the potent ethyl-alcohol fuel.

Emert's penchant for alcohol seems oddly appropriate. The last in a long line of whiskey makers, he still remembers stories of those dark Prohibition years. Forbidden by law to make whiskey, George's granddaddy ("Papaw") took to brewing moonshine under moonlight in the Tennessee woods. His lookouts were the dogs trained to bark warning when "revenooers" came by. George's daddy was a "runner," trucking shine by Model A Ford to secret markets, selling it under the noses of the suited-and-tied still-busters. Daddy Emert finally went into farming. But he passed the moonshine bug—and other family traditions—to his son.

George had just graduated from the University of Colorado when his daddy insisted he follow a grand procession of Emerts to the front. It wasn't war lust, George explains, just that "Tennessee volunteer" spirit. There were Emerts at King's Mountain and Yorktown during the American Revolution and at Appomattox at the end of the Civil War. Uncle Otha spent 33 months in Chinese prison camps during the Korean War. At any war you can name, Emerts were there.

The only fighting going on when George got out of school was in Vietnam. And as uncles Otha, Stanley, Butler, Orie, and Glenn and George's daddy pointed out, George wasn't too old and wasn't even married. So George did his duty.

You don't mess with George Emert when he's doing his duty. He did two tours in Vietnam as an officer in the Green Berets in the mid-1960s (Bronze Star, 1966) and presumably liked it, since he volunteered both times. After Emert's Green Berets "pacified" Vinh Thanh Valley, it became known as "Happy Valley." You don't want George Emert to make you happy.

When he got back from Nam he spent a summer at Stanford University's marine-biology research station. There he noticed "beach hoppers," marine animals that ate soft-drink cups littering the sand. If these creatures could eat paper, Emert figured, they had to be capable of digesting cellulose—the hard, sugary substance of which plant cell walls are made.

Emert soon learned that the beach hopper's skill came from enzymes produced by microorganisms living in its digestive tract. If such organisms could be harnessed, he knew, their digestive power could be turned loose on tons of currently useless biomass—corn stalks, wood chips, wasted food, and paper. They would quickly get to work digesting the cellulose, breaking it down to molecules of glucose. The glucose could then be broken down to such high-energy compounds as ethyl alcohol, or ethanol, by ordinary yeast.

It was the germ of a great idea. But millions of different microorganisms could digest cellulose, and Emert had to find the

CONTINUED ON PAGE 124

SEEDS OF LIFE

From the abyss of space came the comets . . . and life

BY TERENCE DICKINSON

Today a spectacular comet brandishing a vaporous tail like a detached segment of the Milky Way is a sight so rare that only a few people see a comet more than once in a lifetime. But 4 billion years ago, when there was nothing on the earth but primal ooze, the sky was alive with comets.

Night and day the scimitar shapes swept across the skies of primitive Earth. And every few centuries a Gibraltar-sized cometary nucleus would smash into this planet, throwing tons of comet stuff—water, methane, ammonia, and huge quantities of clay-like dust—into the atmosphere.

It went on like this for several hundred million years during the last and longest phase of the solar system's formation. This was the time when the seeds of life fell to Earth.

Cometary bombardment has recently emerged as the elegant mechanism that may have created Earth's

PAINTING BY HELMUT WIMMER

biosphere its atmosphere its oceans its crust and its life forms Comets a few scientists believe were the manna from heaven that scattered the ingredients of life across a young planet which otherwise might have remained sterile

Some researchers have carried the thesis even further suggesting that life did not originate on primordial Earth at all comets deposited it here in the form of viruses We it seems are comet stuff

While few investigators are willing to go that far interest in comets is heating up after decades of neglect This renewed enthusiasm couldn't be better timed Less than three years from now Halley's Comet will hurtle through our sector of the solar system it will not be ignored Five robot spacecraft will greet Halley in February and March 1986 providing mankind with its first closeup views of a comet These explorations are taking on new significance as evidence accumulates to suggest that our own origins are intimately interwoven with these cosmic wayfarers

Until recently the connection between comets and life went largely unnoticed Before the 1980s conventional wisdom had it that the components of Earth's biosphere emerged from within the planet through volcanic activity Although planetary scientists have yet to junk this concept more of them are now taking the comet scenario seriously U S Geological Survey (USGS) planetary geologist Eugene Shoemaker representing the comet camp goes so far as to say "The old notion that Earth somehow was formed of stuff that had these things already in it is frankly rather naive"

Shoemaker and others are convinced that the sun once pumped out 1 000 times the energy it does today baking the material in the region where Earth would form In such heat they believe, the lighter elements remained gaseous and could not solidify when the planet did "It never got cool enough for [the elements] to condense out" Shoemaker asserts Yet these elements are now common in the biosphere they must have arrived after the earth formed Shoemaker's explanation The light elements got here by means of the comet express

Naturally there is a certain amount of crystal-gazing involved in tracking down Earth's genesis but a few facts point us toward the comet thesis According to analysis of the Apollo lunar samples the era of heavy cometary bombardment on the moon (and, by inference on Earth) ended about 3 9 billion years ago Since it is known that Earth's crust has been largely undisturbed since that time comet stuff most likely has formed a good percentage of our planet's surface layer

Another piece of evidence comes from ancient rocks found in Australia and South Africa They hold preserved microfossils of primitive bacteria dated at 3 5 billion years On a geological time scale this life seems to have emerged surprisingly suddenly Could comets have carried to Earth more than just the chemical ingredients of life? Could they have carried life itself? This tantalizing question has stimulated comet research in the last few years eliciting some eyebrow-raising theories in the process (More about them later)

Most astronomy texts will tell you that comets are bit players on the solar system stage, but now powerful number-crunching techniques applied to data that have been available for decades have led scientists to suspect that the significance of comets is not minor after all In fact they may be after the sun the most massive constituents of the solar system

Some basic facts According to the experts comets are chunks of ice and dirt that range in size from a boulder to a mountain a few miles in diameter Their tails are mere wisps of vapor created when the sun melts the icy body's skin but they can span more than an astronomical unit the distance from Earth to the sun Several times a century a comet visible to the naked eye will grace the evening or morning sky Each year a dozen or so lesser comets are seen most remaining inconspicuous Both impressive and obscure comets spend most of their lives in the solar system's storage freezer beyond Jupiter

"Recently cometary bombardment has emerged as the elegant mechanism that may have created Earth's biosphere, its atmosphere, its oceans, its crust, and its life forms"

Halley's Comet for example spends all but two years of its 76-year round trip beyond Jupiter's orbit Halley's path follows an elongated circuit around the sun crossing the orbits of seven planets from Venus to Neptune Since 240 B C it has been seen on all but one return to Earth's vicinity Last October Caltech astronomers using the 200" telescope at Mount Palomar, spotted the famed object near Saturn in the first sighting before its next swing around the sun in February 1986

About 130 less well known and mostly dimmer comets have orbital periods that vary from 3 3 to 200 years More than 500 others have been seen only once the tar ends of their orbits extend well into the abyss beyond Pluto They won't be back for centuries or perhaps even millennia

Most astronomers today believe that somewhere beyond Neptune and Pluto a colossal reservoir of these celestial iceballs surrounds the solar system This remote comet storehouse even has a name the Oort Cloud after the Dutch astronomer Jan Oort who first suggested its existence The question now is Where did all its comets come from?

Astronomers generally agree that the majority of comets originally condensed from a vast cloud of primordial gas and dust that once occupied the solar system in the region beyond the present orbit of Saturn—where Uranus and Neptune now circle the sun The formation of Uranus and Neptune had the effect of shunting the comets in this area out into what is now called the Oort Cloud Stars that passed within two or three light-years of the cloud occasionally had enough of a gravitational deflection to tug loose some of these remote comets Eventually they would circle back toward the inner solar system Thus the comets we see today are escapees from the Oort Cloud

But this is an inadequate explanation for the heavy cometary bombardment that occurred early in Earth's history Comets visible today follow a long circuitous route swinging halfway out to the stars before eventually looping back to Earth some eons later This Oort Cloud escape mechanism is too awkward to account for the active heavy comet phenomenon of long ago It is more likely that primordial comets came to Earth directly from that early comet nursery just beyond Saturn

And what drove them toward Earth as well as out into the Oort Cloud many believe was the formation of Uranus and Neptune "When we look at the most reasonable mechanism for the formation of Uranus and Neptune from the protosolar nebula says Shoemaker we find that tens of Jupiter masses are needed to make these two planets The accretion [buildup] process out there was very inefficient Only one percent of the primordial material in the region actually found its way into Uranus and Neptune Most of the rest of it remained in the form of cometlike bodies This means that the outer sector of our planetary system initially harbored trillions and trillions of comets whose total mass was many times that of Jupiter

Planetary formation in the outer solar system was unhurried compared with the accretion of the inner planets—Mercury Venus Earth and Mars Their accretion probably was 99 percent complete in 10 million years while according to University of Toledo astrophysicist Armand Delsemme "out in the region of Uranus and Neptune this process was going on for more than half a billion years"

During these eons Shoemaker says 50 percent or more of the trillions of comets in the Uranus-Neptune region were ejected from the solar system Many others found a resting place in the Oort Cloud However our calculations show that a surprising amount of cometary material worked its way into the inner solar system Shoemaker reports "more than enough to pro-

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No man can turn
back the hands of the clock,
but according to
this chemist, who revolutionized
the laws of
thermodynamics, time is on our side

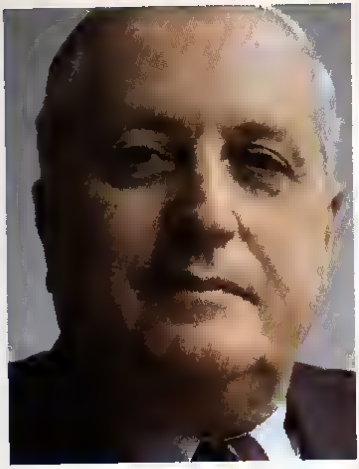
INTERVIEW

ILYA PRIGOGINE

On a wall in physical chemist Ilya Prigogine's office at the University of Texas at Austin is an Albert Einstein quote blown up to poster size. "For us believing physicists," it reads, "the distinction between past, present, and future is only an illusion, however persistent." The poster is one of the few personal effects in a room of austere, university-provided furniture (Prigogine is in Austin only three months each year) and its presence is symbolic. To Prigogine, time is the forgotten dimension. His lifelong efforts have been directed toward better understanding its role in the universe. In recent physics time has emerged as a central theme in several major areas of inquiry, from the instability of elementary particles to the problem of irreversibility in both living and inanimate systems. Prigogine's contributions have come largely in irreversibility, or as Prigogine calls it, "the arrow of time."

In 1977, after traveling on the outskirts of scientific acceptance for nearly 20 years, he was awarded the Nobel Prize in chemistry, largely

PHOTOGRAPHS BY MALCOLM KIRK



"Einstein wanted to transcend time. Science was a way to get to a safe harbor in eternity. But I want to feel the evolution of things, to be embedded in a reality that is temporal."

for his theory of dissipative structures. "Prigogine has fundamentally transformed and revised the science of irreversible thermodynamics," noted the Nobel Committee in making its announcement. "He has given it new relevance and created theories to bridge the gap that exists between the biological and social scientific fields of inquiry."

Ilya Prigogine's background may have been as tumultuous as his effect on the scientific community. Born in Moscow at the outbreak of the Russian Revolution, Prigogine and his family fled first to Lithuania, then to Berlin, before settling in Belgium. Nevertheless, his parents tried desperately to raise their two sons with a sense of grace that war-torn Europe could not easily provide. His mother taught them music, and, according to her recollections, Ilya could read piano scores before he could read words. (He played Bach, Mozart, Schumann, and Debussy and he dreamed of becoming a concert pianist.) And when he did learn to read books, he devoured the classics. Because of his early interest in history and philosophy he wondered why science paid so little attention to time. "The fact that in chemistry and physics, past and present could play the same role, I found a little strange," he remembers. "It was so much in contradiction to ordinary experience. Everyone knows that tomorrow is not the same as today. Yet chemists and physicists described a universe where present and past were identical, timeless, and reversible."

After completing his fourth year in chemistry at the Free University of Brussels, Prigogine decided to study thermodynamics there, focusing on the special significance of time. He received his Ph.D. in 1941, and by 1946 he had already begun to formulate his concept of dissipative structures. This theory describes the workings of open systems—that is, systems in which there is an exchange of matter and energy with the outside environment. (A human being is an open system. An individual takes in food and oxygen from the outside for energy, and excretes waste, thereby achieving a remarkable, albeit temporary, order that is maintained, however, at the expense of the environment. A true closed system, on the other hand, is an ideal concept—as unattainable as a perpetual-motion machine. A terrarium or a space colony could be considered close approximations, but these, too, rely on external energy from the sun.)

Irreversibility is a key concept. Prigogine believes. Just as certain chemicals, when mixed together, can never "unmix" into their original molecular structures, the universe and what it contains, says Prigogine, are irreversible. "You cannot reverse the evolution of the universe," he says, "even theoretically. And you cannot predict its future except in terms of scenarios that depend on never-ending series of crossroads in the chain of causality." Prigogine's definition of open dissipative structures encompasses human social behavior, chemical reactions, and ecosystems—things whose structures are maintained by continuous flows of energy permeating them. And energy flow, Prigogine observes, may become so complex that it causes fluctuations too great for the system to absorb, thus forcing it to reorganize. But each reorganization produces greater complexity and greater likelihood of random fluctuations. The result: more instability, more reorganization, in other words, a quickened creation of living matter into new structures. Evolution.

Among other things, Prigogine's theory vastly broadened the scope of the second law of thermodynamics—that hallmark of nineteenth-century physical science. The "terrible" second law depicts the universe as moving inexorably toward decay and disorder. The second law includes the concept of entropy, which assumes that in a closed system, disorder increases relentlessly until equilibrium (or random dispersal of particles) is reached. The idea of entropy was an outgrowth of the development of thermal engines; scientists noted that no machine ever yields as much as it consumes. Thus, whenever work is done, an amount of usable energy is irrevocably lost. Carried further, this ominous logic implies that all the matter and energy in the universe will ultimately degrade to a state of tepid, inert uniformity (equilibrium), or what is popularly called heat death.

Generally speaking, before Prigogine the important advances made as a result of the second law concerned reversible processes in enclosed systems, such as the steam engine. Classical scientific inquiry confined itself to reversible processes, leaving outside its purview the more disquieting open or "nonequilibrium" systems. But rather than viewing nonequilibrium as a negative factor, Prigogine believed that it was actually a source of organization and order. In effect, he turned the second law on its head and made it relevant to the natural world and its open, complex, nonequilibrium systems.

The impetus for his intuitive leap came from his observation of a phenomenon known as the Bénard instability. It occurs when a liquid is heated from below. As heating intensifies, the mixture suddenly begins to "self-organize," taking on a striking spatial structure sometimes resembling miniature stained-glass cathedral windows, with ovals of brilliant colors arranging themselves in kaleidoscopic patterns. The phenomenon intrigued scientists because these patterns resembled living cells, in that within each cell, ordered molecular motion occurs. Prigogine reasoned that if this was possible in fluid dynamics, it would also be possible in chemistry and biology. This self-organization of matter represented to him a critical link between animate and inanimate matter. It could even provide a clue to the spontaneous eruption of life's beginnings.

Without proof, however, Prigogine's the-

ory remained just that for nearly 20 years. Actual experimental evidence to substantiate it did not materialize until the late Sixties. Then, chemical processes known as the Zhabotinsky Reactions (after one of the Russian biophysicists who discovered them) confirmed Prigogine's theory. Just as he had predicted, the reactions which require a continuous outside source of energy occur at states far from equilibrium and, like animate matter itself, they're self-organizing. The concentrations of the various chemicals oscillate with clocklike precision, changing the solution from red to blue at regular intervals. The effect is what Prigogine calls "order out of chaos."

Since then Prigogine's output has continued unabated, as has his effect of stimulating new directions of scientific research. As a person, lauded the usually stodgy *Chemical and Engineering News*, Prigogine emerges as a figure whose work could create that long-sought bridge between the physical and social sciences.

Already his theory has been widely adopted. The U.S. Department of Transportation used it to predict traffic-flow patterns. In biology the theory has proved useful in understanding a number of phenomena including the glycolytic or sugar cycle, a metabolic process by which living cells extract energy from food.

Most important perhaps, the theory offers a guardedly optimistic alternative to the pessimistic view of mankind's future—that winding down of nature toward a kind of heat death. Prigogine has emerged as a hero to those who hope to bridge the "two cultures" gap between the sciences and the humanities noted by C. P. Snow. One of Prigogine's recurrent themes as he travels the international lecture circuit is his rejection of Snow's explanation for the schism's existence. "I think that as long as scientists had only naive views of time there was not much to communicate," he says. But now Prigogine thinks society can begin to investigate cultural and social change in dialogue with science.

A short, sixty-six-year-old man with a gracious manner and a sense of precision in thought and word, the "poet of thermodynamics" continues to direct the Solvay Institute in Brussels and teach at the University of Brussels as well as head the Center for Studies in Statistical Mechanics at the University of Texas at Austin. His book *Order Out of Chaos* will be published in the United States later this year. It was in Austin that Los Angeles-based journalist Robert B. Tucker interviewed Prigogine (with additional research supplied by former *Omni* European editor Bernard Dixon).

Omni: The concept of time is central to your work. Was there a particular incident in your life that caused you to become interested in it?

Prigogine: That's difficult to say. Perhaps my interest corresponds to impressions I received during my childhood. I was born in Russia in the year of the Revolution. My family left Moscow and I've always wondered whether this migratory part of my life left me with a vivid sensitivity to change. In any event, I was always deeply interested in humanities where time plays a central role. Beyond that it is a question of inclination. Some people are interested in electronics, some in looking for archaeological artifacts. I went on to study physics and chemistry. And I was astonished that the time element was missing.

Omni: Can you recall a particular moment when you had a flash of insight into a specific problem you were working on?

Prigogine: Well, I always remember with pleasure my first work on nonequilibrium thermodynamics in 1946, when I realized that nonequilibrium might be a source of organization and order. I was very, very happy to have this idea, which has never left me. Perhaps in science at some point there is a close relationship between who you are and what you try to do. Science is a much less objective enterprise than often assumed. It's true you need some tools. You need to write down your findings, and convince yourself and others. But the driving force for new ideas has to be a deep personal involvement in the problems you're working on.

> "What we see on Earth is the opposite of entropy. Instead of going to heat death, we see successive diversification and this energy streaming from the stars."

Omni: Are you an intuitive person?

Prigogine: Oh, yes. For me mathematics is only a tool to write down my ideas so that in the long run they can be communicated. I say "in the long run" because in my history all of the ideas I have proposed have been poorly accepted.

Omni: What was the scientific climate like when you first began to study time?

Prigogine: Well, quite naturally I was interested in the reaction of well-known scientists to this line of research. Their reaction was uniformly negative. It was 1946 or 1947 when one of the most famous scientists attending a lecture I gave stood up and asked, "Why is this young man devoting his interest to irreversible causes? Irreversible causes are just illusory. Time is just a parameter, so forget about it." I was so stunned by this reaction that I was unable to get up and respond. But I happen to be very stubborn, so I continued. Today the situation has changed quite a bit. Time has become an essential factor in elementary particles as well as cosmology.

Omni: You were a nonconformist, a dissident. How did you muster up the conviction to go against the prevailing ideology?

Prigogine: I would say again, this probably corresponds to a deep psychological element that isn't easy to make explicit. The attitude of Einstein toward science, for example, was to go beyond the reality of the moment. He wanted to transcend time. But this was the classical view. Time was an imperfection, and science a way to get beyond this imperfection to eternity. Einstein wanted to travel away from the turmoil from the wars. He wanted to find some kind of safe harbor in eternity. For him science was an introduction to a timeless reality behind the illusion of becoming.

My own attitude is very different because to some extent I want to feel the evolution of things. I don't believe in transcending, but in being embedded in a reality that is temporal.

Omni: You've said that recent studies you and other scientists have made in the area of irreversibility constitute a new dialogue with nature. How so?

Prigogine: What was considered by classical physics to be the basic structure of the world is now appearing more as an exception, something almost artificial. And what was considered to be exceptional in the classical view is now becoming the central object, the most interesting part.

Omni: What do you mean when you say the classical view?

Prigogine: I mean a mechanical view of nature. This view held that the world is made up of unchanging substances—atoms, molecules or elementary particles. It also held that the only type of change is through locomotion such as the rotation of planets—that there's no qualitative change. The classical view gave rise to the idea of the world as an automaton.

Omni: What assumptions of the classical view have now been debunked?

Prigogine: Mostly those relating to the basic conviction that at some level the world is simple and is governed by universal time-independent laws. This now appears to be an excessive idealization. It's as gross as reducing a building to a pile of bricks. Out of those same bricks you could build a factory, a palace or a cathedral. But only on the level of the building as a whole do we perceive it as a creature of time, as a product of culture. But I believe this analogy isn't quite on target. In nature there seems to be nobody around to put the bricks together to make a cathedral or a palace. And everywhere we're faced with complexity and time. So the existence of these two distinct levels—one of bricks ignoring time and the other of the building as a whole in which time appears—is a metaphor that cannot be transposed to nature.

Omni: What you're really saying is that the world is much more complex than science wanted to admit. Are you not?

Prigogine Yes I believe that's correct You see in the classical view we had already essentially discovered the great laws In my view we have yet to discover them If you had asked physicists a few years ago what they understood of nature and what they didn't understand the answer would have been predictable They would have said 'We don't understand elementary particles we don't understand cosmology What we do understand reasonably well is the range between the microscopic world and the world of cosmology'

But now a growing minority, to which I belong would be quite hesitant about making such a claim We have discovered new properties of matter And with all the progress in dissipative structures and irreversibility, we begin to see that the matter around us is much more interesting than we thought There may be black holes in the middle of the galaxy That's interesting but very very far away I don't deny the strong interest in elementary particles and cosmology, but if biological matter has different aspects that we have not yet understood, this makes science much more exciting After all it's the stuff we're made of

Omni Since it was first described, the second law of thermodynamics has been considered profoundly important to our understanding of nature What have you done to change our idea of that law?

Prigogine The second law of thermodynamics always had a dual character On the one hand it introduced a kind of arrow of time In isolated systems, entropy is always increasing It introduced the idea of thermodynamic equilibrium [complete randomness] the state corresponding to maximum entropy Our work has shifted the emphasis from equilibrium to nonequilibrium—irreversible processes

Of course in its original form the second law recognized the existence of irreversible processes but gave them only a negative role The idea you remember came into prominence around the time of the Industrial Revolution Many people thought of irreversible processes as destructive because of friction or rapid propagation of heat, or whatever

According to the second law entropy is increasing And classical physics was concerned with the point where all irreversible processes have already played their role Such systems are in equilibrium Chemical reactions have stopped heat conduction has stopped Our contribution has been to argue against the idea that equilibrium states are the most important or interesting On the contrary it is nonequilibrium that is essential to the understanding of our world and universe

Within the framework of the second law irreversible processes can have a constructive positive role rather than a destructive one They give rise to dissipative structures Now looking at biology social behavior ecology and economics we begin to have a meeting point between the various concepts of evolution

Omni Aren't there aspects of your theory that defy the laws of thermodynamics?

Prigogine No On the contrary, they show only that the meaning of the laws near equilibrium and far from equilibrium are different Near equilibrium you always go to the most banal the most uniform state The general idea of classical physics is, we progress toward the running down of the universe This may be true to some extent for the universe as a whole But at the moment it's a very difficult question because we don't know the relation between entropy and gravitation

What we see here on Earth is just the opposite of entropy Instead of going to heat death we see successive diversification And so in spite of the fact that the second law is probably satisfied we are not going toward equilibrium because this stream of energy comes to us finally from the stars the galaxy and so on It ultimately originated in the big bang or whatever—the original presence in the universe

"You drive in a way that influences other drivers. They influence you. On the highway you no longer have free will but are part of a collectivity to which you contribute."

Omni The concept of bifurcation is key to the theory of dissipative structures [A simple example of bifurcation is seen in an audience's response at the end of a concert A few people start clapping and suddenly everyone begins to clap in a seemingly spontaneous outpouring This changes the nature of the concert hall and the audience and gives feedback to the performer] How are you using the word?

Prigogine Bifurcation is the appearance of new states of matter at critical points Before that critical point is reached you have a chaotic structure But once that point has been reached you have order The chemical clock [Zhabotinsky Reactions] is an example of it It shows that the reacting mixture is not chaotic, but there is actually a coherence There is the possibility of chemical communication between molecules over long distances and long periods of time That is a property everybody always accepted in living systems, but in nonliving systems it was quite unexpected Through such experiments in dissipative structures we see that matter is much more integrated than we thought The gap between life and nonlife is smaller than we used to believe Before, we thought that life was the great exception, the contradiction of the laws of physics Now we see that complexity can spontaneously arise far from equilibrium

Omni How does bifurcation apply to life?

Prigogine The way structure appears is a tantalizing riddle Of course, living organisms are historical—they carry genetic information from half a billion years of evolution So the appearance of structure in biological systems is not easy to study because you have to take into account what is heritage and what is assembled today But it seems to me bifurcation is the key phenomenon in shaping morphogenetic patterns, especially when you see the type of monster malformations produced after exposing living structures to X rays for example Here you have started with a very symmetrical system whose symmetry has been broken How does this happen? In a sense there are choices and the system can go in one direction or another A good example is the formation of a body the egg cell is basically spherical and symmetrical but then goes into less and less symmetrical structures Of all the problems in biology the role of bifurcation, the transition from one direction to another, is vitally important

Omni Doesn't molecular biology provide answers to problems of development?

Prigogine No one would disagree that molecular biology has made enormous advances However, let us not forget that organisms and parts of organisms are coherent systems What happens in your head has a repercussion on your leg and vice versa We are dealing with enormously more powerful uses of information than the interactions between individual molecules

Omni What is the biological importance of the chemical-clock experiments?

