

# Omni



FEBRUARY 1988 \$3.00

**SEX AND LOVE:**  
**HOW DINOSAURS**  
**DID IT!**

**ACUPUNCTURE:**  
**GETTING DOWN**  
**TO THE SCIENCE**

**VALENTINE SPECIAL:**  
**THE GREAT OMNI**  
**TREASURE HUNT**

**STARRY KNIGHTS:**  
**AMATEURS WHO**  
**MAP THE COSMOS**







# FIRST WORD

By Senator Claiborne Pell

• Our national science agenda should explore the full range of man's physical, psychological, and spiritual capacity in order to discover and understand the world of science as a whole. •

In my years on Capitol Hill the Senate has voted in more than \$90 billion for basic science research. Overall the taxpayer has received a valuable return on this investment in new knowledge and technology. But our science program has never been carefully developed and comprehensively evaluated to serve the people of the world in its fullest capacity. It's time for a general review of our national science policy.

The national views on science are predominantly reflected in the federal research agenda. For instance, the program directed by J. Robert Oppenheimer, out of which emerged the atomic bomb, was not carried out by a group of scientists hunkering around. These physicists were soberly responsive to the wartime dictates of the highest elected officials. They were carrying out the scientific research policy of the time.

Two years after the atomic bomb was dropped on Japan, Oppenheimer described the costs and consequences of his scientific accomplishments. When he said, "In some sort of crude sense which no vulgarity, no humor, no overstatement can quite extinguish, the physicists have known sin, and this is a knowledge which they cannot lose."

In 1957 initial Soviet satellite claims, substantiated by the Sputnik launch, had a profound impact on our nation. Sputnik sparked a major change in our own educational system. Science research funding for universities and federal predominantly to space exploration.

Today some of the national research projects are initiated by federal funding agencies that issue announcements on specific areas of research they are willing to fund. The rest of the projects depend on the initiative of the individual scientist to submit a research proposal for work that he is interested in pursuing. Either way, all research is geared toward traditional disciplines of science that the nation's policy considers worthwhile. Researchers who might want to work in areas outside the current policy envelope are not usually given any support.

Various methods are used to prevent research that is out of the mainstream from ever getting off the ground. One way to avoid unpopular topics is to manipulate the university curriculum by keeping controversial subjects out of the classroom. The serves to suppress knowledge and potential interest in the subject. Ridicule is also used to demean a scientist from daring to conduct research in unpopular fields. The most powerful suppression, however, is administered by professional journals that refuse to accept reports in nontraditional areas, such as research exploring the depths of human consciousness. This censorship severely reduces the opportunity to build interest

and potential insight into the various avenues of interdisciplinary research.

What process should be used to establish science policy and who should be involved? The process should be part of the normal business of Congress. The shaping of a national science policy could be accomplished in proper hearings, where all factions of the scientific community would have an opportunity to support their interests in one policy or another. The legislative process would then serve as implementation for basic research policy and guidance for the President of the United States. Because broad thoughts in science and technology may suggest new directions for inquiry, basic policy should be reviewed by Congress as necessary but the entire program should be evaluated every couple of years.

The National Science and Technology Policy, Organization, and Priorities Act of 1976 provides the nation's priority goals and makes a declaration of science policy principles. There are sound statements of goals in this legislation. One of these goals calls for American scientists and engineers to expand their understanding of man and his universe and to make these discoveries available at home and abroad in a quest for international peace, tranquility, dignity and well-being. Other stated goals address problems related to pollution, health care, energy and peaceful uses of outer space. But something isn't working. The words seem correct, but the effort and the energy should be greater.

I am somewhat saddened by the current administration's enthusiasm with gearing up our scientific establishment to be more competitive with those of other nations. There is a logical or moral justification for focusing our scientific energy on any objectives other than those that directly affect global survival. As Dr. E. Sverreus put it correctly when he said, "Nature is neutral. Man has wrestled from nature the power to make the world a desert or to make the deserts bloom. There is no evil in the atom; only in man's soul."

Our science policy should reflect far more than the current foreign and domestic policy of the nation. The full range of man's physical, psychological, and spiritual capacity must be explored in order to discover and understand the world of science as a whole. Our national science agenda should lead the world in acknowledging the need for a synthesis of these values and should focus on the priorities of such an undertaking. The result, I believe, will lead to solutions of current and future global problems. □

Senator Claiborne Pell, a Democrat from Rhode Island, is chairman of the Senate Foreign Relations Committee.