Prigogine The amazing thing is that each molecule knows in some way what the other molecules will do at the same time over relatively macroscopic distances These experiments provide examples of the ways in which molecules communicate The chemical clock is perhaps one of the simplest examples of the chemical communication that plays such an essential role in biological systems

Omni You once used highway driving as an example of dissipative structures as applied somewhat loosely to social situations How does that work?

Prigogine When you drive on the highway you have your own program your own speed When other people drive at the same time competition begins This competition brings about a change in your driving This is feedback Feedback is a situation that involves nonlinearities It is far from equilibrium in the sense that as more and more people drive the situation becomes more and more distorted

Omni I don't understand what the nonlinear aspect is

Prigogine The competition between the

drivers. You can make a very simple theory, which I did twenty years ago, that incorporates the effects of your own wishes, the way other people wish to drive, and the competition between the various wishes. You come out with the kind of nonlinear equation that describes this evolution.

First you drive as you want to. Then you take into account the other drivers, but you still drive as you want to. That is what I call the individual regime. Then you go beyond the critical concentration [of cars] and come into a new organization in which you force the other drivers to drive as you drive. I call that the collective regime. It's a very good example of bifurcation, a phase change to a coherent structure—the highway as a whole. Now, this is not necessarily beneficial. You are embedded in something that does not depend on you and in which you are a part. You contribute to it but can't escape.

Omni: What are the characteristics of being embedded in something?

Prigogine: Being embedded implies a mutual situation. You drive in a way that influences others, and other people influence you. You can no longer say that you have free will. You are part of a collectivity to which you contribute, even in a sense against your will. And data on highway driving show there really is a transition to a different phase when the critical concentration is reached.

Omni: Could you cite another example of nonlinearity and feedback?

Prigogine: The way in which music developed. Music evolved in each society according to the particular types of instruments people invented. Metal, wood, and string have the same physical properties everywhere. But the musical instruments that emerged affected the music that could be played, which in turn influenced the type of music that was composed, which altered the evolution of the instruments. So a symphony orchestra is one expression of what wood, string, and metal can do. But we also have Chinese music, Indian music, and so on. And there are different underlying value systems as well as different observed behaviors. We appreciate one kind of musical scale, another culture a different tonal formation.

Omni: What effect do you suppose your vision of nature will have on the cultural tensions that are usually associated with classical science?

Prigogine: Well, the classical view of nature was passive. The world was thought to be an automaton, the universe clockwork. Joseph Needham, the great [British] historian, often said that Western thought has oscillated between seeing the world as an automaton and seeing it as a theological construct in which God governs the universe. Actually, these two views are not so inconsistent. If the world is an automaton, it needs a God to govern it. An automaton is not self-governed. But this kind of concept presents us with a rather tragic choice: to accept scientific rationality and the alienation that is the consequence of this acceptance, or to go into philosophical speculations that are divorced from contact with science. I think such a choice is no longer necessary.

Omni: Why is that?

Prigogine: The classical view divided the universe between spiritual self and the physical, external world. Yet inside us we see time activity: we experience change. This internal experience is in complete contrast with the view of the world as a timeless automaton. As we begin to discover the roots of time outside us, this duality tends to disappear. We see a convergence between the world outside and the world inside us. With the paradigm of self-organization we see a transition from disorder to order. In the field of psychological activity this is perhaps the main experience we have—every artistic or scientific creation implies a transition from disorder to order.

Omni: What was the classical response to time-dependent processes?

> *"Today various climates could evolve. Glaciers could come down and the earth could be covered with snow. Yet it would be the same planet revolving around the sun."*

Prigogine: To try to avoid them. You see the famous entropy principle isn't a real law. It simply states that some events are more likely to occur than others, since entropy is considered to be only an approximation. But because there was such a distrust of time, there was also a distrust of life, because all life is obviously time-oriented. Still, you will find many people saying that life is an accident—that life is not within the laws of physics.

Clearly in the physical universe four types of phenomena occur. Structures appear, as with biological systems and social systems, and they disappear, as when you mix two liquids. There are also deterministic processes, like the motion of the earth around the sun, and nondeterministic processes. What has changed is the perception of the relative importance of these processes. We begin to see now that the deterministic processes can be seen only in isolated, artificial systems. The natural world, on the other hand, is a world of *irreversible* processes, of self-organization. So I talk about a new dialogue with nature because I think we are beginning to perceive nature on Earth in exactly the opposite way we viewed it in classical physics. We no longer conceive of nature as a passive object. I can't stress enough that it is an active object in our lives. And we see now that life has much deeper roots than we once suspected.

Omni: Why did you choose to call those systems that are embedded in a stream of activity dissipative structures?

Prigogine: I wanted to bring together two concepts: the idea of structure, which generally is static, and dissipation, for which you need energy continually brought in and going out. This is the type of structure that may appear at some distance from equilibrium. Far from equilibrium you have specificity. The world is multiple. We have ants, elephants, plants, and civilizations. New, highly specific solutions appear when you go far from equilibrium.

Omni: Why do you suppose this emphasis on reversible processes existed for such a long time?

Prigogine: Your question reminds me of a story about meteorites. We know they were observed long ago. And by the beginning of the nineteenth century there was a marvelous collection in the museum in Vienna. Then a new curator appeared who said that meteorites were obviously products of superstition. They did not exist because there was no place for them in the Newtonian view of the planetary system. So he threw the entire collection away. Then the French Academy was asked to give its opinion about some meteorites found near Paris. It sent a deputation there and they came back with the message: "Meteorites do not exist; they are artifacts—probably old industrial debris." Then a little later still, a real rain of meteorites smashed nearly all the windows of the academy. At this point its members could hardly help concluding that meteorites existed.

Omni: And how would this analogy apply to the classical world view?

Prigogine: Well, I think today we have begun to accept the idea that our physics is the result of our conscious activity. The classical idea was that when you studied physics you looked at nature from the outside, as if you had the infinite wisdom that traditionally has been attributed to God.

Omni: How important is human consciousness in determining the kind of world view we ultimately construct?

Prigogine: Consciousness plays an essential role because we construct reality through mathematical concepts. If our consciousness had a different structure we probably could not use the same type of constructs that we do. That's not to say physics is subjective; there must be a relation between our physics and reality. However, the way in which we speak about this reality is something we create.

Omni: Has our desire to understand reality led us to greater complexity?

Prigogine: Max Born, one of the great founders of quantum mechanics, once wrote that he believed ideas such as ab-

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Marshall McLuhan warned that aliens were coming. He was right. They are Silicon Valley's

TECHNO-KIDS

BY BARBARA ROWES

On December 31, 1980—some would call it the last day of the Industrial Age—Marshall McLuhan closed his bloodshot brown eyes for the last time, at exactly the moment he had prophesied. "The future society will not include me," he once confided. "I belong to the dying breed."

A revolution was under way, McLuhan saw, and its impact on society would be devastating. "We are living in the apocalypse," he warned

in 1975. "Mom and apple pie will never survive." The new breed McLuhan imagined would be as at home with electronic media as earlier generations had been with footballs and bicycles. In a world where messages flash from Toledo to Tokyo at the speed of light, the future child would live in the moment, reacting to information almost as fast as computers could churn it out, digesting little of it as it sped past.

"They are the children of the Electronic Age, evolving the qualities necessary for survival in the world of tomorrow," he said of the first techno-kids.

"In the not-too-distant future they may have more in common with a creature from another planet than they have with their own mothers and fathers."

Only two years after his death, the children of Silicon Valley are beginning to appear among us. They closely resemble the techno people of McLuhan's vision. "Kids used to have a corner lemonade stand when they were eight years old," observes Everett Rogers, a hip professor of communications at Stanford University's Institute for Communication Research. "Now they are paid consultants to large computer companies in Silicon Valley."

Last summer at Stanford University, a corps of technologically advanced students from Palo Alto's Jordan Middle School earned $3.50 an hour by teaching adults how to work computers. "I wouldn't do it for free," says David Pier, age thirteen. Just as my father delivered newspapers, I work with computers to earn extra money." The Palo Alto prodigies are far from unique. In a forthcoming book entitled *Silicon Valley Fever*, Rogers describes David's peers who live in enclaves of techurbia flourishing across the United States. The first such community grew up around Stanford University; by 1975 some 54 high-tech companies had spread from Palo Alto to San Jose. On the East Coast, Silicon Valley's counterpart sprang up near MIT and clustered around Route 128, the bypass that circles through Boston's western suburbs. Two other well-known high-tech centers can be found around Rensselaer Polytechnic Institute in Troy, New York, and in the "Research Triangle" formed by Duke University, the University of North Carolina at Chapel Hill, and North Carolina State University at Raleigh.

Other centers of the electronic society are budding. Rogers has found them in Rochester, New York; Ann Arbor, Michigan; Minneapolis; Portland and Eugene, Oregon; Colorado Springs; and the west side of Denver; Dallas and Austin; Salt Lake City; and the extended suburbs of Los Angeles. Each has grown up around an outstanding school of engineering with a bent for industry. Each center is witnessing the first stages of the electronic culture McLuhan foresaw.

In the classrooms of Silicon Valley, especially seventh- and eighth-graders are already running on a program different from that for kids in the rest of the country.

Few of our children are being prepared to live in the world of tomorrow," warns George Tressel, of the National Science Foundation. "Parents do not seem to understand that their children will live in a world where listening, talking, thinking machines are everywhere. The pressing problem is to give our children enough technological literacy so that they'll be able to compete on this exciting new frontier. Otherwise they are destined to become second-class citizens of the new society."

To watch the new breed in training, visit Palo Alto's Jordan Middle School, where David Pier and his fellow Stanford teachers learned their computer skills. Of the 825 students there, 460 voluntarily attend a computer laboratory each week. "They don't score any brownie points," says Joan Targ, the teacher who set it up. "They don't get any credit. They come out of curiosity." Or, says Gwendaline Mazzara, "because our mothers force us."

The parents of Silicon Valley, most of whom are computer-industry managers, are programming their children to survive in the future. Moving into techurbia without a home computer is like living in suburbia without a car. Notes Irene Stafford, who teaches first grade in San Jose's Williams School: "When the school district did not supply computers in the classroom, the parents went out and collected the money to buy them."

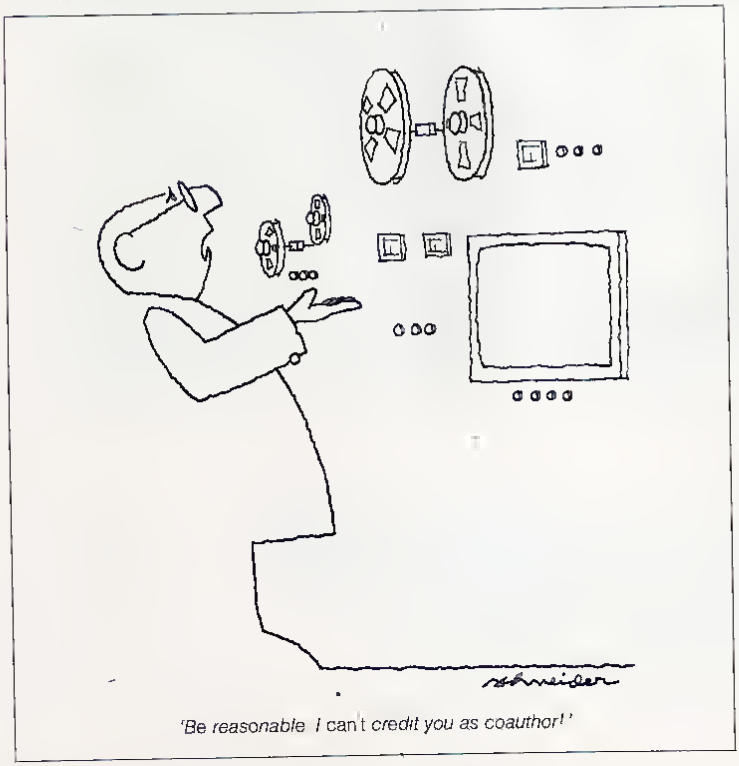
Even to those on the scene, the effect of the electronic machines may not be apparent. "I don't think they are different from other kids," declares Jordan's principal, Peter Heilman. "They don't look different. They don't behave differently. They're not a bunch of scientific eggheads."

Yet he acknowledges, "I would guess that virtually all the kids here have grown up with a practical exposure to technology. Over and over again, I'm astonished by the normalcy of computers in their lives. They just accept them as a natural part of their environment. But that doesn't make them freaks of nature, does it?"

Not yet. But neither does it make them the kind of kids their parents were. "For boys," according to Targ, digital dexterity "means prestige, possible jobs, and a little macho." Sixteen-year-old David Blatner agrees that computer skill carries weight. "If you can create tricky programs that really haven't been done before, everybody wants to get into your head." He smiles. "Even if you don't make it as a football player, you can score some status points with the girls at the keyboard."

For girls, the transition to the new society has been more painful. "Most girls are scared off by the fallacy that you have to be a mathematical wizard to program a computer," reports Targ. "At the computer center, we try to present programming in a totally different context."

Still, nationwide, relatively few girls have made the breakthrough. At twelve and a



'Be reasonable. I can't credit you as coauthor!'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Something Wicked This Way Comes
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DOLBY STEREO IN SELECTED THEATRES
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half Gwendaline Mazzara is in the vanguard A petite eighth-grader, she would have become a cheerleader in an earlier generation; today Gwendaline is becoming a computer programmer

"I didn't want to do it" she blurts out honestly "My mother made me It was just like taking piano lessons—something I had to do because it was good for me When I first walked in the door of the computer center I wanted to run out I just knew it was going to be really stupid

"Maybe I thought it was dumb because I wasn't sure I could do it if I can't do it I always think it's stupid

Over the months Gwendaline started to have fun at the keyboard It's hard but I really like the way it makes me think Now I can do graphics on the IBM and even play music on the North Star Horizon Why should I take piano lessons when I can play music on the North Star Horizon by pressing a key—PRINT #7? Now I don't practice too hard That's real progress to me!

Fifteen years ago predicting Gwendaline's comfort at the computer keyboard—and distaste for hard work at the piano keyboard—won McLuhan more notoriety than followers "Marshall was a kind of prophet of the twentieth century" comments his student and close friend Walter Ong a professor at St. Louis University and an eminent cultural humanist in his own right. "No man can live as a prophet in his own century; he becomes the source of too much controversy "Some of the things Marshall was trying to say we still have not succeeded in formulating completely," he adds "But there is a growing understanding of his vision"

"What's dramatically different today is that we are conscious that we are living through a social revolution" suggests professor William Paisley of Stanford's Institute for Communication Research "The Industrial Revolution was not perceived as a revolution by those going through it

McLuhan's key insight was that electronic technology challenges the natural laws of communication In the past he said "geographic distance created social distance only members of a single community could achieve the close contact that binds societies Suddenly a message typed in Atlanta arrives instantaneously on a desk in Altoona Our concept of space and time will never be the same

Already the changes in our mental processes are appearing in the young even outside Silicon Valley And again these modifications are as McLuhan foresaw For one thing there is a definite shortening of our attention span observes Tressel

Christopher Crawford chief game theoretician for Atari experienced it firsthand In two years of lecturing he talked to more than 300 000 students in northern California high schools Our rule was that you didn't talk on any one topic for more than thirty seconds he reports "We discovered the hard way that if you talked any longer you'd start seeing spitballs flying around and hearing rumbles from the audience After a minute on the same subject the murmurs would get louder If you were stupid enough to talk for two minutes the place would be a shambles.

With shorter attention spans has come more precise speech "If you ask kids what time it is notes Andrew Molnar of the National Science Foundation they will tell you it's eight thirty-one Phrases like half past and quarter of have gone out of their language Kids are growing up with an exacting digital consciousness Few of us recognize the importance of this unprecedented precision in speaking, but it signifies an entirely different relationship with our environment"

Marshall McLuhan recognized it and he did not like what he saw He was a born anachronism a man who adhered religiously to the values of his own generation A mid-life convert to Roman Catholicism he read the Bible (in any of five languages) before sitting down to breakfast A devoted husband and authoritarian father of six children he headed an ultraconservative household in the officious manner of Clarence Day in *Life with Father*

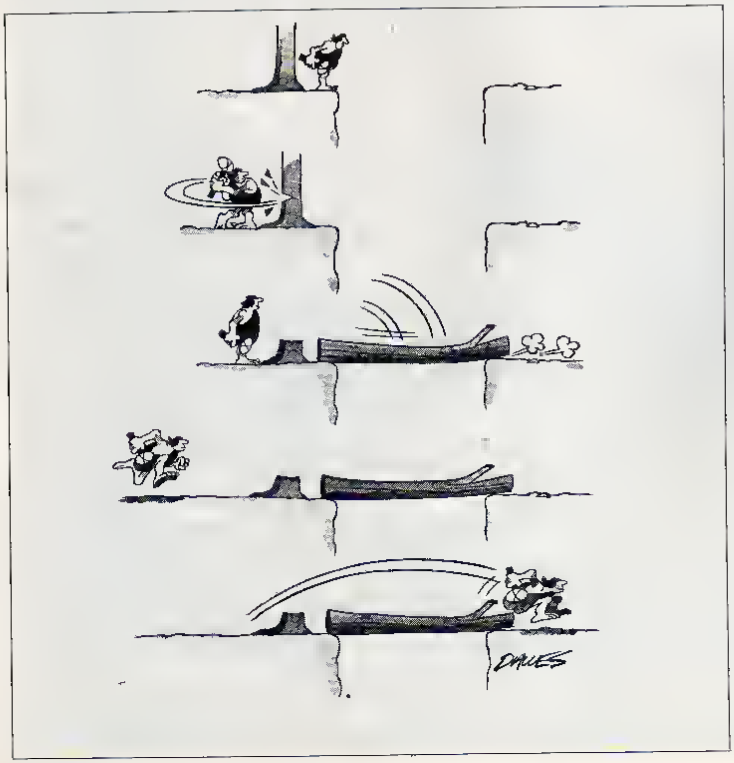
In the sultry autumn of 1975 McLuhan sat in a tattered beige armchair in his unfinished basement contemplating with horror the future of the world "In my writings and lectures I never offer my point of view he confided "But if you ask me what I personally would do with electricity I would turn the whole thing off It's going to ruin everything in this world that holds deep meaning for people like me"

McLuhan meant what he said wherever he could he protected himself against the Technological Age He walked around Manhattan with cotton plugs in his ears "How do other people stand this noise?" he wondered He moved his only television a 1967 Motorola out of the living quarters into the basement "It was an invasion of our privacy" he explained He deplored rock music Once he turned the speakers of his teen-agers' stereo to project the music out the window rather than into the living room And he refused to tape his dictation or let his secretary switch from a manual to an electric typewriter

Yet he knew that the time-honored values he defended were already lost "The members of the older generation are hoping that as the kids grow older and have families of their own they will adopt more traditional values But their values are not going to improve As far as I can see they're only going to get much worse

"People followed traditions to increase their sense of security and continuity with the past But the electronic society is built on continuous progress not tradition "It looks forward to tomorrow instead of backward to yesterday It has no past no heritage The only thing stable is the knowledge that things will change"

When McLuhan heard the then-popular



CONTINUED ON PAGE 122

A world of magical causality where pencils and green peppers float through imaginary mindscapes

HIDDEN CONNECTIONS

PAINTINGS BY DONALD ROLLER WILSON

The children are playing in the attic, dressing up in fancy old clothes, acting out dramas of their own devising in scenes of great purity and silliness. The artist is also there, an unseen presence, and he, too, is playing. In these games there's always something moving and unfixed—a smoking cigarette, a twister seen through the window, green peppers, or a yellow pencil suspended miraculously in thin air.

The artist plays at being children playing at being apes, nuns, dogs, and cats. The attic is full of interesting things, props for the children's dramas. The artist plays with what the children find, and invents what they need: teeth, smoke, plumed hats, shoes, skulls, baby carriages, baboons, bulldogs, and olives stuffed with pimientos. The paradoxical images are koans inviting true response, stifling the obvious. Feel the painting with your mind. Touch it with your sensibility. Your reward will be a little satori, interrupting the dreary thingness of the everyday world.

TEXT BY ROBERT SHECKLEY

The twofold basis of Zen is a separate transmission outside the scriptures, not dependent on words or phrases, and a direct transmission from mind to mind. This is also a formula for the appreciation of art. Therefore, do not rely on what is written about art; take your vision directly from the mind of the painter into your own mind. Don't stop at co. Enter the artist's domain directly. Do not interpret; sympathize. Do not translate; appreciate. Do not even appreciate; apprehend directly. The vision that can be explained in words is banal. Meaning is not to be found in words.

The artist presents us with reality/surreality snapshots, no two alike, no two really different. The dramas he paints cannot be understood through his characters. They are his dreamchildren, wearing masks and playing at being someone else. Nor does the key lie in the relationships between objects; the connections are buried deep in his mind, hidden even from him. If you must seek meaning, look for it in the fold of fabrics, the gleam of light on a skull, and in the ape's peculiar grin. Meaning is on the surface. Depth is the illusion.

SEEDS

CONTINUED FROM PAGE 80

vide a substantial part of Earth s biosphere through impacts

Delsemme estimates that comets could easily have supplied the water for a global ocean a mile deep and an atmosphere (consisting mainly of carbon dioxide) 100 times denser than our present one Comets gave Mercury and the moon the same treatment, as the craters on those bodies testify but their low gravity could not retain these gifts for more than a few million years There is also evidence that Venus once had oceans similar to Earth s they were steamed off by the much closer sun Conversely any water present on more distant Mars probably forms a thick layer of permafrost below the planet s desert soil

Let us return a moment to the Oort Cloud Shoemaker and his USGS colleague Ruth Wolfe were jolted when their figures showed that about a Jupiter-mass of material should still be out there This means there must be trillions of comets left in the cloud

Comets seen today even bright ones like Halley probably measure no more than ten miles in diameter But larger ones in all likelihood are waiting to be discovered 'The planet Pluto has the characteristics of a giant comet,' Shoemaker suggests Such monsters must be so rare however that few ever cruised the inner solar system

A comet itself is a curious amalgam of materials and textures Despite its icy nature, a comet s nucleus is surprisingly dark barely more reflective than a chunk of coal

'The standard description of a comet is a dirty snowball,' says Carnegie Institute planetologist George Wetherill 'But when we look at a comet, we see that the material ejected during vaporization is almost exactly half dust and half gas so we could just as easily call it a snowy dirtball'

Halley or any comet resembling it which gets twice as close to the sun as to Earth loses about 0 1 percent of its mass during each trip to the inner solar system After about 1,000 of these loops around the sun Halley will be worn out as an active tail-sprouting comet and will spend the remainder of its existence as a comet corpse, with a mass of about 90 percent dust and 10 percent ice

Such corpses, which have indefinite life spans, are what Shoemaker thinks have collided with Earth 'A dead comet continues to orbit the sun until it hits a planet or is gravitationally kicked out of the solar system,' he explains 'Comets have been seen splitting up as they near the sun Chunks come in all sizes, from dust up'

Even now about 10 000 tons of cosmic matter strikes Earth annually It ranges from fine small-sized particles to peanut-sized particles that become meteors as they flare into incandescence as a result of atmospheric friction on their descent Also each year a few hundred boulders some as big as suitcases survive the fiery plunge and arrive a little charred but essentially intact These meteorites are of several types chunks of iron and nickel, stones similar to igneous rocks and a group called carbonaceous chondrites some of which resemble clods of dirt

Much of this cosmic fallout originates with comets Annual meteor showers, such as the Perseids (seen each August) have been linked to dust and pebbles that are shed when a parent comet vaporizes

The carbonaceous chondrites have proved the most interesting of the heavenly debris Several of them recovered in virtually pristine form from Antarctica, have amino acids of extraterrestrial origin This is not extraterrestrial life, but since such complex molecules were generated in a meteorite the idea that comets 4 billion years ago brought more than just raw materials for life wins further support

Comets may have brought life itself, according to English astronomer Fred Hoyle and his colleague Chandra Wickramasinghe head of the astronomy department at University College Cardiff, Wales, and an authority on the composition of interstellar dust Hoyle and Wickramasinghe assume that a comet forming from the primordial nebula in the Uranus-Neptune region would be well supplied with the precursors of life They cite the Milky Way in which radio astronomers have detected molecules from such simple and familiar compounds as water and ammonia to more complex ones such as formic acid and vinyl cyanide These molecules form naturally in nebulae and survive because their enemy ultraviolet light can't penetrate to break them down

> *Even now about 10,000 tons of extraterrestrial matter strikes Earth annually It ranges in size from fine dust to peanut-sized particles*

During the genesis of the solar system these molecules and probably more complex ones too could have been incorporated into comets The University of Maryland s Cyril Ponnamperuma an internationally recognized expert on the origin of life agrees 'If the comets were formed from the presolar nebular gas' he says 'it is not surprising to find similar compounds in both the comets and the interstellar medium' But when Earth formed intense sterilizing radiation from the primordial sun would probably have made it impossible for life to develop

Now Hoyle and Wickramasinghe have made the bold leap A giant iceball of a comet they say could contain enough decaying radioactive elements to warm and thaw thereby melting the core and providing a fertile pond for the nebular molecules to continue their evolution Eventually the molecules could form life—viruses they suggest Later when the comet, or a portion of it, reached Earth this primitive life would seed the planet Four billion years later *Homo sapiens* 'Earth might be said to have become infected with life,' Hoyle and Wickramasinghe suggest

Hoyle insists that this scenario would not be so hard to swallow (indeed most astronomers and biologists choke on it) if the old ideas 'were not so hallowed by tradition' But, predictably these flying biological ponds have few advocates

The idea that comets were the laboratory where Earth s biochemistry originated fascinated University of Houston biophysicist John Oro the first (in 1961) to suggest it in detail After closely examining the theory however he concluded that chemical evolution in comets must have ground to a halt long before life ever appeared But the questions of whether there are organic compounds present in comets and whether the carbonaceous chondrites triggered life remain unanswered

The next step in the search for certainty is to obtain a closer look at a comet With Halley coming the wait may be short

During Halley's swing by the sun three years from now almost every telescope on Earth will be pointed its way Scientists from the United States Japan Germany, France Great Britain the USSR the Netherlands Canada and at least a dozen other nations met last year in Athens to exchange information and to coordinate their efforts by formalizing the International Halley Watch This effort will be in high gear by 1984

In addition every nation with a suitable launch vehicle (with the glaring exception of the United States) will send spacecraft—five in all—to greet the celestial visitor There will be two Soviet robots They will first drop probes to the surface of Venus then move toward the comet for closeup photography A multinational European vehicle named *Giotto* flying in a kamikaze plunge into the debris-strewn zone within a few hundred miles of the comet s icy nucleus will take photos and other readings Two small Japanese spacecraft round out the fleet To the dismay of planetary scientists everywhere Reaganomics prevented an exquisite flyby comet explorer from getting off NASAs drawing boards

There s no way to know beforehand whether the Halley probes will tell us anything about comets and life s genesis on Earth That will probably have to wait until we get a chip off one of those ancient travelers from the abyss Then we might see back to where it, and we began

Space scientists in the Soviet Union and America are engineering the next giant step in evolution

LIFE AFTER LIFTOFF

BY NICK ENGLER AND DONNA CHESHIRE-ENGLER

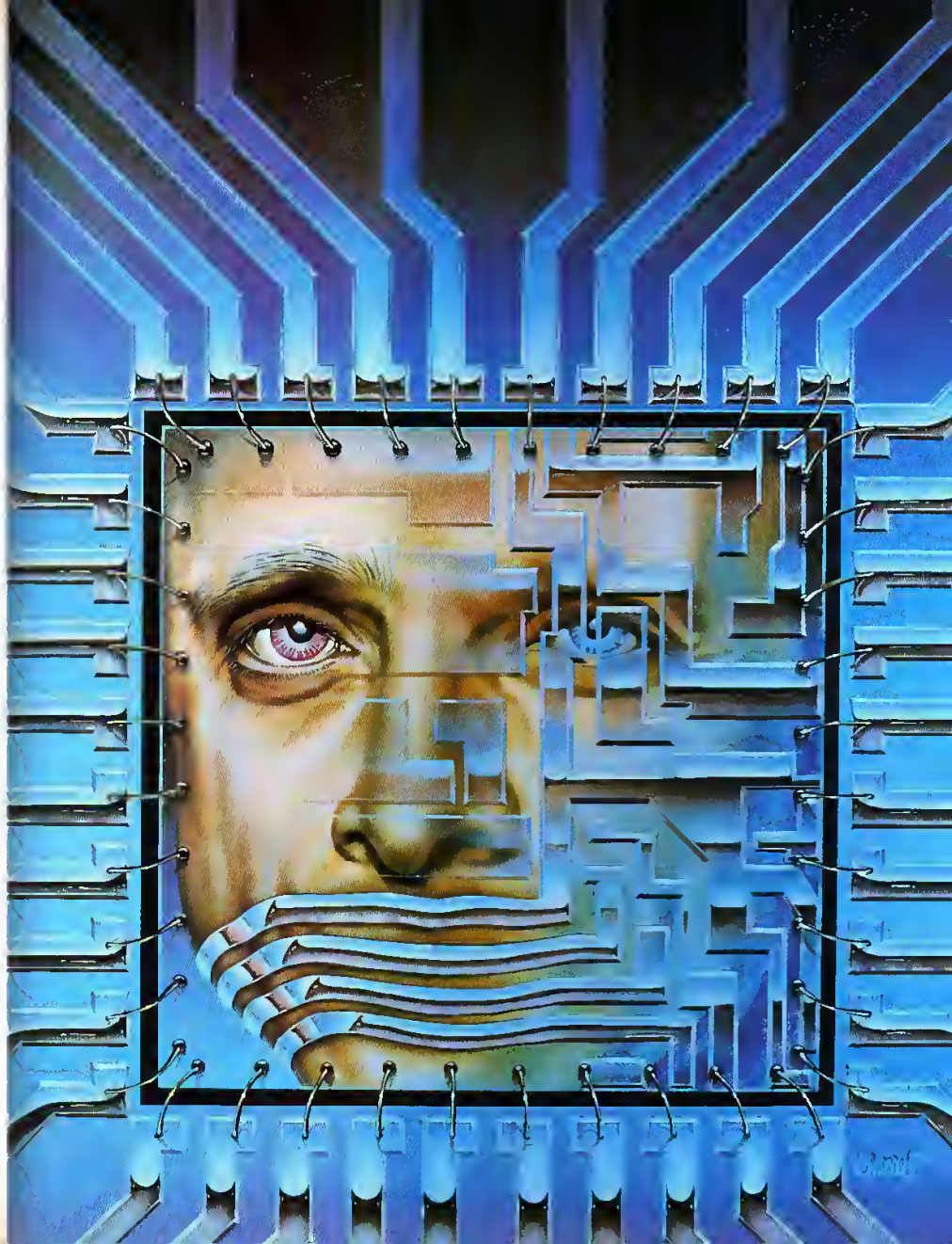
There is life on the moon. There has been for 16 years. Apparently, some adventurous streptococcus mites, described by NASA as "frequent, normal, benign inhabitants of the respiratory tract," stowed aboard *Surveyor 3* and in April 1967 made a giant leap for microbe-kind. Several years later *Apollo 12* astronauts retrieved parts of the robot spacecraft from the lunar surface. When biologists back on Earth incubated a piece of insulating foam from *Surveyor*'s TV camera, a colony of the wayward bacteria appeared. Unexpectedly, microorganisms have shown themselves well adapted for space missions.

At the other end of the biological spectrum, man is also proving to be remarkably adaptable to spaceflight—though he goes through some frightening physiological changes. After 211 days aboard the space station *Salyut 7*, cosmonauts Anatoly Berezovoy and Valentin Lebedev could barely stand, the muscles in their legs and back were so atrophied. Their hearts had shrunk, they had lost blood volume, and much of the calcium had been sapped from their bones. Yet they were healthy enough to survive the rigors of a harrowing nighttime landing. And after a few weeks of physiotherapy and massage, their condition improved so dramatically that it was almost impossible to tell that they had ever been in space.

The investigation of adaptation and readaptation in all manner of organisms, from microbes to man, is part of an infant science called *bioastronautics*—the study of life in space. Twenty years ago the discipline sought merely to determine whether living organisms could endure brief rendezvous in space. But as missions grew in length, long-term habituation became an increasingly important consideration. Researchers began to study how the conditions of space influenced such diverse functions as the growth patterns of plants, the hatching of insect larvae, and myriad physiological processes in man. Now thanks to mounting interest in space colonization, bioastronautics is branching out in still more directions. The questions it strives to answer range from the immediately practical—How should medical emergencies be handled in zero g?—to the wildly futuristic—Will it be possible to establish an Earth-like microcosm in space, an artificial oasis that will support microbes, plants, animals, and man? Already some specialists have begun to anticipate the problems that will arise when space settlements evolve into full-fledged civilizations, complete with their own governments and institutions.

Bioastronautics grew out of

PAINTING BY BARCLAY SHAW



'the reconciliation of biology and hardware," according to one of its pioneers, head academician Oleg Gazenko director of the Soviet Institute of Biomedical Problems (IMBP). Sifting in his Moscow office next to the stuffed remains of the dog Belka, one of the earliest space travelers Dr Gazenko emphasized to *Omni* the contributions of hard technology to space biology His own involvement began in the Fifties, when he first engineered the equipment that would keep canines—and later, humans—alive while riding a missile.

According to Gazenko the hardware-biology reconciliation still concerns space doctors, and it will continue to do so far into the future For example Soviet bioengineers are developing a mechanical antidote for spacesickness, the zero-g equivalent of seasickness Known as a Cuban boot (after the Cuban cosmonaut Arnaldo Mendez, who tested the prototype), the device puts pressure on the bottom of the feet, making the cosmonaut feel as if he's standing on solid ground—biology fooled by hardware

At NASA doctors worry that astronauts may suffer heart failures during the first four to six weeks in space, when they are most susceptible to cardiac arrhythmias Cardiopulmonary resuscitation is a complicated procedure in microgravity but Dr Joseph Degioanni, of the Johnson Space Center in Houston, is designing a "thumper" that may simplify matters A compressed-air-powered piston it wraps around the astronaut's chest and automatically administers blows to the sternum—biology revived by hardware

Another problem facing space doctors is how to restrain an incapacitated astronaut. NASA's first solution was a cumbersome and costly system of bungee cords But astronaut Bob Overmyer came back from the fifth shuttle mission with an easier answer. "Duct tape," he told the medical experts. "You stick them down with duct tape. Vance [Brand] and I stuck *everything* on the shuttle down with the stuff." Duct tape is now included in the shuttle first-aid kit—biology restrained by ordinary dime-store hardware

As the above examples illustrate space hardware is not necessarily synonymous with high technology. Before better engineering designs can be developed, we must achieve a fuller understanding of the body's response to weightlessness. Consequently, hardware development is no longer the main preoccupation of bioastronautics research; increasing emphasis has been placed on the study of physiology in zero g.

The absence of gravity causes acute changes in the cardiovascular system, muscles, bones, metabolism, even anatomy. On Earth we expend one third of our energy fighting gravity. In space the heart takes it easy, capillaries shut down, and oxygen metabolism slows. "Antigravitational" muscles atrophy, the body loses potassium, magnesium, and calcium. Legs become birdlike and the waistline reduces as body fluids and internal organs shift foward the head. Aboard *Salyut 7* French cosmonaut Jean-Loup Chretien experienced difficulty placing a cardiac sensor because his heart had moved so far up in his chest cavity.

Space doctors point out that none of these reactions are pathological. "Everything that happens to the body in space is normal; the normal adaptive reflex takes over," explains Dr Stan Mohler, director of the Aerospace Medical Program, at Wright State University near Dayton, Ohio. "In a new environment our bodies seek a new balance." With the exception of the calcium metabolism, most human biological processes reach this new equilibrium—called homeostasis—after 40 to 50 days in orbit. And most scientists expect that calcium loss will level out in one to two years, as it does in bed-rest studies.

But as man adapts to life in space, he *disadapts* to life on Earth. A sudden return to a one-g environment could overload a weakened heart or snap demineralized bones. So researchers are developing means to arrest (or at least slow) the adaptive reflex: rigorous exercise, supplemental minerals, mechanical devices to restore Earth-normal circulation. "Our earthman," warns Gazenko, "must not be allowed to become too much a spaceman"—if he or she wants to come home.

"Weightlessness will cancel many of the negative aspects of aging. You won't develop jowls, breasts and buttocks will never sag, bone and joint disease may disappear."

Scientists are also investigating whether an earthman can ever become a complete spaceman, even if he or she does *not* wish to come home. The question may sound academic, but within the next half century space doctors fully expect to begin multigenerational missions—space settlement and/or interstellar exploration—during which travelers will live, die, and raise children in space. If biological adaptation were permitted to run its full course, how would the changes affect reproduction, growth, and the aging process?

The research on reproduction is fascinating, though inconclusive. George Nace, a biologist at the University of Michigan, has conducted experiments on frogs. His findings indicate that gravity is essential to the symmetrical development of the embryo, and that microgravity may increase the likelihood of abnormalities. But killifish embryos developed normally aboard *Apollo-Soyuz*. On *Salyut 6* flies and flour beetles flew multigenerational missions in good health. White mice became pregnant aboard a Soviet biosatellite, but aborted after an unusually rough landing. In an experiment slated for August 1983 on *Salyut 7*, the Soviets will allow the mice time for gestation and birthing. This they hope, will provide the first good look at mammalian sex, embryology, and growth in space.

The aging process is not so well researched, but it raises equally fascinating questions. Dr. Mohler performed this thought-experiment for *Omni*: "If adaptation is allowed to fully unfold, what do you get? Atrophied muscles, brittle bones, decreased cardiovascular capacity—in short, the body of a one-hundred-year-old man. Adaptation to space is very similar to the aging process, but weightlessness cancels many of the negative side effects." In microgravity, you won't develop jowls, breasts and buttocks will never sag, bone and joint diseases such as arthritis may disappear. The difference between youth and old age will become less distinct. Mohler thinks it is unlikely people will live longer in space, but the elderly may live fuller, happier lives than they would under the tyranny of gravity.

Of course, all of this assumes that man can adapt fully to space. When asked to speculate if humans will be able to live, love, and grow old gracefully in a zero-g environment, most doctors are guardedly optimistic. "Life evolved in the sea, a close analog of a weightless environment," points out Dr. Don Stewart, a resident specializing in the problems of long-term space flight, at Wright State's Aerospace Medical Program. "Who knows? We may be better equipped genetically to live in space than in one g."

Adaptation isn't the only unknown that needs investigating before man begins to live and work in space. Bioastronautics has expanded to include studies in microbiology, botany, and behavioral and physical sciences. Here are a few samples:

Artificial gravity. Gravity can be simulated in space simply by spinning the spacecraft. Everything inside literally sticks to the walls. This may be a mixed blessing for anyone on board. Rats subjected to artificial gravity on Soviet biosatellites retained calcium at normal levels and showed little signs of muscle atrophy or cardiovascular change. But they had difficulty learning to run a maze and even more difficulty retaining what they had learned—probably because the rats were simply "dizzy." This doesn't spell the end of artificial gravity, however. "People become more tolerant of vestibular stimulation [fluid changes in the inner ear thought to cause dizziness] as they spend more time in space," notes Dr. Stewart. For almost a month after re-

turning home. *Skylab* astronauts could be vigorously spun around in a chair without suffering any ill effects.

Life support. As missions last longer, plants will become essential to help regenerate air, water and food. Due to the lack of gravity, roots, stems and leaves grow in all directions, and plant development is generally slower than on Earth. Still, cosmonauts on *Salyut 1* successfully sprouted wheat and peas, although the plants produced no seeds or blossoms. Aboard *Salyut 5*, the Soviets used weak electrical current to stimulate plant growth and coax arabidopsis (a small plant with a brief biological cycle) to flower. *Salyut 7* has a permanent garden called OAZIS, from which cosmonauts periodically harvest tiny crops of green onions, dill, parsley, and cucumbers. In addition to changing the cosmonauts' diets, the green, growing things provide psychological benefits. Soviet crewmen opt to spend much of their free time gardening.

Radiation. Both NASA and the IMBP closely monitor radiation inside and outside space vehicles. The Soviets, in particular, are concerned about the possible dangers of cumulative doses of radiation. During periods of solar activity, cosmonauts don protective shielding or change orbit to avoid pockets of ionizing radiation. The Moscow Institute of Genetics, in coordination with Gazenko's IMBP, has conducted studies on various plants and animals in space to determine the full extent of the danger. So far, there have been no genetic mutations or other adverse effects. The Soviets note, however, that the antitumor stability of rats decreases in space. This, combined with higher-than-normal radiation, might mean an increased risk of cancer for space settlers.

Health Care. The conditions of space may make us resistant to some diseases and vulnerable to others. For example, although radiation may increase susceptibility to cancer, studies of crown gall (a plant tumor) indicate that malignant cells do not proliferate as quickly in microgravity. So cancer may at once be more prevalent and yet less threatening in space. Viruses also seem to have trouble growing in space, sometimes producing 25 percent fewer progeny than on Earth. If further research supports this finding, colds, influenza, and other common viral infections should be relatively rare among space colonists. Bacterial infections, however, are another story. Unlike viruses, bacteria thrive in weightless environments. NASA doctors are understandably concerned that they may become major scourges in space. Their fears are compounded by uncertainty about how antibiotics and other medications work in the absence of gravity. Because of fluid shifts, the body reacts differently to different drugs. Cosmonaut Vladimir Shatalov once took a mild decongestant, then spent the rest of the day in near-slumber. To determine safe dosages, the Soviet IMBP is studying physiological parameters in space, from blood pressure to hormone and immune system levels.

Exobiology. If space doctors finally decide that man can't adapt to the environment, it may be possible to adapt the environment to man. The Jet Propulsion Laboratory (JPL) in California and the Space Biology Laboratory at Moscow University have both studied the reactions of terrestrial life under Mars-like conditions. For example, JPL scientists reproduced the Martian atmosphere inside an airtight chamber, complete with artificial sandstorms. Temperatures fluctuated between 20°C and −60°C while the vessel was pelted with X rays and ultraviolet radiation. Into this hostile environment the experimenters introduced a variety of species. Birds and mammals expired in a few seconds. Turtles survived for six hours, frogs up to 25 hours. Several species of insects lasted a few weeks. But some algae and bacteria adapted easily to the harsh conditions. These organisms could be used to establish a primitive ecology on the Red Planet, fixing carbon in the soil and emitting oxygen. As the density of the atmosphere increased, temperature would rise and polar icecaps would melt, pouring tons of water across the thirsty Martian landscape. This would make it possible to introduce higher and higher life forms. The entire process, from microbes to man, would take more than 10 000 years.

> *"Do you know what would happen to me if, as a NASA physician, I asked someone with the Right Stuff to go in a corner and contribute some of his, uh, stuff to medical science?"*

No one expects this project to get under way anytime soon. The United States and the Soviet Union have agreed to quarantine the planet until 2018. But if any of the Mars landers were contaminated, like *Surveyor 3*, we may have inadvertently begun.

Perhaps the most serious problem in bioastronautics today has nothing to do with bioengineering, adaptation, medicine or any other single study. No matter what the mission, space doctors are often flying blind, crippled by a lack of data.

Ask a simple question: 'Is heart disease more common among astronauts than among the general public?' Physicians will reply that only 100 men and women have ever been to space, not a large enough sample to give you a valid answer.

In the United States, the problem of obtaining data is further aggravated by a fundamental rift between scientists and subjects. "You've got to understand," a NASA physician explained, "there's been twenty years of bad blood between astronauts and doctors. Since the Mercury days, the Right Stuff has resented being poked and prodded by medics. Astronauts insist on 'limited veto' rights over medical experiments. As a result, many studies never get off the ground."

For example, while trying to validate a rumor that sperm counts of Soviet cosmonauts are abnormally low in orbit, *Omni* asked space doctors if similar studies are performed in the United States. One answer: 'Do you know what would happen to me if I told someone with the Right Stuff to go in a corner and contribute some of his, uh, stuff to medical science?'"

Astronauts may become more obliging guinea pigs, however, when the U.S. Air Force starts to take an active role in spaceflight. As another physician points out, "The Air Force will have a totally different relationship with its astronauts than we (NASA) have with ours."

More information about space medicine should also become available with the launch of *Spacelab 1* in September 1983. American and European scientists plan to conduct increasing numbers of life-science experiments aboard this prototype orbital laboratory. In addition, *Spacelab* will feature a "biorack," a reusable facility to study molecular, cellular, plant and insect biology in space.

But despite all the work that hasn't been done, bioastronautics has already firmly established itself as a scientific discipline. There are three schools in the United States and one in the Soviet Union that train physicians in space medicine. And in the near future, bioastronautics is likely to spawn two new spinoff sciences: psychoastronautics and socioastronautics.

Marathon space missions demonstrate the need for psychological studies. Throughout their 185-day flight on *Salyut 6*, Valeri Ryumin and Leonid Popov were starved for social contact and familiar things. They became emotionally attached to several flies that they freed from an experiment and even gave them pet names. ("At the time, these insects were the only other living beings on the space station," explains Gazenko.) Before the arrival of each new *Progress* tanker, the cosmonauts were as excited as kids at Christmas because the supply ships contained the smells of Earth.

On the ground, the Group for Psychological Support develops ways to ease this emotional strain. It monitors the moods of *Salyut* crews through analysis of voice harmonics and facial gestures. When a problem is recognized, the Group provides therapy. The next supply ship may contain a much-missed personal item for a depressed cosmonaut or a privacy curtain to "expand the psychological living space."

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He dashed to the bathroom, splashed cold water on his face, and shot the specters with his Polaroid One-Step

ANTI MATTER

UFO UPDATE

It isn't that Rev Harrison E Bailey minds taking dictation But when he was stirred at 1 30 A.M to record the words of two disembodied heads he started to shake Bailey s incredible tale is enough to shake just about anyone

The preacher says he awoke early on the morning of November 1 1978, to find a couple of ghostlike aliens against the window shade of his Pasadena, Calitornia apartment He dashed to the bathroom, splashed cold water on his face and returned to shoot the dark brown specters with his trusty Polaroid One-Step

Then came the message a half hour of religious generalities Stenography isn t the former steelworker s best skill, yet Bailey managed to get it all down—including the final "I love you" repeated ten times in Chinese a language he does not speak

To help the clergyman prove his story the aliens sat for more photos, growing wizened whitish legs for the full-length portraits They also donned Halloween masks that Bailey had saved from a party It made them look a bit less authentic but the minister took five pictures (including he claims the one shown above) anyway

Suddenly Bailey says the aliens darted toward the bathroom their shapes now humanoid and four feet tall He got a photo of each in the hallway then glimpsed them shoot through the ceiling in whirling globes of light

Bailey returned to bed and dreamed fitfully of his strange visitors After fretting for more than two months he told his tale to friend and longtime ufologist Ann Druttel who passed the pictures to psychic researchers for criticism and analysis

As might be expected the photos got mixed reviews Cyril Permutt of the Bureau for the Investigation of Paranormal Photographs in London has reported that they showed no trace of a hoax

One Los Angeles ufologist however announced These photos are an embarrassment The entities might be made from stockings Some of the photos were puzzling even to Druttel The photos with the man asks she says seem to have been taken with a [illegible] Bailey says he didn use one She offers what she feels is a logical explanation though think the right source was paranormal

The beings disrupted Bailey s sleep for a year Then, this past Halloween he asked Druttel and psychic Anita Furdek to exorcise the creatures As Druttel and Furdek tell it was a hard battle Furdek was tossed all night as though racked by epileptic seizures The creatures weren t hostile, Furdek feels just playful and young

At dawn Furdek finally persuaded them to leave Bailey in peace then went downstairs to discover that Druttel s car had been stolen I looked out the window Furdek says to see the E T s having the last laugh

It s a strange tale Druttel admits But she says, Most of the researchers who meet Bailey feel he is extremely rational and honest We just have to accept his word because he has been unable to duplicate this effect in front of scientists *ALAN VAUGHAN*

REAL RAIDER OF THE LOST ARK

His name is Jones. He's tought Arabs and eluded unscrupulous competitors escaped from deadly vipers and crashing boulders. He's even searching for the Ark of the Covenant.

But he's not the movie character Indiana Jones of *Raiders of the Lost Ark*. He's Vendyl Jones, head of the Institute for Judaic Christian Studies, based in Israel and Texas.

The similarities between Indiana and Vendyl are more than coincidental. Phil Kaufman, who wrote the story on which the movie is based, worked with Jones on an archaeological dig near Jerusalem in 1977. "Phil asked me if he could do a story based in part on things that happened to me," relates Jones. "He took some events and romanticized them."

It could be argued that some of Jones's adventures have been even more difficult and dramatic than the Hollywood version. For example: the real life Jones escaped from a site booby-trapped with not one but four gigantic bouncing boulders. (A member of the excavation party jumped off a cliff to avoid being crushed.)

And though Indiana Jones *found* the Lost Ark, Vendyl is still searching. Before he determines the whereabouts of the Ark, however, he'd like to locate the ashes of the Red Heifer, an ancient cow that was allegedly sacrificed and burned. Once the Red Heifer has been found, legend has it, the mystical power of the Ark will be restored.

Working with his own translation of the Copper Scroll (one of the Dead Sea Scrolls), Jones has already found some 20 reference points allegedly leading to the Heifer—including a plaster floor, two man-made niches in the wall of a cave, and a burial rock with white sand beneath it. If his interpretation is correct, then the Heifer's ashes will be found in a bronze vessel, with the Ark buried somewhere nearby.

Finding the Heifer and then the Ark, says Jones, will have enormous religious significance. "According to Judaism," he points out, "the Sanhedrin Court (the highest Jewish council) will be reestablished, temple worship will be reinstated, and Jews from all over the world will return to Israel." —Sherry Baker

"Would there be this eternal seeking if the found existed?"

Antonio Porchia

COLLEGE FOR WITCH DOCTORS

Time was, in Zimbabwe, when young healers studied medicinal herbs and roots in the bush, under the guidance of an elder witch-doctor mentor. But now, many budding witch doctors attend Zimbabwe Herbal College, earn their TMP (Traditional Medical Practitioner) degree, and then intern at a healing clinic.

When ready to open a practice, the graduate plunks down $20 and joins the 15,000 member Zimbabwe Traditional Healers Association, the witch doctor's AMA.

Eighty percent of the patients in Zimbabwe turn to witch doctors, claims the president and founder of the healers association, Gordon Chavunduka, TMP. "Many of our members use incantations or speak to the spirits, they wear beads and feathers. But despite such superstitious practice, they still refer patients to M.D.'s for the treatment of certain maladies."

Chavunduka, also chairman of the sociology department at the University of Zimbabwe, makes radio and TV appearances to promote a positive image for witch doctors. The practitioner does not collect a fee, he notes, until a patient recovers.

Herbs and roots, when ground into powder or boiled in tea, reportedly cure backaches, mental illness, cancer, and, for an extra fee of $20, infertility.

Eric Mishara

"I don't believe in God because I don't believe in Mother Goose."

—Clarence Darrow

TRICKERY IN THE NAME OF SCIENCE

When Washington University's McDonnell Laboratory advertised for psychic test subjects in 1979 Steve Shaw eighteen, and Michael Edwards seventeen applied Over the next three years they became laboratory stars astounding director Peter Phillips and other experimenters with apparently stunning examples of psychic skill

Then on January 28 1983, magician James The Amazing Randi revealed that the wunderkinder were actually conjurers who had conspired to fool the researchers They had spent years using simple leverage—not psychic powers—to bend forks and spoons Shaw used a nearly invisible thread to move a quartz clock And when Edwards spat on a camera lens, he convinced researchers that he'd psychically projected bizarre images onto the film

The boys had been told to reveal the truth if asked about their honesty Randi said...but they were simply never questioned Consequently he claimed they bamboozled the researchers so badly that results were published in *Research in Parapsychology* a collection of abstracts

Countering Randi's claims that the scam had exposed claptrap science Washington University quickly declared that the parapsychologists had reached no particular conclusion in their published pieces Spokesmen cited a December 1981 McDonnell Lab statement that the boys performance could have been accomplished *without* psychic skills And they also said the boys *had* been confronted with inquiries about their honesty with no confessions made

Whether or not scientists were fooled, a crucial question remains Can we justify fraud in the name of science? Many psychologists don't think so But Steve Shaw has a different view 'For years Randi told parapsychologists that they were being fooled But they wouldn't listen they had to be shown'

—Marcello Truzzi

REFUGEES IN SPACE

Suppose you were faced with 50 million refugees Where would you put them?

Tackling this problem toward the end of World War II the U S government formed a plan to ship refugees into outer space at least according to the controversial February/March issue of *Mother Jones* magazine The plan says *Mother Jones* was developed as part of "M" Project a classified report on world migration commissioned by President Franklin D Roosevelt in 1942

Last summer Philadelphia librarian Sandy Meredith found a summary of 'M Project in Temple University archives and took it to writer Bob Sanders who collaborated with her on the *Mother Jones* article What struck them as most callous and monstrous they said, was a 'chapter titled Interstellar Migration, in which 'M" Project director Henry Field suggested that temporary quarters' for the homeless might be built "on Venus or Mars

Some investigation, though shows that the *Mother Jones* story went a touch too far Meredith admits for instance that Interstellar Migration was incorrectly called a chapter when it was merely a subsection of a subsection She and Sanders also neglected to mention that in the very first line of Interstellar Migration Field called his discussion just a highly impracticable flight of fancy The reason for the journalists' tactics? 'We wanted the story to be read' says Meredith not moldering on a back shelf in some obscure little left-wing magazine

Even with the facts straight however the thrust of M Project gives one pause Field not only admits that Roosevelt planned some forced migration' he also gives evidence in the summary that as far as he was concerned, extra-terrestrial emigration might have been more than a passing whim Describing an attempt he once made to establish contact with outer space by longwave radio, Field concludes We shall know the answer about life on other planets within forty years"

—Mark Teich

"Something unknown to our understanding is visiting the earth

—Mitrovan Zverev, Soviet scientist

EEEEEEs DROPPING

When Judy Reeves returned from a hard day at the office last fall she found her Belleville Illinois home surrounded by 100 pieces of metal each one five inches long and shaped like a capital *E*

Collecting the letters from her pavement her garage and even her tomato patch she began to fear that the sharp metal prongs could hurt her eight year-old daughter Kim (mother and daughter are shown holding the *Es* in the photograph above) and other neighborhood children To prevent another attack she vowed to trace the *Es* to their source

"At first I thought kids had flung them at my house Reeves says 'But later I found some *Es* embedded an inch deep in my roof—much too deep for child s play I realized they must have fallen from the sky'

Reeves then assumed that the *Es* had been dropped from an airplane as part of a military exercise at nearby Scott Air Force Base But federal aviation inspector Troy Simms soon convinced her that if the letters had fallen from a plane they'd have scattered like leaves, covering the entire neighborhood

She was still baffled when she received a call from Illinois Power Company engineers who had heard of the *Es* in the local news The letters they said seemed identical in size and shape to the tin alloy guts of their electrical transformers After studying the letters however Illinois Power denied all responsibility "It would have taken a spectacular explosion and an incredible power failure to send this metal hurling onto someone s roof, ' says company spokesman James Shipp "But we've had none of that Maybe they fell from a manufacturer s delivery truck But if so, then don t ask how they got into the sky

To Reeves who thinks that Illinois Power may be trying to avoid a lawsuit, the *Es* remain a mystery She lives in dread of the day another metal shower destroys her garden or strikes her on the head ' But she adds, ' my neighbors' jokes are the worst of it I don't go a day without someone saying Heard your house was bugged you know *EEEEEEs* dropping '

Peter Rondinone

"The ghost that got into our house on the night of November 17, 1915, raised such a hullabaloo of misunderstandings that I am sorry I didn't just let it keep on walking, and go to bed "

James Thurbar

'No man will be found in whose mind airy notions do not sometimes tyrannize, and force him to hope or fear beyond the limits of sober probability

—Samuel Johnson

KUDZU JESUS

Hundreds of people traveled to the tiny mining town of Holden West Virginia, last fall to stare at a poplar tree covered with kudzu vines The reason for the pilgrimage? The profile of Jesus Christ, people claimed seemed to shine from the tree s thick foliage

The tangled kudzu vines leaves and branches didn't seem particularly strange in broad daylight But late at night, with streetlights aglow the tree appeared to take on the solemn image of a praying Jesus as portrayed in religious paintings

The 30 foot-tall tree s unusual shape was first discovered last September when a group of men had a few too many drinks in a nearby deserted building explains Brenda Bingess a Holden resident Word quickly spread, and visitors from throughout West Virginia and neighboring states soon created traffic jams as they flocked to see the Kudzu Christ

While some visitors called the tree ' spooky,' others labeled it a miracle" and ' a sign of things to come But no matter what their opinion, says resident Joan Means, they were reverent, like they were in church "

Regardless of its meaning though the Kudzu Jesus of Logan County is now a thing of the past Cold weather killed the vines and the tree itself is doomed A highway will soon be built right over the spot

Sherry Baker

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solute certitude absolute exactness final truth, and so on are figments of the imagination and should not be admissible in any field of science. I agree with him most in his belief that this loosening of thinking was the greatest blessing modern science has given us. You see, to me this coexistence of unconscious and conscious activity—of opacity and transparency—will ultimately lead to a new cultural unity.

Omni: Of what sort?

Prigogine: Well, by rediscovering time and randomness in physics, we encounter many things that are of basic interest in other fields of human endeavor. All this leads to a common perspective. I think there is a common stream running through the development of physics in our century—be it relativity, quantum mechanics, or the second law of thermodynamics. In a variety of ways they all show that there are limits to our power to manipulate matter. In classical physics we thought we could send signals with infinite velocity and measure any physical quantity with arbitrary precision. Today we know both of these feats are impossible. For example, the velocity of signals is limited by the velocity of light. Measurement is limited by quantum mechanics. Our manipulation of matter is limited by the second law of thermodynamics. But these limitations don't mark the end of our knowledge of nature. On the contrary, they are the starting points for some of the most powerful theories humankind has ever constructed.

Omni: In a commemorative lecture you gave several years ago honoring Albert Einstein, you noted that he had become the Darwin of physics. Darwin, you said, taught us that man is embedded in biological evolution, and Einstein taught us that we are embedded in an evolutionary universe. How would you characterize Einstein's contribution?

Prigogine: Einstein became the Darwin of physics against his will. His view was of a static, nonevolving universe. And when people showed that this static universe was unstable and had to be replaced by an evolving universe, Einstein was astonished. I knew some of the founders of the expanding-universe theory very well—among them the Belgian [physicist] Lemaître. Lemaître told me that Einstein was always saying, "Well, this big bang, this evolving universe, sounds too much like Genesis. I'm not so happy about this. I think you take my theory too seriously." But today we have all kinds of confirmation of the existence of this large-scale evolution. However, let's be careful, because we don't know whether this is the evolution of the overall universe or just some galactic neighborhood in which we're living.

Omni: In the lecture on Einstein you noted that his most striking contribution was the idea that we are in an evolving universe and that therefore the laws of physics must have changed. What did you mean?

Prigogine: The fact that there is an evolving universe, which started from very different conditions than now exist, completely changes our idea about the laws of physics. When the universe started, the conditions of matter were so different that present-day laws have no meaning. You can't speak about laws of life when there is no life. You cannot speak about laws of human behavior if there are no human beings around. Therefore, the very idea of law itself becomes an evolutionary concept to a certain extent.

Omni: Do you see any relationship between the way society has evolved in recent years and the way science is now considering new pictures of nature?

Prigogine: That's a very difficult question to answer. There is an internal history of science corresponding to the evolution of theoretical views. There's also an influence of culture on physics as a whole. On the one hand, the discoveries of unstable particles and of the dissipative structures haven't much to do with societal problems. Yet they lead to a rethinking of the concept of a natural law. The whole notion of a law of nature was formulated by Descartes and Newton in the seventeenth century, a time of absolute monarchy. Nature had to follow somewhat as people had to follow the edicts of the kingdom or the emperor. The idea of natural laws certainly has a sociological context. I find our period remarkable precisely because some of the questions in social science and in natural science form a kind of confluence. In the past we've seen two other periods in which such convergences occurred: the Greek classical period and the Renaissance. And during both those periods you had people like Plato and Aristotle, or Descartes and Newton, who were philosopher-scientists.

> *"If you're living in a repressive society it's difficult to be creative in science, because you can't be creative in other ways. In Russia new ideas are relatively exceptional."*

Omni: A number of social thinkers now cite your theory of dissipative structures to explain the transformation they see occurring in American society. What relevance does your theory have to social systems?

Prigogine: What they are saying is that I emphasize self-organization, and therefore spontaneity and amplification. In large societies it becomes increasingly difficult to maintain the spontaneous activity of members of that society. I'm not a social scientist. However, I think what we need in society is amplification, spontaneity, and fluctuation. And that is exactly what is missing in forms of society where one tries to categorize people, to pattern their activities into well-defined channels. Nature gives us a different model. Nature is trying experiments all the time; some of them are amplified, others are not. This spontaneity of nature is a model we must keep in mind.

The common denominator in these very different issues is the desire to avoid the mistake of classical physics, which believed we could control nature. Today we want to act on our creativity to promote fluctuations that we can't control anyway.

Omni: How do your ideas apply to an open system such as climate?

Prigogine: Well, not very long ago everybody was convinced that the history of climate was an external history. The sun was changing, for example; there may have been cosmic dust around and supposedly this would explain how the axis of the earth had changed. And these external events accounted for climatological changes. But today we have quite a different picture. We ask whether climate is really stable. What will happen as a result of small fluctuations? Scientists now believe that climate is generally unstable. Even today we could have various climates evolve. For example, a difficult situation could develop if there were a series of cold winters in succession. The glaciers would come down. Earth would absorb less energy from the sun, and the planet would start to cool down. There would be a multiple effect, which could continue until the earth was completely covered by snow. With the same planet, the same chemicals, and the same flow of energy from the sun, various climates are possible.

Omni: It sounds as if we are living under a permanent threat.

Prigogine: Yes, but we are also living under what may become a promise, because once we have recognized the situation, we can hope to change things. I mean in the long run, not tomorrow. In a sense, we are following a bifurcation, one of several possible structures. There were times, say twenty thousand years ago, when we had humid and warm interludes between two glacial periods. During these times the earth was much more fertile than it is now. So the notion that the present climate completely determines the future is an oversimplified one. It is being replaced by a picture of multiple futures that hinge upon fluctuations. That is, of course, a very threatening idea. But it's also an idea that brings hope if there are no catastrophes that destroy us.

Omni: What role does society play in fostering creativity?

Prigogine: It's very difficult to be creative in science and not be creative in more

general terms. When you are living in an oppressive or repressive society it's difficult to be creative in science. This is one of the reasons why, in spite of the great attention and money Soviet Russia is lavishing on science, creativity and new ideas there are relatively exceptional.

Omni: You speak of the Soviet Union's scientific environment. What about the scientific contributions of other countries or continents, Asia, for example?

Prigogine: It seems to me the recent evolution of science takes us away from the cultural context of the West, where modern science was founded. The idea of a self-organizing universe is close to the Chinese scientific tradition. The idea of a universe we see in us—with its important temporal component—converging with a universe outside us, is reminiscent of many traditions of Indian thought. I don't want to imply that modern science will justify Oriental wisdom, however, or vice versa, for that matter. But I do believe that the growth of science now makes it a planetary endeavor. An ever-increasing contribution will flourish from outside the Western world.

Omni: What kind of scientific progress do you see over the next twenty years?

Prigogine: The purpose of classical physics was to find some fundamental level of simplicity in terms of which our universe could be deciphered. I doubt if this level exists. Instead we will have to deal with the complexity we have discovered. But this very complexity will lead to new disciplines, which will help us to transfer our knowledge from one domain to another. Perhaps the challenge of these coming years will be to master complexity.

Omni: What are the religious implications of your research?

Prigogine: I think that instead of the duality that Needham described—between seeing the universe as an automaton or, on the other hand, as the picture of a guiding God who acts through us and has created both a dead universe and the human soul—is mistaken. I see us as nearer to a Taoist view, in which we are embedded in a universe that is not foreign to us.

Omni: Your views sound similar to those of Teilhard de Chardin.

Prigogine: Not really. Chardin described the world as if he were outside of it. He was sure that every change, every new bifurcation, was going in the right direction—in the direction of increased spirituality. On the contrary, I am more impressed by the existence of multiple time horizons. A bifurcation can lead us to the best or to the worst. We are participating in an evolution whose outcome isn't clear to us. So I leave open the question of the meaning of being. I'm not even certain whether, put in these terms, a scientific answer is possible. Probably it has more to do with feelings or emotions. In any event, I believe it is more hopeful, more exhilarating, to be embedded in a living world than to be alone living in a dead universe. And this is really what I try to express in my work. DO

TECHNO-KIDS

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slang phrase "Go with the flow," he stopped dead. "That's not a remark," he bellowed. "That's a direct mandate." He wanted no part of it. Yet he did not reject young people, not even the hippies, whose loose morals he deplored.

"They should not be condemned as just crazy kids," he explained. "They were actually the first primitives, electronic tribes, and they were having a rather hard time of it. I think all the marijuana they consumed was necessary to relieve the pressure. They instinctively recognized that the values of the establishment had no relevance for their lives. What they didn't understand were the changes in the environment causing them to drop out of the traditional society and adopt a tribal life-style."

In the media figures of the time, he identified the survival traits valued in the electronic tribes. "Who would you say is the goddess of the cult," he asked, "the most intriguing and popular figure on television?" In the early 1970s it was Cher.

McLuhan, who was still watching Marx Brothers movies on the tube, had never heard of her. Yet he captured her electronic persona perfectly in a few questions: "Is she tribal?" he asked. Cher was part Indian, a heritage she celebrated with long, straight black hair.

"Is she known for her cool or deadpan? Does she seem to wear a mask and a lot of costumes?" Her expressionless face and gaudy clothes were Cher's trademarks. McLuhan had guessed it.

A few days after Christmas in 1975, on a blustery Toronto noon, McLuhan decided to prepare lunch in his spacious country kitchen. He dumped a can of tomato soup into a pan of asparagus soup. "This is going to be awfully good," he predicted. While scraping the bottom of the bowl, he got back to the topic. "Man's thinking," he said, "will be transformed by the rate at which electronic technology transmits information. Speed is the root of our problems today.

"The drugs people are taking," he said of widespread cocaine use, "are a temporary measure to speed up natural responses. Once people have interiorized electronic communication, they will no longer need the drugs. They will naturally be on the electronic wavelength."

"I guess what concerns me the most about the quality of life in the Electronic Age," he summarized, "is the total loss of any human depth. Man simply will not have time for it. In the future a friend will be somebody with whom you had an enjoyable conversation on a plane."

In a world where survival requires instantaneous responses, McLuhan added, today's children must think only to help them act. There is no time to sit back and reflect, or weigh options. "The kind of guy who succeeds in this situation," he said, "is the perfect bureaucrat whose entire personality is subjugated to his role, like a great actor.

"If you want to see the image of the man of the future," McLuhan said five years before the elections of 1980, "look to a guy like Ronald Reagan."

Yet paradoxically, in McLuhan's vision, future man will frequently fail to act physically. Almost 20 years ago, McLuhan railed against the physical dangers of passive television-watching. Today home computers and arcade games are competing with stickball and street basketball—and high-speed circuitry often comes out the winner. The results are already appearing in the children of Silicon Valley.

"Everything is slowing down," says Dr. Harold Sandler, chief of NASA's Ames Biomedical Research Division, in Mountain View, California. "Electronic technology seems to be causing the next generation to grow up more and more passive physically. Recently some doctors have been pleading with mothers to become more aware of how inactive their children are and get them away for a while from watching television, playing video games, or programming. The human being still needs physical exercise, but in the electronic world it doesn't seem to come naturally."

Stanford's Rogers confirms the trend. There is, he reports, "a growing feeling in schools around here that physical ability isn't very important. Instead, being smart is becoming more respected, not smart in a bookish sense or based on a quotably high I.Q., but winning a science fair or scoring high in a video game."

McLuhan foresaw it years ago when he predicted, "What is going to count is creativity and brains. The mind is finally going to conquer the body." Such changes do not frighten the new breed. "Why should I be scared?" asks Jordan High School's David Pier. "I'm in on it."

McLuhan's insights won him little public acclaim or academic reputation. "If I were Alvin Toffler, I'd be really famous," he once lamented. "But people don't understand me." Openly McLuhan shunned the admiration of crowds; secretly he regretted that none of his books ever reached *The New York Times* best-seller list.

Shortly before his death McLuhan's reputation was at its lowest ebb. In 1980 the University of Toronto announced plans to shut down his Centre for Culture and Technology, founded in 1963. Recently, however, interest in his ideas has flowered again. The university now plans to reopen the center and is bidding against other institutions for McLuhan's eclectic library. Last November the first conference on McLuhanism, in Venice, drew scholars from around the world.

As McLuhan himself would have predicted, though, it is too soon to declare that his intellectual legacy is secure. Ask one of the new breed whether she has ever heard of Marshall McLuhan. "Sure," Gwendaline Mazzara replies. "Isn't he a programmer for Apple?" ∞

MIND

CONTINUED FROM PAGE 22

the patient, allowing him to wash his hands in the morning, and then removing the faucet knobs from the sink.

A brief look at the history of cleanliness provides a perspective on our current mania. The ancient Greeks used baths more for health reasons than for the removal of dirt, and in Rome bathing was a social duty to be performed in the company of others. But by the Middle Ages people who had not bathed in years might hold conversations through handkerchiefs soaked in perfumes or aromatic herbs. Bathing as a matter of private cleanliness did not become fashionable until the mid-1800s.

Bathing is the cornerstone of the American notion of cleanliness, but its psychology is no simple matter. Dr. Ernest Dichter, founder of the Institute of Motivational Research, in New York, discovered that in the late Seventies when the Armour-Dial Company asked him to analyze the bathing behavior of the American people.

His study showed that people who depend on the shower to wake them in the morning were almost addicted; without it, they reported, their whole day went wrong. For others it seemed that "the bathing ritual helped generate the hope that this day will be better than the last." Still others savored the sensuous self-discovery involved in bathing. "The lathering of one's body—getting all of it covered and then washing it all off—comes close to narcissism," Dr. Dichter noted.

Many bathers, it seems, took literally the Protestant dictum that cleanliness is next to godliness. Most adults in the study associated bathing with such rituals as baptism and absolution, among other soul-cleansing rites. Some even saw in bathing a hint of immortality—perhaps because cleanliness suggests smooth skin, an antidote to the wrinkles of old age.

There are a few drawbacks to our mania for cleanliness. Worrisome to clean nature lovers is that the perfume in most soaps, after-shave lotions, and deodorants attracts mosquitoes, gnats, and black flies. But while attracting insects, fastidiousness can repel spouses, say some psychologists. Unless mates hold compatible standards of cleanliness, a marriage probably will not be happy or long lasting.

Perhaps the most disturbing side effect of cleanliness is that it masks our body odors, in effect throwing a blanket over our pheromones, the body's natural aphrodisiacs. King Louis XIV apparently had an instinctive awareness of this, since it is known that he would never let a woman into his bed if she had taken a bath within the previous month.

In the end, our desire to clear the air, clean the sky, wash the wind, and take stone from stone and wash them, to paraphrase T. S. Eliot, will never ward off a simple truth: Cleanliness is next to impossible. ∞

MOUNTAIN

CONTINUED FROM PAGE 76

most efficient one for his ethanol scheme to get off the ground.

He got the chance in 1970 while doing research at Virginia Tech. Screening thousands of organisms, he finally discovered the extraordinary digestive power of a fungus called *Trichoderma reesei*—the bug, he says, that caused the jungle rot you've heard about during our various Asian wars.

Analyzing the organism, Emert and coworkers found three crucial enzymes. During the next few years, they determined the environmental conditions under which those enzymes worked best: at 104°F with both the yeast and enzymes added to the fermentor at once. When isolated from the fungi and put to work at those conditions, the three enzymes could break down paper, wood chips, and straw in one day instead of the customary three.

By 1975 Emert understood the process so well that the Gulf Oil Company decided to build him a pilot test plant in Pittsburg, Kansas. It operated for three and a half years, indicating that the process could produce more alcohol at less cost than any competitive process. Emert's sponsors were convinced—Simultaneous Saccharification Fermentation, or SSF, as Emert's technique was called, would actually yield an impressive profit.

Then, in 1979, Emert left Gulf to start preparing for a larger test plant. He would do much of the initial work 110 miles due south at the University of Arkansas in Fayetteville. The reason for the move? The Arkansas area Emert explains is "packed with paper companies, trash-handling companies, agricultural co-ops, grain producers—a host of industries that could provide biomass for our plant, then use the resulting ethanol themselves."

The George Emert of today has come a long way from Papaw's moonshine still. As a conversation piece, he keeps in his office a half pint of dynamite trash whiskey, distilled from the fruits of a suburban Baltimore dump. He speaks with no trace of a Tennessee accent, although a certain softness in his voice hints at something Southern. He is a political conservative of the William Buckley type, wears expensive three-piece suits, and jets around the world seeking funds from corporate friends in Britain, South Africa, and Japan.

Specifically, Emert is now seeking $40 million in largely private funds—federal stuff wouldn't be turned down, as conservative as Emert is—to build a demonstration plant capable of producing 1.2 million gallons of ethanol a year. (After that, he hopes to build a commercial plant that can pump out 50 million gallons a year.) The new Arkansas moonshine professor Emert tells his benefactors does not create social problems, it solves them. It can be made from most kinds of trash, which otherwise would go to waste (pun intended). It can be mixed with ordinary gasoline, creating a new type of fuel that gets just as much mileage at comparable cost. And it can replace petroleum as the raw material for all kinds of plastics and chemicals.

If that's not pragmatic enough, Emert asserts, residue from the process can be used to feed cattle!

Once agriculture and energy are restored, folks in postdoomsday Fayetteville might have a hankering to communicate with the world. But if you think they'll return to the primitive days of the black dial phone, think again. They'll have in their midst one Gregory Salamo, Fayetteville's keeper of Sicilian-Neapolitan genes—and a laser expert who's helping to revolutionize fiberoptic communications.

Salamo, who comes from Brooklyn, New York, loves everything about Fayetteville but the limited choice in Italian food. He started the physics department's laser program in 1975, following postdoctoral work at one of the nation's premier laser centers, the University of Rochester. Consonant with the U. of A.'s desire to capitalize on strength, laser experiments and theory now occupy two thirds of the 15-professor physics faculty.

"No one expected it," this frictionless and relaxed people-lover with none of the surface Brooklyn toughness said of his widely noted paper in *Physical Review Letters*. "But recently a lot of people have called it rather cute."

Salamo's cutie might help revolutionize fiberoptics—the communication technology that transforms information into pulses of light traveling not over wires but through hair-thin fibers of ultratransparent glass.

Because light pulses can be made shorter than electrical pulses, Salamo explains, it's possible to pack more of them into a given space. Thus optical fibers, by their very nature, should carry more information than electrical wire. If a single fiber was working at optimum efficiency, it would carry many messages (each made of millions of light pulses) at once. The result: superfast computers, compact telephone lines, and even TVs with a vast array of new channels.

But those optimizing the technology have long had one problem. Fibers had to come equipped with switches capable of separating the tightly packed light pulses, sending them off in different directions depending upon the message to which they belonged. Engineers could build switches to separate widely dispersed signals, but when it came to separating the more frequent pulses, scientists were stuck.

That's when laser-pro Salamo entered the scene. The rapidly operating switch he envisioned was nothing more than a simple semiconductor. Whenever electrons in the semiconductor were excited, he theorized, they would reflect a pulse of light. When they ceased to be excited, they would

let light pass through By knowing just when a light pulse was supposed to arrive engineers could make sure that the semiconductor electrons either were or weren't excited In that way the switch could direct each pulse toward the appropriate channel and keep all the messages intact

Salamo's proposal raised enormous excitement in the optic community but it wasn't until this past winter that he and his team faced the crucial test finding out whether electrons could in fact, be excited at the rapid rates required In order to test the concept, Salamo's team examined a cell of sodium Using a laboratory laser they found they could excite the sodium (and its electrons) fast enough to separate pulses traveling down a fiber at the rate of a billion a second Salamo's next step is to build a switch from a semiconductor It should separate pulses zooming down fibers at the rate of a trillion a second

Salamo's switch should be ready for use in about a decade And when it is, the man from Brooklyn predicts it might well render electrical wire obsolete in communication fields across the board

Salamo admits there is some professional risk to practicing international physics in a remote place like Fayetteville But the quality of life is perhaps more important—he is sick to death of the Brooklyns of the world And surprisingly enough he finds the Fayetteville schools which his two children attend to be "supergood" (A university administrator speculated that the educational quality is high because many teachers are professors' wives)

Regardless of what offal and effluvia hit the future fan, folks in the remote Victorian water-forest jewel of Fayetteville will get by If you can't believe this you can't believe anything

One evening, sitting around in George Emert's comfortable passive-solar house (oriented exactly 33° to the southwest so that the winter sun falls directly on a heat-absorbing black wall and the intense summer sun is shaded out by large overhanging eaves) I heard the master moonshiner discuss his life and art

As he spoke I looked at his thick straight hair standing up for about half an inch, then falling back without a part and I thought of what a great crew cut it would make I saw the unlined boyish face the control the discipline the air of the black belt I saw Commander Cool and thought of "Happy Valley" back in 'Nam

"There is one thing you must remember about killing someone," Emert said softly "There are *two* victims"

Emert's house in Fayetteville is on nine tillable acres with an Emert-dammed well-stocked fish pond and trees bearing various high-protein nuts Emert has plans for wind- and water-paddle energy schemes, among a host of other survival contingency measures

"I learned very early on to survive, because of the environment [those rough Tennessee Smokies] in which I was raised" Emert reflected "I got into fights every day, and most often I was whipped because I was smallest This taught me a basic survival lesson Stay out of fights if at all possible But I know how to take care of myself I don't have to work at it because it's the way I grew up"

Emert is most concerned about the high rate of suicide and drug abuse among returned Vietnam veterans More have died of these causes than died during the course of the war he claims

"But look at one time there were more than six hundred thousand of us in Vietnam and you never read that most of those people are back and doing just fine," said Emert, doing just fine

Knowing of my own concern about surviving a dim future Emert offered to lend me three of his treasured survival manuals—very rare items indeed I hesitated then accepted and inquired whether he wanted me to sign a receipt

"No that's all right," Emert replied with a quiet smile warning "If you try to disappear with them, I'll find you" I smiled back, of course and left for Roger's, which is where I want to go when I die after George Emert catches me ∞

FICTION

VENGEANCE IS YOURS

Ex-lovers sometimes turn up in the strangest places

BY PAT CADIGAN

I told the bartender I'd give him a fat tip if he'd make me something that looked deadly and smelled more so. On the spot he invented the Silver Bombe—tonic water with a pearl onion, a pimento speared on a giant, curved upholstery needle, and a spoonful of those little silver balls you sprinkle on cupcakes. The finishing touch was the leftover Christmas tinsel tied around the stem of the glass. You didn't look at it, you beheld it. Behold, the Silver Bombe. It smelled like a bender. I pushed the glass back toward the bartender. "I said, no booze."

"That's just a little grain alcohol I wiped around the outside of the

PAINTING BY STEPHAN BECK

glass here, miz," the bartender said, pushing the Bombe back at me. "You said you wanted aroma."

I can smell it inside the glass, too."

"Just a kiss. For aroma. I swear to God a baby wouldn't feel it."

God being unavailable for comment, I decided to believe the bartender. He was a skinny blond kid who didn't look as though he'd learned how to lie yet. I had a sip of the Bombe while he bright-eyed me. As a drink it was a real bomb, but I wasn't about to complain. It was just a prop, after all.

"Good work."

He glowed. "I swear I'm a genius, miz, I really am. Every part of that drink means something, you know? See, there's the drink itself, and the onion represents the bomb, the pimiento's the fuse—lit, as it were—the needle means you'll really feel it, and the silver balls stand for little explosions."

The metaphysics of drinking—I hadn't known there were any. Maybe they were teaching that at bartending school now, along with mixology. Ever since the turn of the century, people seem a little crazier to me. "What about this?" I flipped a strand of tinsel with my index finger. "And what does this mean?"

"That's Happy New Year."

I didn't comment on the fact that it had been Happy New Year for something over three weeks now. He reached for the bill. I was sliding to him across the bar, but I didn't take my hand from it. His smile vanished. "I just got married. I'm not going home with you or anyone else."

I grinned. This was the glorious liberated future humanity had been striving for, where everyone's a sex object or in training to be one. "All I want is for you to keep our little arrangement confidential. Even from the other bartender. If anyone asks you, this is a vodka drink."

"How about gin?" he suggested, brightening perceptibly.

"Whatever. I couldn't stand gin, myself, but the drink was his invention, not mine. I took my hand off the bill and he made it disappear into his perky red paper vest.

"Thanks, miz. Flag me when you're ready for another." He began puttering around, arranging glasses and checking drink programs on the console under the espresso machine. Down at the other end of the long bar, the other bartender had most of the action, which at the bare beginning of Attitude Adjustment Hour wasn't much. But things were going to pick up soon and Jeremy Currin would be in for his regular Wednesday night hit in about fifteen minutes if he was lucky enough to make all the lights coming down VanBendt. He usually was. He was that kind of man.

I leaned against the barstool backrest (mandatory for all bars in the city since the infamous if comic Hund vertebrae lawsuit of 1988) and looked around. It was easy to see why Currin liked this place. It was a dark-wood-and-bress lounge with an abundance of antique accents, including a mirror behind the bar—just the sort of place where a data analyst with lumberjack fantasies could sip whiskey and pretend he had calluses. Whether the hell—if a button-pusher thousands of miles from a sequoia wanted to effect the look of the Great Northwest of yesteryear, nobody really cared much. It wasn't my night to be critical anyway.

I was just supposed to pick him up, which wasn't going to be very difficult.

I'd been hanging in with the man for close to three months, firsthand and by proxy. He had regular habits with a spontaneity factor of under ten percent—set in his ways but open to suggestion if the timing was right. Single, never married and never would be. Definitely not my type, which was why I was drinking an unloaded Bombe. I'd have to be sober to take him, and I never could hold my booze.

But after Currin smelled the Bombe he'd probably think I was the baddest drinking woman in the place.

Way back in the corner two big guys were dwarfing a silly little table piled with hors d'oeuvres and watching me while they stuffed up on shrimp. I swiveled around and gave them a deadly glare, which put an end to that. When I'm on a job, I don't need people screwing me around by staking me out or just looking like they are.

A chill gust sent my cocktail napkin flapping away as a group of young up-and-comers came in. Currin wasn't among them. In another three minutes, he'd be officially late. I wouldn't have to get edgy for a quarter of an hour. If he didn't show by then it would mean he'd decided to break his pattern for some reason. *Stay in your rut, Currin,* I begged silently. *Don't make me have to set this up again.*

The people at the other end of the bar began to spread out as the music came up a little louder. A couple of them gave me a glance, but I knew they didn't recognize me. I'd kept a low profile before, never coming in alone or sitting at the bar. I turned sideways, indicating I was not annexable. None of them were Currin's friends.

My bartender was coming back to me when the front door opened again and I saw a familiar blond head gleaming in the overhead light of the crowded vestibule.

"One second." I said to the bartender and craned my neck to see where Currin would go. The bartender followed my gaze, standing on tiptoe to see who I was looking at. Currin began walking toward my end of the bar and I turned away quickly.

"*Oh,*" said the bartender.

"Oh, yourself. Freshen this. If you can find a bigger needle, put it in."

Currin passed behind me with another man and three women in tow. The five of them clustered against the wall around the curve of the bar so Currin could watch the talent easily. From the corner of my eye I tried to see him just as Karen Kitterman had seen him.

He was one of those variegated blonds—pale hair overlaying darker hair—and his beard had come in fuzzy and brown. His shoulders stretched the plaid flannel of his shirt as he hung his fleece-lined jacket on the back of his stool. One of the women said something to him and he burst into hearty laughter. He had a surprisingly good laugh. His eyes were very blue and his teeth, splitting the beard into a wide smile, were perfect.

A new Silver Bombe with a needle large enough to qualify as a spear appeared in front of me. I looked up to tell my bartender to run me a tab, but he was already over at Currin's party taking orders.

I stirred my Bombe with the needle and thought about Karen.

It was like a story from thirty or forty years ago. Woman meets man, woman loves man, woman loses man, woman loses mind, woman cuts throat. You'd have thought women would have stopped agonizing over men, but people never really change. Revenge, for example, is still sweet; something Karen had realized before she'd selected a serrated carving knife for herself. In spite of her rather fatal foible she'd been an extraordinary person in a lot of ways, and tonight Currin was going to find out just how extraordinary.

A man squeezed behind me, shouting "Jeremy!" over the music, which got louder every time more people came in. I leaned toward the bar, catching Currin's eye as he looked up to greet the newcomer. His gaze snagged on me briefly and when he sat down again, he was facing me directly.

I was contemplating my next move when someone slid onto the stool next to me. I was immediately sorry I hadn't brought another woman or two. Well, I couldn't think of everything. To my relief, the man beside me seemed more interested in one of the women competing for Currin, probably any one that Currin didn't want. My hope that he'd ignore me completely was dashed when he tapped me on the arm.

"What kind of drink is that?" he bellowed over the music.

"Silver Bombe!" I bellowed back, trying to look bored, which is hard to do when you have to shout. "If you want one, he's your man!" I pointed at my bartender, who was busily sorting out drinks for Currin's entourage and having a hard time of it.

Currin smiled at me as he picked up his two fingers of Jack Daniels. With a very subtle motion he toasted me and I nodded once in acknowledgment.

It wasn't lost on the man beside me even while my bartender was explaining the loaded version of the Silver Bombe to him.

which he decided didn't appeal to him.

"If you're here to get lucky," he shouted, "you just hit the motherlode—or at least the mother. A regular bar star, that one. Can have anyone he wants!"

"No offense, but who asked you?" I swiveled around and faced Currin again. People were accumulating around him like old magazines. The alcohol and atmosphere were really working on him now. He wasn't the cheap drunk I was, but it didn't take him long to adjust *his* attitude. His face was glowing and snatches of his conversation came to me as his voice and spirits rose together.

He caught my eye again while someone was shouting something into his right ear; we exchanged grins. I began feeling slightly trashy.

I managed to grab my barfender as he was on his way back from delivering a round to the gigglers on my left. "The whiskey-sipping gentleman is ready for another. Put it on my tab and tell him about it." I figured it was safe to do that by now.

"*He* already told me to bring you another when you're ready!"

"Okay." I chugged the tonic water almost choking on some of the silver balls. "I'm ready!" He sighed, took my glass, held up a hand to someone who was shouting at him, and backed into the other bartender. Currin grinned at me, shaking his head. I laughed at nothing.

"You've made a conquest," the man beside me said, his lips brushing my ear.

I drew away slowly. "Back off, will you?"

He stared at me for a moment and then turned away to move into the crowd. I made sure Currin was watching as I took my purse and put it on the now-empty stool. Understanding crossed his face, then my bartender arrived with the drink I'd bought him. The timing couldn't have been better. I dropped my gaze innocently, fishing a large bill out of my sleeve for the bartender, I wanted to make up for the way I'd been tying him up with dummy Silver Bombes during the rush. Slipping it under the base of my glass, I looked up to smile at Currin again. He was gone.

"This yours?"

I turned around. Currin was holding my purse out to me as he sat down. He had his coat with him.

"Thanks." I put the purse back on the bar without looking at it.

"No, thank *you*. It isn't often a lady buys me a drink." A third Silver Bombe appeared and the old one was swept away, money and all, without comment. "That's on me."

"I appreciate it."

"Mind telling me what it is?"

Silver Bombe. I quickly gulped down half of it to discourage him from asking for a taste.

"Silver Bombe." He shook his head. "I never did go in for mixed drinks. I like my whiskey unadorned. What's your name?"

"Lissa." I lied. Lissa sounded like someone who'd hang out in a bar to make friends.

"I'm Jeremy." He laughed a little. "I know, I don't look much like a Jeremy but I'm stuck with it. You, on the other hand, look exactly like your name."

Thanks. I do?

"Sure. Lissa. That's your whole name, right? Not short for Melissa or anything?"

Why not? I nodded.

"I knew it. I'm not an expert in names—I'm in data, actually—but some people you can just tell certain things about." He looked around. "Be nice if we could continue this discussion at one of the tables, but they all seem to be taken."

I stood up abruptly and pretended to survey the room. "In the corner," I pointed with my drink. "Those two look like they're ready to leave."

"Where?"

"Follow me." I grabbed my purse and his sleeve in one movement and headed for the table I'd pointed at. The two guys sitting there finished their beer and rose just as we reached them. I grinned up at Currin while they vacated and then let him seat me.

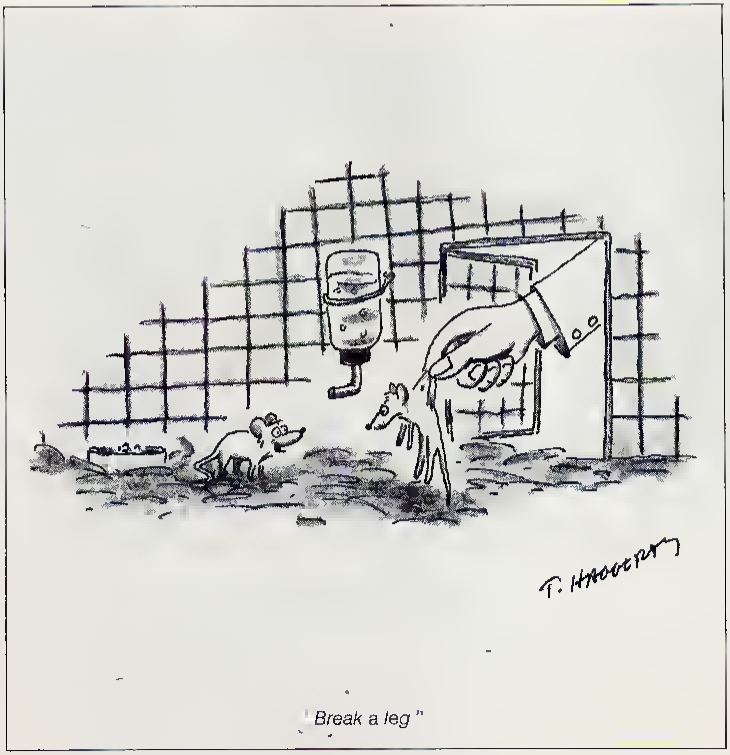
He wasn't really a bad sort. A little shallow, maybe, but nobody goes to bars to find philosophers—philosophers buy their booze in bottles and drink it at home. Currin was glib enough, and under other circumstances I might have found it easy to believe he was sincere. That had been Karen's mistake. I smiled as he made a joke I couldn't quite hear and he waved at the overworked waitress for this section. The former occupants of our table were explaining something to her as they stood near my old spot at the bar.

By the time she got to us, Currin's arm had fallen off the back of the chair onto me. He was friendly when he was high, but he was even friendlier drunk. He remained coherent, but I could tell that everything was looking better to him with each swallow, especially me. His smile got broader, he laughed louder, and he seemed to be unaware of how drunk he was getting, which suited me just fine. If he didn't know how drunk he was, then he wouldn't know how drunk I wasn't.

About the time he hit what I had gauged was his saturation point, he suggested we get something to eat. I had to boost him up out of his chair without seeming to, and we did a little tango while I helped him on with his coat. He was happy to let me lead him between the tables, one hand on my shoulder to steady himself.

People were calling to him, but I kept moving so he had to stay with me or fall down. We had to wait at the front door to let in a crowd that had had its attitude adjusted elsewhere and was coming in to try its new outlook on the positive drinkers in here. I slipped us out before Currin had a chance to recognize any of them.

"Whoa!" He staggered a bit as the cold air hit him. "Talk about an eye opener!" He looked down at me and yanked me close.



"Break a leg."

enfolding me in his open coat "You must be freezing"

We stood there snuggling for a few moments and I began to feel a little regret for what was about to happen Currin wasn't totally incapable of being a nice guy in his own simple way Might as well get this over with, I thought, and pulled loose

"I'd better drive," I said and herded him down the sidewalk "My car's right here at the corner"

"Yours?" He stood back to admire the low, fast lines of the ElectraCharger His own car, I remembered, drank a lot of house current I unlocked the passenger-side door and raised it for him He sort of poured into the front seat "Always wanted an ElectraCharger," he muttered enviously I tucked his legs in and then ran around to the driver's side In spite of the thermal skins under my clothes, the chill was biting into me

"Hey," Currin said, putting a hand on my arm as I inserted the wire into the ignition I turned toward him and got a faceful of fuzzy brown beard I managed to get one arm free and reached into my purse without disturbing him "I can't remember when I've had more fun getting acquainted with someone," he said after a while

"Me, too" I got my right arm up around his shoulders and played with his hair "And you know what?" I asked, drawing my head back a little

"What?"

There wasn't even time for him to be surprised He was still trying to raise his eyebrows when he pitched forward on top of me, pinning me against the door

I tried shoving him back with my left hand while I held the right clear I didn't want to give him another jolt with the joybuzzer and I didn't want to zap myself, either My fingers were tingling painfully No matter how they try to insulate those things, you always get a little punch yourself I twisted around to no effect at all, struggling with him, cursing the tight quarters of the ElectraCharger's front seat Then, through the windshield, I saw two large shapes coming down the street toward the car—the two big guys whose table we'd taken the same ones who had been staring at me earlier One of them came around to my side of the car and raised the door I fell backward and hung there with my hair dragging the pavement The guy stood over me and tried hard not to laugh

"About time," I said as he helped me sit up "Get him off me, will you? Watch it I've still got the buzzer in my palm"

Currin slept peacefully as we loaded him into the van and he was still sleeping when Coll and Phinny unloaded him in the cemetery We had his hands and feet cuffed by then, not tight enough to hurt him, but too tight to let him move around much when he woke up

They wanted to put him right on top of the grave, but I wasn't too sure about that Eventually we compromised—half on, half off He had to be positioned just right

"You coming back to the van?" Phinny asked as he finished arranging Currin

I shook my head "I'm going to watch right here"

"You'll have to move back some Otherwise the camera'll pick you up"

"Fine I'll call you"

Phinny and Coll headed back to the van, which was parked up the hill on one of the cemetery's narrow roads I waited until I heard the door slam and then got the adrenaline patch out of my purse

Currin was snoring when I opened his shirt and jammed the patch onto his chest For a moment nothing happened Then his eyelids fluttered and he made a small noise I put my hand over his heart It was just starting to race Good I'd put exactly the right amount of adrenaline in the patch He was going to wake up jitterbugging

"Jeremy?" His eyes opened and I moved away before he could focus on me There was more than enough light to see by from the streetlamps above us, and I watched him discover that he couldn't get his hands out from behind his back or pull his feet apart He tried to sit up and flopped over onto his stomach with a moan of pain Now he was finding out about his head—I understand being joybuzzed is a lot like being kicked by a mule with steel hooves He looked up, blinking, and then saw the gravestone It took him over a minute to read the carving on it I was too far away to read it myself, but I knew what it said

KAREN KITTERMAN

He went *ah-ah-ah* and tried to squirm away, but the adrenaline was jerking him in ten directions at once so all he did was twitch around Then a clod of dirt hit him in the face and he stopped trembling

The soil on the grave was moving, and as Currin watched, a hand broke the surface fingers flexing and clutching at nothing I heard him suck wind with a whooping sound Then there were two hands, small, feminine, and pasty white A dank, rotten smell was in the air, making him choke on the breath he'd just taken

The hands reached up, pulling free of the grave, and the arms that appeared were mottled, as though the flesh had fallen away in spots The fingers groped, just missing Currin by inches He howled and tried to stand up again, forgetting about the cuffs and rolled himself into the gravestone instead His whole body was shaking as he watched the thing wrench itself from the ground, dirt flying and the smell getting even stronger It wasn't very big—it had only managed to free its upper body Most of its hair was gone, and its sunken face was silvery in spots Lying on his side, looking up at it, Currin lost his voice altogether The rotted arms opened to embrace him

"Jeremy," said a high, female voice "I've missed you so"

I hugged myself against the chill

"It's me, Karen," said the thing, bending forward One hand found his coat and dragged him, kicking and squirming, to itself "You haven't forgotten me, have you? I haven't forgotten you" The voice was sticky with yearning "So glad to see you" Currin managed one more scream before the thing bent its head to kiss him and bashed him squarely in the face "So glad to see you" The thing's left arm jerked back and forth, the hand opening and closing in spasms There was blood on Currin's face "So glad to see you So glad to see you" the thing repeated, its head slamming into his each time

"Oh, *shit*" I ran forward, intending to pull Currin away from it when it suddenly collapsed on top of him with a ragged little moan Currin was out again, blood pouring from his broken nose I dragged him onto the grass, turning him on his side so the blood wouldn't go down his windpipe Coll and Phinny were running down to the grave from the van

"What the hell happened?" I demanded "It was supposed to kiss him with its rotting, grave-fresh lips, press him to its deathly cold bosom And that's a direct quote"

Coll and Phinny pulled the mecho gently out of the dirt and examined it by flashlight

"Dirt in the mechanism," Coll said "It's all in the circuits and everything"

"Oh, that's wonderful!" I leaned on the gravestone "I had to bribe the general manager at Sartaine's Department Store so I could borrow it from their display It's supposed to be back tomorrow afternoon and if there's anything wrong with it, I'm out five grand"

Coll looked up at me "That much?"

"It's an antishoplifting device besides being a mobile display unit"

"Better not tell them you buried it, then" Coll chuckled "There's no permanent damage done A little forced air'll take care of the dirt and she'll be good as new" He picked it up, slung it over his shoulder, and went back to the van with it Phinny and I began replacing the dirt on the grave, stamping it down with our feet until it looked normal again

"This is gonna give me nightmares," Phinny complained

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"It was easy to see why Currin liked this place It was just the kind of lounge where a data analyst with lumberjack fantasies could sip whiskey and pretend he had calluses"

LIFTOFF

CONTINUED FROM PAGE 112

As space stations and their crews get larger, group dynamics will become increasingly important. Experience aboard submarines and on Antarctic expeditions shows that the danger of acrimony and hostile behavior rises dramatically when a group has more than three members and a mission lasts longer than two weeks. Warns *Skylab* commander Gerald Carr: "I expect the sociological problems (of living in space) will prove more difficult to solve than the technological ones."

Space doctors, caught up in the enthusiasm of an emerging science, love to speculate. They hope that eventually space biology, psychology and sociology will produce yet another spinoff: space civilization. But they warn that if bioastronautics continues to develop as it has for the last 20 years, life in space won't be what we've come to expect.

Current American movies paint a multiracial democracy in orbit, blasting away at problems with laser beams. Soviet science fiction depicts a cosmic Communism: the stars populated by *Homo sovieticus* (the new Soviet man), with the golden rule: "From each according to his abilities to each according to his needs" inscribed in his very genes. "What we've done," observes Mohler, "has been to impose our own social conditioning on a space environment. It's more likely that the environment will impose on us the need for undreamed-of space institutions, alien value systems, even biological change."

Ask yourself: Will the children of multigenerational missions ever want to readapt to something as debilitating as gravity? Would they wish to visit the surface of a planet any more than we wish to spend our vacations naked and unprotected on the African veldt? In all likelihood, citizens of space will embrace microgravity and allow the adaptive reflex to take the body through an incredible, possibly irreversible, metamorphosis.

Faces will become rounder, necks and spines elongated. Symbiotic bacteria might be engineered to produce adaptogens—new hormones to counter the negative effects of adaptation. Legs might be dispensed with. "We've seen that legs are nearly useless [in space]," Dr. Robert Heaney of Creighton University in Nebraska told a NASA Life Science Symposium after the *Skylab* missions. "Leg tissue requires food, oxygen, and time for exercise. The ultimate cost of legs on long missions must be staggering." Dr. Heaney seriously proposes that amputees would make cost-effective space colonists and should be considered for future missions.

"We'll get a different race in space eventually," says Mohler. "The transition from life on Earth to life in space will be remembered as an enormous step in the evolution of our species."

All of this is blue sky, of course. A thought-provoking sort of blue sky, but too much of it obscures what is really happening in bioastronautics.

In his laboratory in San Antonio, Dr. Jefferson Davis, president of the International Aerospace Medical Association, predicts a more certain future. "Let's talk about the contributions of the space program. The press has given a lot of play to medical telemetry and instrumentation [biology monitored by hardware]. But the most important development on the horizon is very simply, a thorough understanding of cardiovascular dynamics. Twenty years from now this knowledge will have a bigger payoff than cardiac monitoring."

To Dr. Davis's cardiovascular dynamics, Oleg Gazenko might add the effects of radiation. Stan Mohler would include the aging process. Each pioneer in the field points to promising studies in his or her specialty. But the point is, bioastronautics has necessitated unprecedented investigations into every area of biological science, investigations that are just beginning to bear fruit. "I can't tell you how we will use the results of this basic research in the future," says Davis. "But one thing is sure. The knowledge will be priceless."

BOMBED UTAH

CONTINUED FROM PAGE 59

ings They were consistently high along the backs of the sheep There was concern among members of the team that none of the really sick or dead sheep were available for examination The sheep with the fewest symptoms and lesions were the only animals left for the team to look at

Brower asked all the doctors in the AEC group if he could get a copy of their official studies They agreed Meanwhile the medical men wrote their reports

Dr Veenstra wrote "The location of the lesions and the nature of the sheep to nibble grass short leads one to suspect that the lips and foreface could easily come in contact with material on bushes grass etc that would cause these lesions It is my opinion that radiation was at least a contributing factor to the loss of these animals" And Dr Thompsett reported "Examination of these lesions leaves little doubt as to their origin a diagnosis of radioactivity damage

The others on the preliminary team concurred None could find any convincing alternate cause But there was a major problem Neither the sheepmen nor county agent Brower was informed of these results Instead a long series of machinations began behind the AEC's closed doors The AEC coverup remained hidden for almost three decades until it was revealed in congressional hearings and an extraordinary court decision Today court documents tell the story that the government hoped would never come to light

Summer 1953 In Washington D C Los Alamos New Mexico and Hanford Washington letters phone calls visits and classified documents began to reflect panic on the part of the AEC's upper echelons If radiation was the cause of these massive damages what would happen to the testing program? How many millions of dollars of other claims would come in? What kind of precedent would be set? What about public furor? Commissioner Eugene Zuckert was worried "In the present frame of mind of the public" he told an AEC meeting on May 22 1953, "it would take only a single illogical and unforseeable incident to preclude holding any future tests in the United States.

Brower got a hint of what was going on backstage when he asked veterinarian Thompsett for the promised copy of his report Thompsett said 'Even my own copy has been picked up I've been told to rewrite it and eliminate any reference to radiation damage or effects'

Brower and the sheepmen got another hint when the second group of AEC specialists arrived in Cedar City on June 10 Paul Pearson chief of the Biological and Medical Division was a Utah man with divided loyalties

He took Brower aside and told him off the record that the AEC would never let a radiation-damage precedent be established

The others on the second AEC team were brusque and unceremonious In sharp contrast to the attitudes of Veenstra and Thompsett They dismissed the sheepmen's comments with curt rebuffs They came down hard on rancher Doug Clark when he challenged the AEC suggestion that the sheep had died of malnutrition, called him too dumb to understand anything about radiation and harangued him for more than ten minutes Two hours later Clark died of a heart attack

AEC's Pearson began to pressure Veenstra He sent him AEC data that ruled out radiation and wrote "I would also like to have an expression from you as to whether or not in view of these data you feel that radiation was a contributing factor"

Refusing to change his mind Veenstra was taken off the case So was Thompsett Their reports were classified and radiation observations mysteriously disappeared Over the next few weeks AEC officials drew up a strategy for explaining the fate of the sheep The deaths had *not* been caused by radiation There were poor range conditions that winter and the animals had died from malnutrition or disease

Other things happened Joe Sanders, AEC Deputy Chief in Nevada, wrote to Lieutenant Colonel Bernard Trum a member of the second AEC team to visit Cedar City "Thompsett called me last Thursday" Sanders reported "He said they had reproduced burns comparable to those found on the Cedar City sheep in the [AEC] lab at Los Alamos and we are really in trouble" Bone samples taken for further laboratory analysis were mysteriously lost No attempt was made to procure further samples from the dead sheep

An AEC reading of 10 rads on one report was arbitrarily changed to 5 rads Many symptoms were ignored or misrepresented by the AEC blood abnormalities bone radiation readings retarded growth loss of wool, readings of hot areas on the neck and wool A report from Pearson's department stated that the gamma dosage did not exceed 5 roentgens Yet the same report contained information that indicated the true reading should have been in the range of 30 to 100 roentgens—and possibly as high as 169 rads The AEC report also neglected to mention that the readings quoted were made 26 days after exposure, when many of the fission products would have decayed

When Veenstra wrote a follow-up report on July 20 he commented "The activity shown to be present in the tissues by the gamma photon scintillation counter and the chemical analysis strengthen my previous opinion that radiation was a contributing factor in the death of the animals"

By October five months after the sheep deaths began Gordon Dunning of the AEC's Division of Operational Safety in Washington D C was fearful that the commission would tighten the purse strings on future U S weapons testing He per-

suaded a group of AEC and Public Health Service officials to sign a statemenf thaf discounted radiation as a cause The statement was supposedly for AEC inter nal use only But Dunning turned around and gave the report to AEC public-information services within a week

In January 1954 the AEC issued a public statement the culmination of an eight-month whitewash intended to rule out radiation damage It eliminated all the incriminating evidence that had appeared in earlier drafts Statistics on the sheep deaths had been deleted An assertion that there was no support for disease was cut as was a report admitting the conclusions of the experts were far from unanimous When Utah health officials complained that they had *not* 'concurred" in the report the wording was changed to read that they had *'reviewed*" the report

The statement was released on January 16 1954 The general public was unaware of these elaborate internal maneuvers AEC press releases painted an optimistic picture But the sheep ranchers couldn f understand why they weren t being reimbursed for their devastating losses which had now mounted to nearly a quarter of a million dollars Some ranchers would go out of the sheep business forever Others would sell everything they had at a horrendous loss Some would be paying off debts for more than three decades

Three days before the report was issued Pearson, Trum and several other AEC men met fhe ranchers in the Cedar City firehouse Minutes of thaf meeting suggest that it was a somber event The AEC men gave all the reasons why radiation could not have been the cause The sheepmen were not impressed Mac Bulloch said We were told we were in a hot spot on the range ' An AEC man answered 'This has been a wonderful opportunity for us to evaluate the actual damage done with a fallout You can f cause a big amount of damage with a small fallout

To the sheepmen this and other statements were a lot of double-talk They listened furfher as Dr Leo Bustad told them about a comparative study of his experi mental lab sheep and those of the Utah sheep He had fed the lab sheep massive doses of radioiodine and concluded ' The Utah sheep showed no evidence of the radiation damage observed in experimentally treated sheep

But this was directly contrary to fact Dr Bustad failed to fell his firehouse audience that his laboratory sheep exhibited almost exactly the same symptoms as the Utah sheep To reveal this would be to admit Ihaf radiation was the cause

Dan Bushnell a fiery and determined young Salt Lake City lawyer, was following the case, and he was angry Although he knew nothing of the backstage antics of the AEC he smelled something wrong, To him there was prima facie evidence of radiation damage and of extraordinary suffering because of it

He filed suit in 1955 The AEC did every lhing possible to block his pretnal discovery process But Trum and Pearson were concerned about the hidden conclusions of Veenstra and Thompsett as the trial date approached

Lieutenant Colonel Trum wrote to Dr Veenstra on March 25 1955 just after the second anniversary of the Nancy shot, suggesting that Veenslra should change his mind about radiation as the cause of death Veenstra wrote back on April 7 'Our position has not been materially changed Basically we are still of the opinion that radiation could have contributed to the death of the animals

Before Veenstra mailed the letter U S attorney John Finn made what appeared to be a special trip from Washington to Veenstra s office in San Francisco As a result the letter was never mailed Court records suggest that Finn picked it up and took it back to Washington Later the general counsel for the AEC mailed a copy to Pearson with the notation ' Please note the original of this letter was never mailed It is to be held in confidence

With his arm twisted Veensfra drew up a hand written note to Trum on the same day as Finn's visit In view of all your data and lack of ours our laboratory has decided not to make any official statement "

Veenstra had bowed to the pressure of Pearson, Trum and Finn Thompsett got the same sort of pressure Trum sent him a ' model letter ' to sign on May 9 1955 It instructed Thompsett to say that he had reevaluafed his original position and now backed the AEC line Thompsett did not give in He wrote back Again with Ihe

sheep losses I am of the opinion that the AEC has contributed to great losses

But this letter was buried in the files Along with Veenstra, Thompsett disqualified himself as an expert witness at the trial

U S attorney Don Fowler was jubilant He wrote in a confidential document To our knowledge neither sheepmen nor their attorney has a copy of any written report made by Major Veenstra or Dr Thompsett concerning the opinion that radiation was or could be a contributing factor to the injuries sustained by the sheep '

The case in 1956 was brilliantly argued by attorney Dan Bushnell But he could not fully penetrate the 'secret' and 'classified' screen set up by the AEC Its experts all took the stand and testified that radiation had nothing to do with the cause of deaths—absolutely nothing

Federal Judge A Sherman Christensen himself unaware of what had gone on behind the AEC scenes could not believe that a group of scientific experts would possibly cover up for the government

He put the question to Dan Bushnell in court "Do you want me to believe that they aren t giving their best considered objective opinion with reference fo the effects if any, of radiation?"

Bushnell stood before the bench and spoke clearly "I do

Although the AEC was unable to come up with any reasonable alternative to radiation damage the judge had to go with the scientific evidence displayed in the courtroom The highest level of fallout could not possibly cause this damage the experts contended Judge Christensen entered a tortured and troubled judgment in favor of the government against the sheepmen The numb and nearly bankrupt owners did not appeal

But the tragedy was not limited to sheep There was a nightmarish aftermath Slowly and almost imperceptibly the horror spread It was reflected not only in towns like Cedar City and St George but in Washington D C too President Eisenhower worried about public concern sent the AEC a directive in the mid-Fifties Keep the public confused as to fission and fusion At a February 23 1955 AEC meeting commissioner W F Libby said to chairman Lewis Strauss "I notice you had cooled about the Nevada test site Strauss answered "My coolness started in the spring of 1953" Chairman Strauss admitted frankly that if the decision were his alone he would load the big-kiloton shots on a ship take them to the Pacific put them on a raft and set them off "

At the same meeting the commissioners discussed wind direction There was almost nowhere a fallout cloud from Yucca Flat could drift safely

When someone suggesfed east Strauss said "No East they [the clouds] go over Pioche and St George which they apparently always plaster "

Strauss was right St George was always being plastered And shortly after these concerns were being expressed and at about the same time the sheepherders were presenting their case in court in 1956 fifteen-year old Karlene Hafen became desperately ill in St George Her mother took her to the hospital in Salt Lake City but there was little that could be done The diagnosis was acute myelogenous leukemia Brought back home to St George she lingered One day as she lay on the living-room couch she called her mother Mama she said "please call the doctor I'm going to die Her mother said "You're not going to do any such thing

Karlene said "Yes I am Mother This room is just full of angels She closed her eyes Her mother called the doctor and took her to the local hospital They worked on her for three hours She was dead

Nine years after that Mrs Hafen s husband died of cancer Later she made a chilling discovery There were five houses on her block Seven of her neighbors had died of cancer Two had undergone cancer surgery Others in St George began to make the same sort of observation Irma Thomas noted thaf 29 people within a one-block radius of her home on Tabernacle Street had been afflicted with leukemia or cancer and eight of them had died Prior to this St George had reported one of the lowest cancer rates in the country—about half that of the United States average

When broad daylight arrived the cloud seeped up over the mountain range and spread out over the town. It seemed to Lorna that a giant reddish-black hand had obliterated the sun.

In 1960 Elmer Pickett owner of a St George hardware store and the man who once had sfood on Sugar Loaf fo watch the blasts took his thirty-eight year old wife to a Salt Lake City hospital The diagnosis was lymphosarcoma and Hodgkin s disease and later leukemia She was dead in seven months The radiologist said to Pickett "I don t know what is happening in St George but we are deluged with leukemia victims We've had practically no cases betore this from there "

Pickett in a state of shock counted the members of his close family who had recently died of cancer or leukemia They totaled 11 His father a mortician went back over the death certificates in the town from the years before the nuclear tests There were practically no cancer or leukemia deaths recorded new records showed a mounting number ot such cases

As widespread apprehension grew in St George Arthur Bruhn saw the fruition of a labor of love The final construction of the new campus of Dixie College which he headed was completed in 1963 He too had watched the tests in the predawn chill warmed by mugs of hot chocolate Now a decade later on a short vacation out in the nearby Pine Valley mountains he and Lorna noticed an inordinate number of claim stakes of uranium prospectors The Geiger readings were high with the counters going off almost everywhere they were set down But the hopes of the uranium prospectors were futile The Geiger count did not indicate potential uranium mines It meant radiation fallouf

It was accumulated fallout from 1 000 kilotons ot blasts of Upshot-Knothole and other tests conducted up to 1963 Total domestic detonations were the equivalent of 77 Hiroshimas The stakeouts were a reminder to the Bruhns of the blasts

Just before Christmas in 1963 Arthur Bruhn complained of a headache and he thought he was coming down with the flu He wasn t His face and skin became yellow and drawn A blood test showed acute lymphatic leukemia He died on July 5 1964 at the age of forty eight

His wife in her bereavement did something she had never done before She began reading fhe obituary columns

In the months that followed a terrifying awareness grew within her and the other townspeople of St George Several of her husband s friends were dying of leukemia A highway patrolman who had worked at the numerous roadblocks was one of them Another was a friend who had worked at a service station washing radioactivity from the cars with his bare hands

In the early Sixties little was heard from the AEC (soon to be split into the Department of Energy and the Nuclear Regulatory Commission) Nor was much mention made of accumulated plutonium fallout—one of the world s deadliest poisons—with its half-life of 24 000 years There was evidence that an increase in plutonium 239 had been found in the lungs of Utah deer and that the herds were disappearing

Edward Weiss a public-health expert and three physicians made a study of leukemia and cancer effects of the fallout in Utah for the U S Public Health Service The conclusions Thyroiditis increased twofold Thyroid cancer increased almost fourfold The results were 120 percent above the control groups in other areas The study was buried because of AEC pressure on President Johnson and not released until it was uncovered in 1979

There was considerable worry in the early Sixties about the minimum safe level of radiation AEC technicians admitted they were in a poor position to defend the 3 9 rads limit Many thought this standard was unsafe and that it failed to consider the internal emitters trom forage and food

One scientist who thought this way was Harold Knapp. He was a tough and feisty AEC Washington investigator assigned to answer critics of the testing. In 1963 he discovered that a fallout hot spot had reached all the way to St. Louis, delivering over 2 rads some 1,200 miles away. Infants there received up to four or five times the allowable limit of radioiodine to the thyroid. The iodine 131 went from the forage to the cattle to the milk. This was a shocker. What about the infants in nearby Utah?

When he checked milk samples at St. George, he found the Fifties tests for radioiodine had boiled off the iodine 131 before it could be traced. It was possible to back-calculate, but this had never been done. (Later an AEC official read a report that mentioned this technique, threw the document on the floor, stomped on it, and said to the researcher, "Don't you *do* that!")

Knapp back-calculated by checking the external gamma dose to find out how much fallout had been deposited on the ground. Then he checked how much fallout stayed in the forage that was eaten by the cattle. The question was: How much radioiodine would have shown up in the milk?

Knapp was astonished. The calculations showed that infant thyroids in southern Utah had been exposed to as much as 840 times the allowable gamma dose. "Mind you," Knapp said, "people were excited already when there were *two* rads in St. Louis." In St. George Knapp's figures showed that the fallout from the Dirty Harry blast alone brought a dose of up to 440 rads. A National Academy of Sciences expert had found that only 100 rads could increase the incidence of thyroid cancer. Knapp was informed by his AEC bosses not to include the alarming findings about St. George in his report. But Knapp would be heard from later.

Ominous signs continued to appear in St. George. In 1965 a total of 70 school children were discovered to have thyroid nodules that were suspected to be related to the fallout. It was arranged for each child to be sent to Salt Lake City for examination. It would be a long-term project with no immediate conclusions. Meanwhile, the people in the region, as solid and patriotic as if they had stepped out of a Grant Wood painting, tried hard not to believe their own government was deceiving them.

But over the next ten years and more, the cases continued to grow far out of proportion to the expected rate—cases like that of twenty-year-old Lisa Pectol. In 1976 she and her husband, Dwight, were so happy they were going to have a child in four months that they didn't much notice the headaches and nausea Lisa was experiencing. She was also losing weight.

Dwight took her to the St. George Hospital on a Thursday night. She went into a coma. She was flown 250 miles north to Salt Lake City on a Friday. She died from a malignant brain tumor Sunday morning without regaining consciousness. Lisa's parents later told Dwight that her skin had turned bright red in her playpen sometime after fallout had blown through her screen door back in 1957, during a 44-kiloton test shot called Smoky.

A year after Lisa died, Dr. Joseph Lyon of the University of Utah School of Medicine began a study covering the areas of greatest fallout in southern Utah. It focused on leukemia because of the known association with radiation. Lyon could not depend on the radiation dosages reported by the AEC, because their figures were fragmentary or hidden. Instead he made a direct count of childhood death certificates. The result: The leukemia rate was 2.4 times higher than the expected rate.

But government officials still insisted that the levels of radiation exposure were totally inadequate to cause the havoc. In the Fifties and Sixties the AEC had made a conscientious effort to keep the exposures down. When the scientists discovered that they had failed, they were inclined either to cover up or try to justify their actions.

"After Mrs. Hafen's husband died she made a chilling discovery. There were five houses on her block. Seven of her neighbors had died of cancer. Two had undergone cancer surgery."

They did so even when a 1979 joint congressional hearing in Salt Lake City uncovered more grisly details of the deception and fraud that had been going on since 1953. It was at this point that Harold Knapp returned to the picture. He was called to the hearings to testify on his radioiodine findings and discovered for the first time the details of the Cedar City ranchers' sheep deaths 26 years earlier. Knapp found that no real attention had been paid to the possibility that the sheep had died not from beta burns or gamma exposure to their bodies, but from eating forage and chopped greens, all laden with deadly fission products.

It all seemed obvious after the hidden documents had been declassified and sorted out. Knapp told a subsequent hearing at Las Vegas: "I will try to be brief. The sheep ate enough fallout to kill them. That is the simple explanation."

But there was much more in his 620-page analysis, which took Knapp 15 months to complete. The government scientists were still denying responsibility on three counts. First, they said the total external gamma dose was not enough to kill, since it was usually less than 5 rads. Second, they said the specific thyroid dose to the sheep was only 1,000 to 2,000 rads. It would have taken up to 50,000 to kill a sheep. Third, they said the beta radiation dose was blocked by the wool and couldn't kill.

The main thing the AEC failed to do, Knapp found, was to figure out how much fallout material went into the sheeps' mouths and guts—not just into their thyroids. In contrast to humans, the sheep grubbed for sand and dirt to get at the roots of the forage, especially in a poor, dry season. A study by Professor M. C. Bell of the University of Tennessee showed that a sheep could take in enough fallout on an 18′ × 18′ patch to start killing some 12 percent of the adult sheep within two months. It wasn't the dose of radiation to the thyroid that killed them by the thousands. It was the dose to the sheep's gastrointestinal tract, which was hit by up to 5,000 rads from the swarm of fission products.

The AEC scientists also failed to take into account the internal dose to the fetal lambs. Insoluble fallout particles passed through the mothers' gastrointestinal tract, Knapp contended. Then they moved through the placental barrier. But the most important questions the AEC never asked were simple. How much fallout does a sheep eat, and how much fallout does it take to kill a sheep? Knapp combed the data seeking answers, even though the government tried to smother his findings with criticism.

But when the 1979 congressional hearings revealed clear evidence of fraud and coverup, the AEC became more vulnerable than ever. In May 1982 attorney Bushnell reopened his case in the federal district court on the grounds that a new trial could be granted when outright fraud could be proved. Judge Christensen, now seventy-seven years old, called for such a trial in an unprecedented legal move. *Bulloch et al. v. the United States* moved into a new phase with the same attorney and judge who had begun the action 30 years before. The government, the judge concluded in anger, had perpetrated a fraud upon the court. The judge stated that the conduct of the government agents was "intentionally false and deceptive." He also came down hard on "improper but successful attempts to pressure witnesses not to testify as to their real opinions."

On the heels of this decision a new and different trial opened in the same federal court at the end of 1982 under Judge Bruce Jenkins. It is an action brought by more than 1,100 cancer and leukemia victims from the affected tristate area. They are represented by former Secretary of the Interior Stewart Udall. Many are from St. George and its environs. Most are typical of the resolute, conservative western-states patriot. They are as reluctant as the sheepmen were to sue their own government.

Government officials will make no further statement to the press beyond the contentions they have presented in court. There is no clear proof that fallout caused

the damage, the studies presented by the claimants are flawed and inadequate. Bernard Trum still feels he was right, even though he is prohibited from discussing the case of the sheepmen.

In St. George residents are confident that the facts are strong enough to prevail in court and that hard work can soften the impact of the bombs. For years, Irma Thomas, in St. George, collected data and wrote to doctors, scientists, senators and congressmen. She feels that her work has contributed to exposing the government coverup. Elizabeth Bruhn Wright—daughter of Arthur Bruhn, who died in St. George in 1964—feels the same way.

When her father was dying, he said to his daughter, "Someday they will prove that the radioactivity caused this, and you must promise me that if ever you can do anything to prevent other families from suffering what we have, you will."

She is doing just that. With her friend Janet Gordon, who became white hot with anger when her brother died a lingering death from cancer, Elizabeth Wright founded a group called Citizens Call. They are setting up a hospice and a cancer-leukemia center in St. George, where victims can be diagnosed and treated locally instead of having to take the long journey to Salt Lake City. Volunteers work around the clock with the conviction that their personal efforts can help alleviate the damage and duplicity of the past and, just as important, reveal any fraud and coverup in the present and future.

Some complacency has set in. When the nuclear tests were moved from surface to underground sites in 1963, many hoped the fallout problems would be buried in the shafts and tunnels where the ongoing detonations are set off. The hopes seem illusory. In 1968 an underground test named Schooner created a crater of more than 17 million cubic meters. A 1,000-foot-thick radioactive cloud moved from Nevada all the way to the east coast and eastern Canada.

Before the 1979 hearings, the Department of Energy, an heir to the old AEC, admitted to only 19 ventings of measurable fallout. Under the pressure of the hearings, General Mahlon Gates, operations manager of the Nevada test site, finally admitted the total was actually 40 and that massive leaks could not be completely prevented. And there were other unannounced detonations that are still classified. Given the shoddy history of continuous coverups over the years, the current tests are still under suspicion.

A detonation in the summer of 1982 created a crater the size of a football field. It was described by a Department of Energy official as merely the most exciting thing he had ever seen. To the people of Utah and Nevada it was anything but exciting. It was harrowing and threatening. That is why members of Citizens Call and other dedicated individuals insist on being notified of each new test that comes along.

Today St. George and Cedar City sit quietly in the surpassing beauty of the Utah landscape as two reluctant monuments to man's irrational, unconscious drive to incinerate or irreversibly poison the planet—if not with a bang, at least with a whimper. There is a numbness among the people from the realization that the government they trusted could have violated that trust.

Dwight Pectol has finished the sturdy home he built for the young wife he lost during her pregnancy. On his coffee table is an album of Kodachrome pictures of her and the wedding guests. Lorna Bruhn, about to retire as a third-grade teacher, looks out at the tips of the mountains at sunset and swallows the bitterness she still feels at the senseless loss of her husband Elmer Pickett checks the shelves of his True Value hardware store and occasionally shares with others a glimpse of his wife's picture which he carries in his wallet. The Bulloch brothers will point out some of the land and buildings they had to sell to cover their losses, recalling the long nights years before on the winter range, looking up at the stars and listening to Kate Smith or the Hit Parade on a battery radio.

"I loved the range," Kern Bulloch will tell you, "because you were not breathing the air anyone else was breathing."

VENGEANCE

CONTINUED FROM PAGE 132

"Help me get the facade off this headstone and don't think about it." The two of us pulled at the front of the marker until the panel we'd pasted on earlier popped off.

"Easy for you to say. This isn't *your* grandmother's grave."

"No, and it won't be hers much longer either. After the spring thaw the city's going to reclaim this land and all the bodies'll be cremated. What's left of them." I patted Phinny's shoulder sympathetically. "But we'll order a few months of perpetual care to make it up to her."

"How can a few months be perpetual?"

"Don't quibble, Phinny. I'd like to get the hell out of here. Desecrating a grave is still illegal, even if cemeteries are going the way of the dodo." I checked to see that Currin was still breathing. The blood on his face was icing over now. He would be okay, but he was going to have nightmares worse than Phinny's. Eventually he'd realize what had happened to him, but it wouldn't do him much good. There wasn't anyone to blame for it but Karen, and she was dead. He'd never find out about her will.

I took the cuffs off his wrists and ankles, rubbing them a little to make the marks disappear.

"I've got the camera,' Phinny called to me. "Let's go, if you're so anxious to get out of here."

I glanced skeptically at the minicam in his hand as we trudged up the hill toward the van. I'd never worked with a videocamera that small before, and I was afraid the picture was going to be kind of muddy. But I was surprised when I replayed the tape on the way home. The picture was as clear as anything I'd ever seen. Phinny had mounted the camera on the headstone next to his grandmother's, and it had picked up every detail right down to the flying dirt and blood on Currin's face. That was going to need a little judicious editing. The executor of Karen's will wouldn't care, but I thought it looked sloppy.

After we'd put several blocks between us and the cemetery, I had Phinny make an anonymous call to the police to report someone asleep or dead near one of the graves. They'd take their time investigating it, but Currin would probably be at a hospital within half an hour or so.

I felt bad about his nose, but they'd give him a new one.

I had intended to wait until morning to call the executor of Karen's will, but I decided I didn't have to be the only one losing sleep over this. As it turned out he wasn't at all upset that I'd gotten him out of bed—just the opposite.

"I'm so pleased you were able to bring it off," he gushed through a yawn. "Frankly, I wasn't sure you'd be able to do it."

"It wasn't that hard. I'll get the videotape to you tomorrow."

"Good. The terms of Ms. Kitterman's will are quite specific on that point."

The terms of Ms. Kitterman's will were quite specific on all points. She'd videotaped it and ended it graphically with her suicide, but I didn't mention that.

"I wouldn't have gone along with this," he continued, "except there is a great deal of money involved and—"

"Speaking of money," I said.

"Ah. Yes, of course. How, ah—"

"Just the way we discussed. Get a money order and make it out to Vengeance Is Yours, Inc. You have the address."

He started to say something else, but I hung up on him. My father had begun this business and he'd told me always to deal in money orders; none of this computer-transfer stuff.

That had been back in the days when V.I.Y., Inc., would just throw a pie in somebody's face for twenty bucks. We're more sophisticated now, but I get a certain amount of satisfaction from making clients go to the trouble of getting an old-fashioned money order. Revenge after all is kind of an old-fashioned thing anyway.

I left the videotape in the machine so I could get right to it the next day. After I cleaned it up a little I'd send it to Karen's executor so he could play it for her brothers and sisters, who couldn't have cared less. All it was to them was a freaky little show they had to sit through before they could inherit her money. Her humiliation by Currin had been nothing to them, and her revenge wouldn't be much more. That's the funny thing about vengeance. Half the time people hire me, they're getting back at the wrong persons for all the wrong reasons. I should know. I'm an authority. But then again, the vengeance isn't mine. ∞

From asteroids to eggshells in the Omni Dictionary

COMPETITION

By Scot Morris

Omni's Fractured Dictionary defines *ax* as "a chopstick" and *cube roots* as "diced carrots." In Competition #25, announced last September, readers were asked to help us with the first five chapters of our dictionary by supplying redefinitions for up to three words starting with any of the first five letters of the alphabet.

Common repeat entries included **asphalt** (hemorrhoids), **aerospace** (quiver), **electron** (1984 campaign slogan: "see electric"; a 1972 slogan), **egoist** (an I specialist), **childhood** (a juvenile delinquent), **derange** (where de deer and de antelope play), **courtship** (the Love Boat), and **astute** (see **flatulence**). There were also words with fracture lines you can probably supply yourself: **canopies**, **demijohn**, **announce**, **defense**, **catalyst**, **acquire**, **abalone**, **euthanasia**.

GRAND PRIZE-WINNER $100

Circular saw A rose is a rose is a rose.'
Digger wasp Preppy archaeology student
Damnation The Netherlands
—*Chris Doyle, Burke, VA*

RUNNERS-UP: $25 EACH

Bumblebee A Jerry Lewis film festival
Champagne Hypochondriac's symptom
Dove Bird of pray
—*Joe Faust, Gillette, NY*

Bassinet Worth two in stream
Cardinal number A spot on the windshield
Curator Dog-show judge
—*Emmalea Kelley, Greenbelt, MD*

Exorbitant *Skylab*
—*Mark Siegel, Los Angeles*

Cluster bomb When Johnny Carson tells several bad jokes in series
—*Bernard Pisarchick, Brockway, PA*

Canvasback Inept boxer
Downcast Performers in *Swan Lake*
—*Rachel Hathcock, Woodbridge, VA*

Eggshell Roeboat
—*Robert A. Smith, Miami, FL*

Bureaucrat A person who cuts red tape lengthwise
—*J. M. McCabe, Washington, DC*

Asteroids A proctological disorder common among home-video gamers
—*Joyce E. Navary, Colonial Heights, VA*

Au lait Cheer given at a food fight in a French cooking school
—*Ben Gottlieb, McLean, VA*

HONORABLE MENTION

Broker What you get in the stock market
Electrocute What R2-D2 is
—*Robert C. Westerfeldt, Largo, FL*

Ambidextrous A sugar that is its own stereoisomer
Analogy Overprotective response of the immune system to foreign protein
Binary Frugal fiscal policy
—*Lawrence G. Knight, Corvallis, OR*

Banana First three notes of Beethoven's Fifth Symphony
—*Steven Piantieri, Tampa, FL*

Clone Cell mate
Atrophy Award for lack of exercise
Astronomer Night watchman
—*Harald Schenk, Sheboygan, WI*

Carnallite Lo cal love potion
—*Heber Bouland, Silver Spring, MD*

Alpo What Edgar's friends called him
—*Doug Ingle, Martinez, CA*

Buckboard The Federal Reserve
—*Tim Theophilakos, Perth Amboy, NJ*

Doublemint Twins Chew-chew twain
—*Vera Peterson, Nevada, IA*

Budget Taxes chainsaw massacre
—*Vernon Vanpoucke, Seattle*

Escape artist Science-fiction writer
—*Michael Jordahe, Aurora, MN*

Exegesis Formerly a savior
—*John Litt, Brooklyn, NY*

Dracula The first blood count
—*Christopher Blair, Santa Cruz, CA*

Christmas elf Subordinate Claus
—*David Greenebaum, Racine, WI*

Banshee Stag party
Brouhaha Beer joke
Call girl Ma Bell
—*Tony Reeder, Silver Spring, MD*

Eavesdropper Unemployed roofer
—*Lani Anderson, Washington, DC*

Balfour Declaration "Take your base!"
—*Ellen Goldman, New York City*

Divine right Knockout punch in *Your Arms Too Short to Box with God*
—*Karen Bracey, Burke, VA*

Etiology Study of extraterrestrials
—*Robert L. Witherspoon, Ennis, TX*

Analyze Structures used for hindsight
—*Alfred L. Poff, Muncy, PA*

Brisk Quick circumcision
—*Jerri Howard, Arlington, VA*

Dilate The way to start a toll-free phone call
—*Steve Bresler, Port Jervis, NY*

Cataract Japanese luxury car
Abundance The Bump
—*Mark Smeby, Martinez, CA*

Alternate What happens to us after we all are seven
—*Phil Reynolds, Richmond, VA*

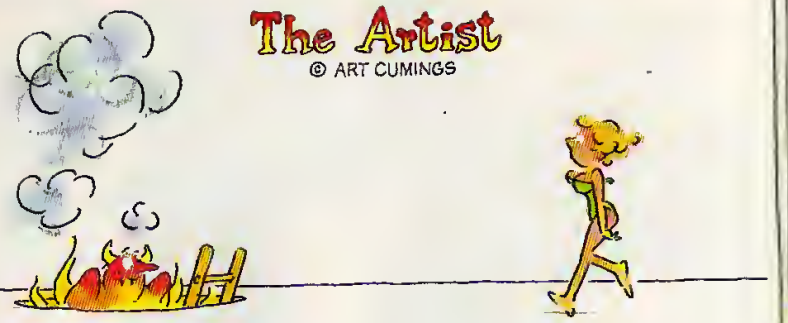
Alkaline Your basic Detroit Tiger
Archaic What we can't have and eat too
—*Miles Klein, East Brunswick, NJ*

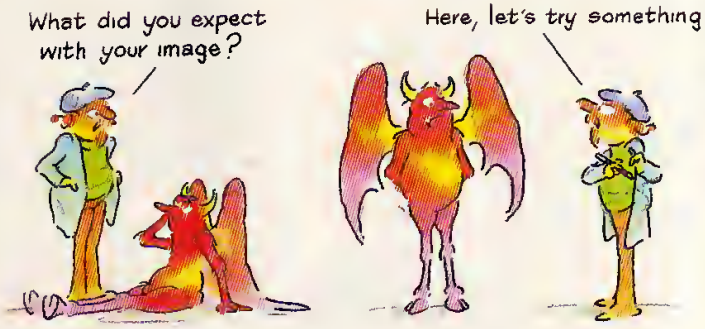
Aftermath Algebra
Chicken feed A poultry sum of money
Bulrush Stampede
—*Jean White, Washington, DC*

Down A terminal condition
—*Tom Beeston, Oracle, AZ*

CONTINUED ON PAGE 150

The Artist





LIFE

CONTINUED FROM PAGE 18

a thirty-year-old pediatrician from Boston. During his six months of volunteer work at Khao-I-Dang, he learned to love the Cambodians, whose gentle Buddhist life-style passed through the horrors of war to the agony of confinement in a strange land. While Bass, Hiegel, and other Western medical staff returned to their houses in the main town each evening, the immigrants were forbidden to pass beyond the barbed wire fence around the camp.

Saddled with hundreds of thousands of refugees fleeing Communist regimes in southeast Asia, the hard-pressed Thais reverted to a policy of locking up "illegal immigrants" in detention centers, much as Haitian boat people were detained in the Miami area. The Thais hope that the prospect of long years of confinement will deter the flood of refugees seeking to enter Thailand en route to settlement in a "third country" such as the United States or Canada. But they keep coming. And the medical problems they bring are unique.

While fleeing war and famine," explains nurse Deirdre Earley, "the refugees were unable to properly mourn the dead. The survivors fear spirit possession when denied Buddhist funeral rites they believe are needed to pacify the souls of the dead. If they think someone from a former life has entered their body, they go into a frenzy until they collapse from exhaustion."

Initially, the volunteers tried to calm the possessed with tranquilizers, but the solution was temporary at best. "It's like sedating a manic Vietnam veteran back home," Earley says. "You're easing the symptoms, not the problem. Also, we didn't want them to become drug dependent."

So the Krous were called. "They sprinkled water all over the patients' bodies and gave them herbal tea to give them diarrhea and cleanse them," Earley recalls. "It worked a lot better than Valium."

At first, the Krous saw patients at home or in the Western hospital huts, but eventually the palm thatch and bamboo TMC was built. Its herbal pharmacy consists of rhizomes, bulbs, tubers, leaves, buds, stalks, flowers, and seeds, as well as various tree barks and hearts. The medicine is prepared in water or alcohol; ointments are made with beeswax and coconut oil. Witch doctors chew betel and spit it on painful parts of the body. But the most commonly prescribed remedy is the herbal tea, and at any given time, at least ten different varieties can be seen boiling away in huge caldrons. More than 1,000 people a day come to take the medicinal teas or consult the half-dozen Krou doctors seated cross-legged on bamboo platforms along three sides of the main hall.

On the right of the hall, two men and one woman give massages that seem to cause as much pain as pleasure. On the left, seated amid bottles of medicines, is bone specialist Sao Yat, from Battambang Province, just over the border. He treats fractures by applying a black ointment for ten minutes, then a white paste made from potato and alcohol, which hardens when dry, is used with bamboo splints.

"Foreign medicine is better than Krou medicine," acknowledges head Krou Soc Niem, a white-moustached man. "You need only one pill and you have X-ray machines. But we are good for prolapse (womb disorder after childbirth), numbness, hemorrhoids, dysentery, orthopedics, fractures, and headaches. We have massage and sauna, and we can cure mental illness, small wounds, infertility, and insomnia."

In the adjoining pharmacy, three men squat among chunks of wood shavings as they chop and grind to dust many kinds of trees used in medicines. "This is for allergy [a general term Krous use for hysteria] and this," says Krou pharmacist An Vourch, forty, pointing to an iron chest full of bags of powders, "is for depression after childbirth. It calms the woman down. She drinks the medicine and the ghost comes out."

Belief in spirits extends to belief in black magic. Someone seeking vengeance on an enemy will pay a Thmop (black magician) to summon harmful spirits. When rumor of the curse gets back to the intended victim, that knowledge is enough to set his mind to creating pains and disease. Upon learning that a contract had been taken out on him, one Cambodian nurse proceeded to lose ten pounds in four days. Although he had been trained for several months in Western scientific medicine, his response was to hire a Krou Thmop (healing magician) to drive out the evil spirits. (Trying to talk a Cambodian out of such beliefs is about as effective as telling teenagers not to think about sex.)

"Lest we play the sorcerer's apprentice," Hiegel cautions, "we refuse to supply the Thmops with 'magic' herbs."

Hiegel admits that many Westerners find it difficult to see the benefit of painful treatments such as rubbing the skin to create friction burns or pressing coins on the forehead to produce bruises. And the curative powers of turtle shell remain a mystery until one considers that—in Hiegel's own words—"part of the action of either a modern or a traditional drug is linked to the psychological experience in which both the donor and the recipient participate."

In their ability to offer something familiar to strangers in a strange land, the Krous definitely have something Western doctors lack. And if the Krous manage to assuage some of the fears and disorientation of the refugees, they may be doing far more to heal their patients than even they believe.

"The cooperation with the Krous allows mutual enrichment," Hiegel concludes. "By teaching us about the customs and beliefs of their people, they have enabled us to practice a medicine which is truly human[itarian." Without those cultural keys to the mind, all the drugs in the pharmacopoeia can be useless at times. ∞

CONTINUED FROM PAGE 32

engineer (Typically Viola turned the crude 'chroma noise' or graininess, of the Beta image into a formal element.) The varied motion—which in video unlike film cannot be achieved in the camera but only with postproduction editing—was added at the TV Lab of Channel 13 in New York, where Viola has been an artist in residence since 1976. On his return to Japan Viola developed his editing techniques further.

As part of his residency Sony gave Viola two month's unlimited access to the BVE 5000 one inch compufer editing system at their Atsugi plant the major factory for developing broadcast equipment. Video technology is notoriously fragile but this was one time that Viola had no worries about malfunctions. "If something breaks down in New York, you just go home," he says. "If anything went wrong at Afsugi an engineer could make a house call and replace a faulty circuit in fifteen minutes. After all they're making the stuff upstairs." Moreover, Jun Takayama, the man who designed the BVE 5000, was available for beer and sushi consultations after work.

Viola used the BVE 5000 to edit *Ancient of Days*, a tape fhat makes virtuoso use of slow and reverse motion as well as time-lapse videography. A burning table reconstitutes itself the Washington Monument charts the course of the sun over a single day, a mountain dissolves into its image on a Tokyo electronic billboard. Viola attributes the tape's intricate rhythms to his constant access to the computer console. "It's like playing the piano. You have to get your practice time in every day." Part of *Ancient of Days* was shot in Japan with a computerized zoom lens designed for Viola by Sony engineer Yasuo Shinohara. The lens, which allowed for motorized zooms of any duration between three seconds and ten minutes, could be preprogrammed to compensate for changes that Viola wanted to make in fhe editing. Thus there's a long zoom toward fhe end of the tape thaf maintains a constant rate of speed even as the movement of the Tokyo crowds Viola recorded slows down to a tortoiselike crawl.

In addition to completing *Ancient of Days*, Viola used his residency to produce *Hatsu Yume* (First Dream). The hour-long tape was shot with a $40,000 broadcast camera, the Sony BVP 300A, and rarely has any video artisf had the opportunity to experiment with what this standard piece of industry hardware can do. *Hatsu Yume* opens with slow and deliberate shots of the sea, a bamboo forest, a windswept mountain, and a Shinto temple. The images are striking not only for themselves but also for fheir clarity and unusually high definition. Much of the tape was shot at night or under extremely low levels of available illumination (including one scene lit by the glow of a single match). "People think I must have used a prototype," Viola says. "But Sony didn't even give me their best camera."

Hatsu Yume hits its stride when Viola takes his camera into downtown Tokyo, shooting at night from a moving car. The surrounding traffic is transformed via slow motion into a blur of force lines, with headlights burning visceral afterimages onto the screen. Taping through the windshield during a heavy rain produced a fantastic deluge of neon blue iridescent green and electric mango. After a few sumptuous minutes this surge of churning refraction resolves itself with an invisible cut into macro close-ups of a pool filled with red and gold carp. "Video treats light like water," Viola says. "Light becomes a fluid on the video tube." The Sony engineers enjoyed *Hatsu Yume* although Viola's deliberate use of image lag in the Tokyo traffic sequence made them uncomfortable in its exploitation of a recording-system flaw. By and large, they preferred *Ancient of Days* for its complex sfate-of-fhe-art editing.

While at Sony Viola saw prototypes of a digital videotape recorder, a VTR built into an 8mm-sized video camera, and a seven-pound broadcast unit. "We can make anything," one engineer kidded him. "We're trying to figure ouf what nof to make." Viola says that although his feelings about technology have been ambivalent since the video euphoria of the early Seventies wore off, he recovered some of his video-freak enthusiasm in residence at Sony. "Just being there I got back some of the positive feelings about technology." (Still Viola's technoadmiration is tempered with mysticism. While in Japan he visited Osoresan Mountain and saw a blind female shaman, or *Itako*, calling back spirits of the dead. "Up unfil thaf time," he says, "I thought that the large Japanese electronics companies were way ahead in the development of communications technology. But after witnessing the *Itako* I realized they were way behind. In their own backyards were people who, without the aid of wires or hardware of any kind, have been communicating regularly with ancestors long gone.") Currently he is most excited by the possibilities afforded by compuferized interactive video discs that can be programmed to switch speeds or order of images in performance. "He's planning a piece with no beginning and no end" that can be shown at any speed.

Viola thinks the video disc will completely alter movies and video as we know them. "Pretty soon the way we approach making films and videotapes will drastically change," he predicts. "The notion of a 'master' edit and 'original' footage will disappear. Editing will become the writing of a software program that will tell the computer how to arrange the information on the next disc, playing it back in the specified sequence in real time or allowing the viewer to intervene."

In other words, the next time Viola has a Whitney Museum retrospective, we'll be using the visual information in *Chott el-Djerid* to make mirages of our own. **DO**

GAMES

ANSWERS TO GAMES (PAGE 160)

1 ABOUT TIME

(a) The lower right vertical segment in the rightmost number position is on more often than any other—some 90 percent of the time

(b) In the three 8 shapes, the lower left vertical segments are on least often—each less than 50 percent of the time. The middle of these is on least of all, 20 minutes an hour (in the ten-minute blocks starting with zero or two), or only 33 33 percent of the time

(c) The fewest number of segments (six) are on at 1 11

(d) The most segments (21) are on at 10 08 (John R Davis Silver Spring, MD)

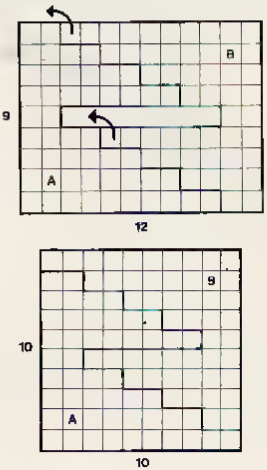
2 SHONIX? Z completes the list of letters in the alphabet that read the same upside down as rightside up (Claudia Herr, Lancaster, PA)

3 PROGRESS? The numbers correspond to the alphabetical positions of the vowels *A, E, I, O* and *U*. The next vowel is *Y* (as in *fly* and *sky*), in position 25. Facetiously was a hint: it is the shortest word that contains all six vowels in alphabetical order

4 TRUTH TIMES TEN There are five true and five false statements on the list: 1-T, 2-F, 3-T, 4-F, 5-T, 6-F, 7-F, 8-T, 9-F, 10 T (Jim Geschwender, Lincoln, NB)

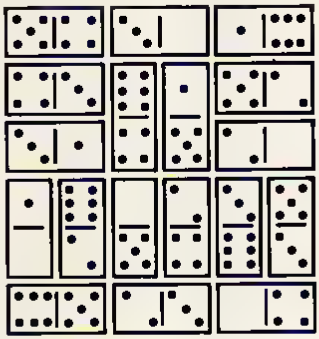
5 FILL-IN The letters are initials of the "counting-by-fives" sequence five, ten, fifteen, twenty, and so on. The missing letters are both *N*, for ninety and ninety-five (James R Reed, Derry, PA)

6 CUT A RUG Cut the 9' × 12' rug into just two pieces as below and fit them together into a 10' × 10' square (T K Barclay, Everett, WA)



7 HAPPY BIRTHDAY The only way two people could be born exactly seven years apart (2,555 days) and share the same birthday would be if there were no intervening leap years. The century years aren't leap years, unless divisible by 400 (2000 will be a leap year). Sam must have been born in 1896, Deborah in 1903. She will be eighty this year and he eighty-seven (Arnold Grinvalds, Lincoln, NB)

8 DOMINI Here's one solution:

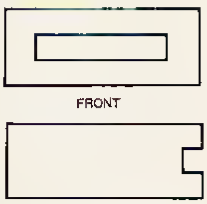


9 FAULTLESS It is impossible to arrange 18 dominoes into a faultless square. The best that can be done is a square with only one fault. Consider: There are ten grid lines (five horizontal and five vertical) and each divides the square into two rectangles having an even number of cells. If a grid line crosses one domino, it must cross a second as well to keep an even number of cells on both sides of the line. In a faultless square, each of the ten grid lines would cross a minimum of two dominoes, or 20 total. But there are only 18 dominoes in the square. There are enough dominoes to block nine lines, but there will always be at least one fault line that cuts all the way through the square

10 TEACH ME He lifted the popcorn bowl, drank the professor's $2 martini, and gave him a quarter for it (Michael Stueben, Annandale, VA)

OLD BUSINESS

The "Two Views" problem last month gave you the front and side elevations of a three-dimensional shape, and asked you to sketch the shape. The answer was withheld until this month. The front and side views we gave you are shown below, along with our sketch of the object at top right. There are other, more complex shapes that could produce the two views shown. The most common suggestion is a rectangular box with a "drawer" hole through it and notches at the back end. (Such an object would have been rotated 90° to the left,



rather than to the right, to get the side view pictured.) Or the shape could be rounded on the notched side only. In an informal survey, fewer than 20 percent of the people who came up with a workable answer thought of the simplest solution. The object is a squat cylinder with a notch in it. From directly above, the cylinder appears as a perfect circle.

The other "held-over" problem last month was this: Last night, moonrise was at 7; tonight it was at 7 04. What day of the year is it?

The moon rises about 50 minutes later each day than the last. This is an average—the time varies from about 20 minutes later than the previous day to about 90 minutes later. The only way you could see the moon rise only four minutes later on a subsequent day is if the moon had actually risen 64 minutes later and you had set your clock back an hour. This happens only once a year, at 2 A.M. on the last Sunday in October. Today's date must be Sunday, October 30, 1983.

The moonrise times given were hypothetical and do not correspond to actual moonrise times this year. The *difference* in times was the important clue. Had the moon risen last night at 7 and tonight at 9 04, you would know (since there is never an actual lag of two hours and four minutes) that you must have set your clock ahead an hour and that it's the last Sunday in April.

Outrageous Extra Credit Question: Andy Rooney. In most parts of the United States, within an hour of 7 04 on a Sunday evening it is possible to tune in a TV set to the CBS program *60 Minutes*.

MAILBAG

Dick Shoup, of Belmont, California, offers this interpretation of William Newcomb's paradox (November 1982), in which you are challenged to outwit a superintelligent being: "Just think of your second serve in tennis," Shoup says. "Sometimes it seems that Lob, the all-powerful god of tennis, can predict whether you'll hit the second serve hard or easy. If he predicts that you're planning to hit a gentle second serve, he makes sure you miss the first one. If he divines that you'll take the risk of blasting your second serve, he instead allows your first to go in. Yes, this could be known as John Newcombe's paradox."

Responding to "Verbal Vexers" (January 1983), A R Ivins of Yorba Linda, California, offers GRANTOR as an addition to our very short list of words that designate real cities and states (JACKAL, AVAIL, LEEKY, THORIA, VICTORIA). There really is a Grant, ORegon.

COMPETITION

CONTINUED FROM PAGE 142

Butterfly nut Lepidopterist
—Jeffrey Staff, Plymouth, MA

Example A successful dieter
—Lynda Cook, Escondido, CA

Ascot Best way to find out who won this Competition
—Lori Jung, Decatur, MI

Before A coordinate on a Bingo card
—Jim Nowak, St. Petersburg, FL

Barroom An elephant passing gas

Cartoon For example. See the USA in your Chevrolet.

Dinosaur Famous cartoonist (see above)
—L. Czarnowski, Newport Beach, CA

Continental plate Part of a continental breakfast
—Ricci Riccardo, San Francisco

Continuum What Guccione and Co. should do with these great issues of *Omni*

Budget What Reagan cannot do with the heavy federal debt.

Astronaut Endangered species
—Julie J. Karpoff, Fair Lawn, NJ

Beware Honey
—Lauri Yablick, Arlington, VA

Autohypnosis One method of making an engine stop smoking
—Robert Capon, Mastic Beach, NY

Ad nauseam Pepto-Bismol commercials

Dognapper A Doberman pinscher
—Diane Nagel, Cranberry Lake, NY

Ballyhoo The unknown pinball company

Arkansas What Noah used
—Carl Pearson, Montgomery, AL

Coral Where sea horses are kept

Exchange Money spent
—John Ray, Montgomery, AL

Acute angle 36°-24'-36"
—Chad Bladow, Wales, WI

Diode Eulogy
—L. Novela, Martinsville, IN

Burden of proof Hangover
—Shirley Montgomery, Tavernier, FL

Cube roots Ernö Rubik's autobiography
—Cathy Staff, Plymouth, MA

Alimony Check mate
—Valentin Weiss, Hamilton, Ont., Canada

Alimony Bounty on the Mutiny
—Keith Bogart, Ithaca, NY

Amenable What a good sermon is
—Irwin Fox, Hillside, NJ

Diehard Fossil
—Bruce Peterson, Nevada, IA

Bromate Sister-in-law

Centrum Cheap liquor
—Maria E. Wallace, Kansas City, MO

Cheese slicer Swissblade knife
—Gregg Law Williams and Jedidiah H. Joyce, Paso Robles, CA

Carousel Horsing around
—Ricky Keene, Circleville, OH

Atomic piles Severe disorder, treated with Preparation H²

Duckbill Last words heard by President McKinley
—Andy Staff, Plymouth, MA

Depend Best place to put the diving board
—John R. Littler, Pasadena

Bespectacle Second-rate epic movie
—David Hiltner, Portland, OR

Coincide What guests do when you vitamin
—Laura A. Taylor, Walled Lake, MI

Elf A bad hobbit

Enumerated What a mathematician gets after too many drinks
—Paul J. Heidt, Humboldt, IA

Cannabis Mexican/Colombian joint space program
—Bill Sherman, Boxford, MA

Apostrophe A gold cup with WORLD'S GREATEST FATHER inscribed on it
—Gina Buffington, Canoga Park, CA

Betamax Totally awesome radiation particle
—Dixon Osburn, Fort Worth, TX

Cheap shot Mexican golf stroke

Endophyte Knockout
—Heber Bouland, Silver Spring, MD

Custard Indian pudding
—Vicki Metcalf, Taos, NM

Bar sinister Speakeasy

Chinatown Dresden
—Debra Morgan, Springfield, VA

Epicenter The balance point of a dueling sword
—Lonnie King, Abilene, TX

Equivocal Horse's chorale also the neighs have it

Diatribe Weight Watchers
—P. J. Veber, Mount Pleasant, SC

Acrobat Small rodent with wings and a fear of flying

Doohickey Large red mark on your doo
—Alan Knight, Phoenix DO

EARTH

CONTINUED FROM PAGE 16

This new life-style Shepard adds left an emotional gap that scientists have yet to explore Conventional psychologists say children naturally bond to their mothers and then eventually achieve independence But as far as Shepard is concerned, throughout millions of years of human evolution a "secondary bonding also occurred Children completely immersed in the natural environment grew deeply attuned to Mother Nature As our bond with nature broke Shepard contends we suffered the same wrenching pain as a child cast out by its mother Crippled by hurt people grew to resent their ecosystems Shepard theorizes and they began lashing out in hope of getting some revenge

So agriculture became the villain the catalyst for an antiecological attitude that grew more pronounced over thousands of years No longer was the world inhabited by powerful spirits in the form of tigers and trees Instead, nature became man's private resource wasn't he promised such dominion in the Bible? And so King Solomon helped strip Lebanon of its cedars and the Greeks wiped out the lions of the eastern Mediterranean region

That angry destruction persisted through the Renaissance as vast forests were stripped and explorers set forth to ravage the New World The devastation accelerated during the Industrial Revolution when machines replaced animals farming declined as an occupation and large-scale industrial pollution was born And today? The path of destruction grows wider says Shepard as we pollute the Hudson dump chemicals in Love Canal and plunder the fragile rain forests of Brazil

Shepard s theory is neither cheerful nor popular and it is impossible to prove Psychologists after all don t believe that a person can experience nonhuman bonding Furthermore anthropologists see more savagery and wastefulness in hunting and gathering societies than Shepard admits After all it was probably primitive hunters scientists say who eliminated the mammoth the giant sloth and the camel from Ice Age North America

Shepard isn t arguing He admits that his theory—far from being scientific—is just pure philosophical speculation And aside from urging a generally greater exposure to nature, he's not even sure what solution to suggest "I may he says have one in another ten years

If there is hope Shepard concludes it may reside in the human spirit itself in the urge to save the buffalo to clean up Lake Erie, to hike in the wilderness or even to visit nature imprisoned in the local zoo Who will win this Jekyll and Hyde conflict between that tortured child and the well-meaning but latent adult? Think about it the next time you throw a rock at a pigeon or carve your name in a tree

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HNCAS

INTELLIGENCE

CONTINUED FROM PAGE 34

• The Otrona Attache A slick 18-pounder it has a 24-by-80 display that manages to be readable despite the five-inch screen At $3 495 the Attache is too costly for many Osborne buyers but its relatively light weight and glossy finish have won it wide acclaim in the marketplace

• The Epson HX-20 Battery operated the HX-20 is roughly as large as this magazine and weighs in at only four pounds It displays only four lines of 20 characters lacks even a single disk drive—most are heavier than the entire computer—and relies on a microcassette tape drive for long-term memory Software for it is only beginning to appear on the market But at only $795 it has been selling at a healthy pace about 10 000 units per month

• The Compaq one of at least five portables that claim to use programs and disks from the IBM Personal Computer (The others are the Computer Devices DOT the Computer Systems PC/8088 the Corona Portable PC and the Dynalogic Hyperion) At a base price of $2 995 it offers a lower cost way to use IBM software

• Commodore Business Machines new family of portable computers Based on the firm s Commodore 64 they offer one or two disk drives a five-inch monitor in black-and-white or color and a Z-80 microprocessor as well as Commodore s own 6510 processor chip Software sold with the machines includes word processing and a financial-analysis program And the Z 80 will allow the computers to use most standard programs written for the popular CP/M operating system At prices ranging from $995 to $1 595 the CBMs promise to sell fast

A growing market for portables seems sure to help all these computer makers and many others Future Computing a Texas research firm specializing in the microcomputer industry predicts that by 1987 portables will be selling at a rate of 1 4 million per year—fully one fifth of the microcomputer market four years from now

What will portable computers be like in 1987? We can t even predict what new machines will appear by the end of 1983 But there have been a few hints A recent bulletin from Kaypro speaks cryptically of new models And a major computer manufacturer is about to announce a lightweight portable We ve promised not to say who it is until next month s column

NEW WARES HARD AND SOFT

Not quite a portable computer the Colby PC-1 Conversion Kit supplies a nine-inch high-resolution monitor a power supply and an under-an-airplane-seat carrying case You remove the innards of an IBM Personal Computer and install them in the Colby shell The result a 26-pound portable personal computer electronically identical to the IBM ($899, from Colby Computer 2 Palo Alto Square Palo Alto CA 94304)

More portable than the portables is the Sharp PC-1250 a 0 25-pound pocket computer With built-in BASIC and a standard QWERTY-layout keyboard—too small for easy typing—the $110 hand-held computer supplies 2 2K of memory for programs and data A calculator-style display shows a single 24-character line Also available is the CE-125 interface accessory priced at $170 It adds a microcassette recorder for permanent program storage and a 24-digit printer using thermal paper The computer comes with an instruction manual geared to beginners (Sharp Electronics Corporation 10 Sharp Plaza Paramus NJ 07652)

Written originally for Data General minicomputers the Word Perfect word-processing system has been converted for use with the IBM Personal Computer and the Zenith Z-100 Unlike most programs Word Perfect displays text on the screen as it will be printed underlining and boldfaced letters appear as well as line and page breaks One text file can be printed while another is being edited and several files can be printed out with a single command (Satellite Software International 288 West Center Orem UT 84057)

EXPLORATIONS

CONTINUED FROM PAGE 40

natural element to their lives.'

Upon sighting the buffalo Koko, the wolf begins to trot, he circles the herd, seeking a weak or vulnerable individual. Teton, the hefty bull, advances, shaking his woolly head. Koko sniffs the ground; discovery of buffalo dung initiates an orgy of scent-rolling, a behavior the wolf shares with his domestic cousin, the dog. While this canine proclivity only exasperates the pet owner, for the wolf it is a means to convey information about the environment back to pack members. The two adversaries posture for about ten minutes. Then Koko retreats and this ecodrama, which once played continually on the American plains, ends. A single wolf and a healthy bison concludes Klinghammer, 'seem able to assess each other with very little overt testing. It takes a lot of wolves and a vulnerable buffalo to result in a meal for the wolves.'

For wild wolves, obtaining a meal can be a lengthy and arduous task; the pack may travel as far as 70 miles between kills to procure prey. The Wolf Park population, however, does not need to stalk its dinner. Road-killed deer (casualties of the Indiana highways) and livestock carcasses obtained from local farmers are fed intact to the wolves, which dismember the dead beasts and divide the spoils among pack members. Expression of hunting behavior is, by necessity, denied to captive wolf packs. But Klinghammer believes that much of the actual 'business' of the hunt involves the ripping and tearing of the prey's flesh. Dispatching the carcasses thus provides the wolves with an outlet for these instincts. Preliminary behaviors such as running and stalking, he says, are channeled through play. The feeding spectacle, admittedly, appears ferocious, but this too is governed by the social mores of the group. Higher-rank individuals eat first; lower ranks must wait their turn.

The most memorable experience at Wolf Park, however, is flesh-to-fur contact with this inimitable legend. With Klinghammer's supervision, visitors enjoy handling a friendly wolf and may even be honored with an affectionate but firm nuzzle, a wolf-to-wolf greeting. Socialized wolves are usually gentle with humans. Nevertheless, Klinghammer cautions that socialization should not be confused with domestication, the product of centuries of selective breeding. A wolf is not a dog and, under no circumstances, should be kept as a pet.

A longtime critic of the flourishing exotic-animal pet trade, Klinghammer is particularly disturbed by the recent surge in pet wolves and wolf hybrids; many spend their unusually short captive lives chained in the backyard. To date, Wolf Park has received 163 calls from individuals whose cute and cuddly pups soon outgrew their novelty status and became difficult and unmanageable adults. "A wild animal should be in captivity for one reason only: to serve as an ambassador for its wild fellows. Klinghammer insists. To keep a wild animal for entertainment robs the animal of its dignity. It may also prove to be a fatal mistake. Recently in Michigan, a toddler was killed by a backyard wolf that apparently perceived the child as prey.

In lieu of personal ownership, Wolf Park sponsors an adopt-a-wolf program in which the interested party pays for the animal's upkeep and in return receives regular updates about, and photographs of, his wolf.

Like the bison it hunts, the wolf has been exterminated throughout most of its natural range in the United States. Ironically, both predator and prey have fallen to the same enemy: man. And the battle is not yet over. On the frontiers of Alaska, the wolf is hunted annually from airplanes and snowmobiles. Minnesota recently enraged environmentalists by proposing a sport hunting season for its 1,000-strong lupine population—a move that follows the illegal killing of at least 250 wolves in that state last year. Wildlife biologists speak of reintroducing the species to national parks such as Yellowstone, but earlier conservation efforts proved discouraging. In 1974 a pilot project involving radio-collared animals released in Michigan's Upper Peninsula ended when all four wolves were found dead within seven months. Unless we educate people and through our research help the wolf in the wild, he will surely not survive," says Klinghammer.

On Wolf Howl nights, visitors join Klinghammer and his exuberant charges for a spontaneous songfest, and as the sounds of civilization blend with the voices of nature, the spirit of goodwill resounds through the air. One can only hope that man will someday learn to coexist with his canine brethren; for if the song of the wolf is silenced, the call of the wild within ourselves may well be stilled with it. ∞

For information about memberships, ethological studies and tours, contact Wolf Park, Battle Ground, IN 47920.

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FILM

CONTINUED FROM PAGE 30

carnival relic discovered in a collector's backyard and renovated by Richard McDonald, the Scottish designer who did the sets for *Altered States*. Principal photography was completed late in 1981. Then came trouble. "I don't mind admitting it because Disney agrees. I was given the short end of the stick," Clayton says. "The best special-effects people in Hollywood, other than the George Lucas people, were engaged on *Tron* and EPCOT [the model city of the future, near Walt Disney World in Orlando, Florida]. I got old men dating from Walt's days. They were the pits."

At last, *Tron* was wrapped up, and its special-effects team, under Lee Dyer, went to Clayton. "Dyer is a very, very charming man," Clayton comments. "very competent, very sensitive, very unlike most special-effects people. He was reassigned to *Something Wicked*, not because Disney appreciated Clayton's anxieties but because the studio wanted to keep the *Tron* crew together and was using my [$16-million] budget to do it." Clayton fumes. "While I was happy to get them, I was furious that I got lousy ones at first, that I got them only to suit Disney's needs."

There was more, perhaps, to Disney's assigning the *Tron* team to *Something Wicked*. As even Dyer explains, "The picture lacked magic. So he suggested changes in five sequences and the addition of 18 minutes of special effects. In proposing these changes, he had to balance the studio's investment with Clayton's pride."

Eventually, Dyer convinced the director with sequences like these. When the carnival appears in town, Clayton's version employed a puff of smoke, followed by a dissolve to the carnival, completely assembled. Dyer replaced that with two minutes of computer animation showing the carnival rising from the ground. In Clayton's version, the Dust Witch tracked the boys home. The studio built a mechanical arm at great expense to smash their windows; it didn't work. Dyer replaced that with a five-minute attack by 200 live tarantulas. "It's very vivid," Dyer says, smiling. "We've not left anything to the imagination." In Clayton's version, Mr. Dark was dragged to death when his foot became entangled in a carousel stirrup. In Dyer's version, Dark is pinned to the carousel by a bolt of lightning.

And so it goes. "We've made incredible shifts in the film to make it exciting. I don't like the words *fix it*," says Dyer. "I hate the word *saved*." But that seems to be the gist of what he's done. "Jack knew there were things wrong, but he didn't know how to correct them."

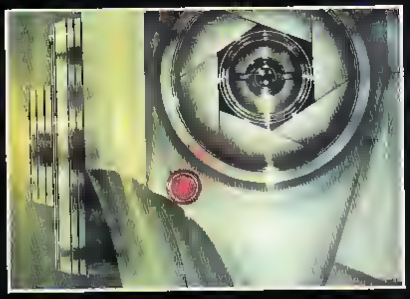
Now Bradbury and Clayton are excited about the film again. Clayton has even admitted his eagerness to try another effects-based film. Can his relationship with Bradbury endure it? "He loves me," says Clayton coolly. "I can't understand it." ∞

PHENOMENA

A specimen of *Chamaeleo jacksoni*, an ordinary horned chameleon, peers out at a slightly distorted world through its set of custom-made spectacles. It wore these lenses as part of an ingenious experiment devised by Oxford University naturalist Lindesay Harkness, who wanted to discover how these lizards flick their tongues out with such uncanny accuracy to hit and retrieve their insect meals. They do not gauge target distance the way people do, using the different perspectives of each eye (a technique called stereopsis). She found this out when chameleon spectacles with one blackout lens had little effect on the tongue-to-insect accuracy. Chameleons do, however, make precise distance judgments by using the focus of each eye. She proved this by having the chameleons wear a variety of spectacles that made an insect look farther or closer than it really was. Knowing the point of focus for each lens, Harkness was able to calculate exactly where an insect target would appear to a bespectacled chameleon. Invariably the tip of the lizard's tongue would shoot precisely to that point. In short, the chameleon does not use a crude aim-and-shoot technique but actually has a built-in range finder of remarkable precision. The tiny spectacles were crafted from opticians' test lenses and mounted on the chameleon's horns with a dab of beeswax to hold them in place. This photo was a time exposure taken with an "antique oscilloscope camera" and Ektachrome film by Harkness and her husband Perry Blackshear **DO**

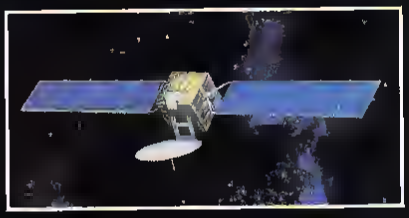
NEXT OMNI

FICTION



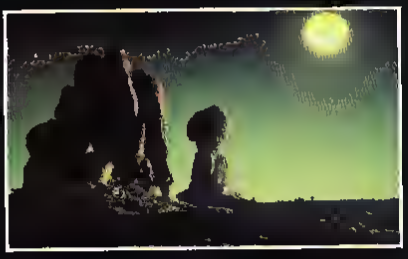
Larry Niven is best known in the science-fiction field for his Hugo- and Nebula-Award-winning hard-science novel *Ringworld* and for his powerful and popular collaborations, *Lucifer's Hammer* and *Oath of Fealty*. *Omni* excerpted the latter in the October 1981 anniversary issue. Next month *Omni* will feature Niven's newest work of fiction, "A Teardrop Falls." It's a tale of futuristic robot "berserkers," machines that have been primed by unknown masters to destroy every living thing in their paths. Also in June, Cherry Wilder's first story for *Omni*, "Kaleidoscope," shows how three lives are disrupted by a freak tropical storm that pulls the characters into another time stream.

COMSATURATION



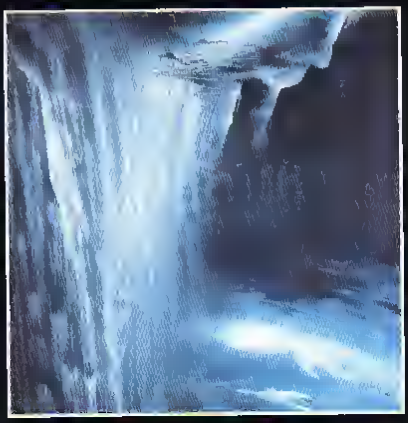
International business conferences with holograms of their participants sitting around the table. Rock shows, Broadway plays, even religious services that hundreds of millions of people attend. These will be some of the by-products of a quiet revolution now going on 22,300 miles out in space as the next generation of sophisticated communications satellite is launched. Read in the next issue of *Omni* how this amazing new technology could make our society truly global.

ROCKSONGS



To the Indian of the American West there is a mythical, magical quality to the world around him, particularly to the stones of the desert. In next month's *Omni* you will see the effort of one man, photographer Dan Morrill, to capture some of the allure of the monoliths of the desert. In a spectacular portfolio of images, rockscapes are transformed and reborn through the white magic of photochemistry. Barren landscapes vibrate with energy. The shapes of the desert become the stuff of dreams, surreal environments where stark vistas explode in a palette of vivid colors.

ORDER OUT OF CHAOS



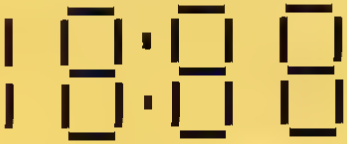
What is behind the random turbulence of a waterfall, the maddeningly unpredictable hop and skip of the ball in a roulette wheel, or the exasperating quirkiness of the weather that eludes the predictive powers of science? Get ready for a heady trip into *chaos*, a new intellectual discipline that tries to analyze what was once considered unexplainable. Employing the incisive intellect of mathematicians and the patience of Zen masters, a growing number of theorists have been working on the study of randomness, or chance. And their excursions into the netherworld of randomness have unleashed a zoo of bizarre discoveries—with names like "strange attractors" and catch phrases like "sensitive dependence on initial conditions." These insights are already providing us with new ways to study how the brain works, why random cells become individual people, how diseases afflict us, and even how society has evolved. Read about it in the June issue of *Omni*.

GAMES

By Scot Morris

This month's games include several of the best original ideas sent in by readers. Each gamester chosen will receive a one-year subscription to *Omni* (or a year's extension on a current subscription) and will be credited on the answer page. The items were selected to give a good mix of difficulty levels, from easy to hard.

1. ABOUT TIME. Most digital clocks showing hours and minutes have a display that includes the 23 line segments below.



(a) Which single segment is "on" more often than any other?

(b) Not including the two leftmost vertical segments composing the 1, which single segment is "on" less often than any other?

(c) What is the fewest number of segments "on" at one time, and when does that situation occur?

(d) What is the greatest number of segments "on" at once, and at what time does that occur?

2. SHONIX? What is the significance of the following letters, and what, if anything, belongs in the blank space?

S H O N I X ____

3. PROGRESS? Can you supply the next number in this series?

1, 5, 9, 15, 21, ____

We don't give hints facetiously, but if you think this is a mathematical question, you're on the wrong track.

4. TRUTH TIMES TEN. Each of the ten statements below can be answered either true or false. The list contains some of each type. Assign a T or F answer to each statement in the only way possible that satisfies all of them at once, without a contradiction.

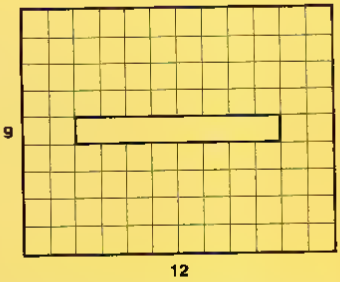
__1. The fourth false statement is odd-numbered.
__2. There are more false statements in the first six (statements 1 through 6) than there are in the last seven (4 through 10).
__3. There are at least five false statements.
__4. There are three consecutive true statements.
__5. There are at least as many even-numbered true statements as there are odd-numbered false statements.
__6. Statements 7 and 10 are either both true or both false.
__7. Of the last three even-numbered statements (6, 8, and 10), exactly one is true.
__8. Statements 6 and 9 can be true only if statement 10 is false.
__9. Statement 7 and the first even-numbered true statement are directly preceded by true statements.
__10. Statement 9 is false.

5. FILL-IN. What are the missing letters?

F T F T T T T F F F F S S S S E E __ O

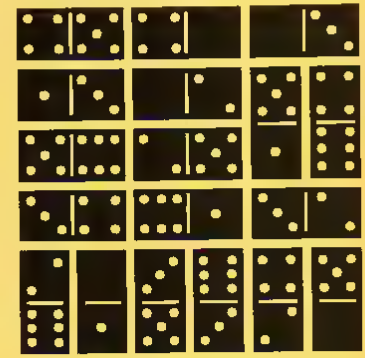
6. LET'S CUT A RUG. Carpet Town, at the Tri-City Shopping Mall, is having a closeout sale on just the rug you've been looking for. They're selling the 10′ × 10′ rug, which is exactly the size you need, at 33 percent off. On the other hand, they have a 9′ × 12′ rectangle of the same rug, which they will sell for 90 percent off because it is damaged—there is a 1′ × 8′ strip missing from its middle. (Seems this was a floor model, and there was this accident. Don't ask.)

Anyway, you decide to settle for the damaged rug (above, at right)—in part to save money, and in part because you are a gamester; you're intrigued by the challenge of finding the optimal way of cutting this rug to fit your 10′ × 10′ room. You have just the right area (9 × 12 = 108 − 8 = 100 square feet). What is the minimum number of pieces into which you will have to cut this bargain-bin special so that the pieces will fit back together in a 10′ × 10′ square?



7. HAPPY BIRTHDAY. Sam and Deborah Gindek are an unusual couple. They celebrate their wedding anniversary and both their birthdays on the same day—July 4. Sam says, "When I met Deborah, I thought it was so remarkable that we were born exactly seven years apart—I'm 2,555 days older than she is—that we decided to get married on our mutual birthday."

How old will Deborah be when July 4 comes around this year?



8. DOMINI. A Latin Square is an arrangement of numbers in a square wherein no number appears twice in the same row or column. It is often used in statistical research to assure that experimental variables are evenly divided—to compare different concentrations of fertilizer on a plot of

land that has a complex or uneven drainage pattern for example

The challenge here is to make a 6 × 6 Latin Square out of the dominoes in a standard double-six set There are a great many ways to do this; so it makes a nice solitaire game to let chance determine which dominoes you use From the 28 dominoes in the set you can discard the seven "doubles' right away—from blank-blank up to six-six From the remaining 21 randomly pick three and set them aside then try to arrange the remaining 18 into a Latin Square

In the example at lower left we have discarded the blank 6 the 1-2 and the 1-4 and have constructed a near-miss Latin Square out of the remaining tiles The columns are all right but the top row has two 4s and two blanks, the third row has two 5s and two 6s and the fourth row has two 3s Can you make a Latin Square out of the 18 dominoes shown?

9 FAULTLESS As a related problem note that the domino square shown has several 'fault" lines that extend straight through the square and divide it into rectangles There are three horizontal fault lines (below rows 1 3 and 4) and two vertical lines (to the right of columns 2 and 4) Ignoring the denominations of the dominoes can you arrange 18 of them into a square that has *no* fault lines, horizontal or vertical?

10 TEACH ME TONIGHT Michael was sitting in his favorite bar one night when in walked his symbolic-logic teacher, Professor Alexander Zymurgy, and ordered a dry martini up with two olives Michael who had already had a drink or two, picked up a large empty popcorn bowl and inverted it over the professor's drink "Doc," he said "I'll bet you twenty-five cents that I can drink your martini without touching the glass the popcorn bowl, or the table I won't touch them directly or indirectly, or have anyone or anything help me Is it a bet?'

When the professor said "Sounds good you're on" what did Michael do?

Answers are on page 148 ∞

Inscrutable For those with a taste for fine art toast or both we offer this tasty rendering, by Tadahiko Ogawa, of Kyoto, Japan of the famous Ms Lisa and her rye smile done entirely in toast

LAST WORD

By Ralph Harris

"Friends of the Earthmovers would be a coalition of heavy-equipment operators devoted to cleaning up the great outdoors by getting rid of the dirt. Not the litter. Just the dirt."

It is widely believed that the major obstacle confronting the environmental movement in this country is the attitude of big business, best summed up as, "Damn the bald eagles, full speed ahead." This assessment is an unfair generalization. Corporocrats are interested in the environment and the quality of life, and would be among the first to man the picket lines for a cause they believed in. Unfortunately, none of them have yet found a cause to believe in. So, with an eye toward rectifying this unfortunate situation, I recommend the immediate formation of the following ecology groups for businessmen:

Save the Real Estate

Appealing to California bankers and realtors, this group would mount protests on behalf of an endangered commodity, West Coast real estate. The cause of the problem is obvious: too many whales. All those 20-ton mammals lolling about in the ocean create the same effect that you produce when you sit down in a full bathtub. They make it overflow. Get rid of the whales and the Pacific will eventually recede, giving us all the real estate we need for building more homes, factories and whale museums.

Friends of the Earthmovers

A coalition of contractors, heavy-equipment operators and other construction types, this organization would be devoted to cleaning up the great outdoors by getting rid of the dirt. Not the litter, just the dirt. Everywhere you look in America there's mud, sand, rocks and just plain dirt. This is filth that you would never tolerate on your living-room rug, yet it doesn't get cleaned up, just because it's outside. The goal of FOE would be to raise enough money to pave the entire United States and build a giant, coast-to-coast condominium, 141 million luxury units with pool and Jacuzzi centrally located somewhere near Mattoon, Illinois.

Campaign to Quit Harping on the Seals

Furriers and spoiled wives could join forces to alert the world to the plight of the northern sealclubber, an endangered jobholder soon to be extinct if corrective measures are not taken immediately. The group could probably accomplish its goal with a lot of the usual media exposure as well as a constant barrage of high-level nagging.

Greenspeace

Any executive whose handicap is less than 15 would be urged to join this effort to save our nation's golf courses from being further destroyed by hackers. Legislation is desperately needed to amend the existing mulligan law (that revered statute requiring golfers to replace all their divots) to make failure to reinstate divots a Class A felony.

Shave the Walruses

Walruses are not an endangered species yet, but certainly there would be much more mating going on if these creatures weren't so ugly. Manufacturers of cosmetics and disposable razors could encourage ecologists to use their products to beautify these unattractive mammals. Trim their beards, put on a little blusher and eye shadow, and their mating could increase literally overnight.

The Campaign to Varnish the Redwoods

Lumbermen and manufacturers of furniture-care products who already respect the fact that the giant redwoods are the oldest living things on earth could unite in this organization. Their mission: Use their vast woodworking expertise to see that these mammoth plants last even longer for future generations to study, enjoy and polish.

Save the Cockroaches

Though not officially on the endangered list, the "harp seals of the slums" are being ruthlessly slaughtered for sport with shoes, newspapers, and even old copies of *National Geographic*. This is tragic. So-called slumlords might rally to the roach's defense and have their roach-infested buildings declared game preserves. This move would allow the slumlords to discontinue the cruel, and expensive, practice of hiring exterminators and might even make them eligible for special tax breaks.

Nader's Degraders

Concerned executives and corporate advocates would ally themselves in this organization to take on Big Ralph. The organization would act as a spokesman for a broad range of corporate complaints and might even air a weekly television show to counter all the unfair charges Mr. Nader made against its beleaguered members. Possible title: *Deface the Nation*.

OPECERS

An Organization of Petroleum Exporters Concerned with Exploiting Repulsive Sources. Oilmen and other energy people could do their part to protect the environment by promoting the development of new technologies that would make available the vast reserves of oil that teen agers have in their skin. It is quite possible through microengineering to install a small oil well on the tip of the nose; the well could yield as much as a barrel a day. Feasibility studies in this area could be underwritten by the purveyors and manufacturers of french fries and potato chips. ∞

Ralph Harris is a freelance writer based in Los Angeles. He takes great pride in never having voluntarily joined any organization, and has even turned down a free lifetime membership in The Friends of Ralph Harris.