# CONTRIBUTORS

## OMNIBUS



FITZ



THE DUFFYING



LEE: THUNDERING WING



THE TASHING OF KUNES



KUNES

Everybody loves a lover." Doris Day sang in the *Pilates*, echoing the words originally written by Ralph Waldo Emerson: "Gee! I feel just about ten feet tall, having a tall," she exuberantly exclaimed. She might have felt differently, however, had she been a *brontosaurus*. Being 40 feet tall, with short, stubby legs and a monstrously long tail, for example, probably made making a little *quintessence* and certainly brought with it difficulties. But in any serious, meaningful relationship, partners can usually work their problems out.

*Dinosaurs* have long captivated our imaginations, but few scientists have seriously considered how the incredible prehistoric creatures mated. Beverly Helstead is perhaps the only one who speaks and writes candidly about the subject. In *Tyrannosaurus Sex: A Love Tail* (page 64) writer Sandy Fritz examines the unorthodox zoology professor's speculation about love among the dinosaurs. Although sexual organ fossils are hard to come by, Helstead has pieced together a kind of *Archaeosaurus Kama Sutra*, based on the beasts' own physiology and using today's birds and reptiles as models.

Fritz describes Helstead as having the boisterous of English explorer Sir Francis Drake and the honesty of American poet Walt Whitman. "He never edits or censors himself," Fritz says. "And he's not afraid" to approach and illuminate topics that are never talked about. "He focused on

dinosaur mating habits, for example, because everyone else had chosen to ignore the subject."

Stephen S. Hall's amateur astronomers (Star Watch, page 46) are lovers of a different sort. They are celestial amateurs. As reported by Hall, whose most recent book is *Invisible Frontiers: The Race to Synthesize a Human Genome* (Atlantic Monthly Press), these stargazers' equipment is less advanced and their methods are often less scientific than those of astrophysicists. Nevertheless, they have made noteworthy observations and important finds, like the comets that have gone on to be named after their individual discoverers. And professionals rely on amateurs to help correlate their own data.

Ellen Kunes's *Indignities for The Tashing of America* (page 40) turned out to be dishwashing and can be summed up in one dirty word: garbage. The nation's health care centers, laboratories and private doctors' offices, she discovered, may be some of the biggest threats to the environment and to health. Each year, hospitals alone churn out at least 15 million pounds of used syringes, bloody bandages, baby pants, and other types of refuse that pollute our air and water.

In past years, few states regulated the disposal of infectious waste. The AIDS crisis, however, has made government and health officials more concerned about the long-standing problem, and steps are now being taken to bring the situation under control. But, comments Kunes, a

contributor to *Omnis Future Medical* (McGraw-Hill), many people living near medical waste incinerators still seem to ignore the potentially hazardous situation. Visiting New York's Southwest Incinerator in Brooklyn, where the infamous garbage barge, finally anchored, Kunes saw health enthusiasts running around the site and playing tennis on nearby courts. Children romp in a neighboring park. Offshore, men fish for their dinner in waters where some say only half-pint jingies infected, two-eyed flounder roam.

Brooklyn also has some of the country's worst drinking water, while Manhattan has some of the best. *Arch Levine* reports on the other good... and bad water sites in the Earth column (page 20).

In this month's fiction, *The Gulf Wars* (page 52) writer Bruce Sterling takes readers to the Middle East. Sterling is the author of *Islands in the Net* (Arbor House, 1988). He also edited *Microstudies: The Cyberpunk Anthology* (Ace), a compilation of postmodern science-fiction stories by a number of authors whose work has appeared in *Omnis*.

Architect Michael Kalis's work has been featured previously in *Omnis* too. Some of his creations are also in New York's Museum of Modern Art. For "Less Than Zero Living" (page 70) the National Space Society's Greg Barr interviewed Kalis about his designs for a future space station crew's living quarters. The pictorial gives readers an astronaut's-eye view of his proposed module. **DO**

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## THE CORPORATION

Should I wear a corporate pin? The honest  
truth is that I don't want to. I don't want  
to be a part of the corporate system, and I  
don't want to be a part of the corporate  
system.

### EDITORIAL

OMNI magazine has established a reputation  
as a source of information and insight into  
the world of science fiction and fantasy. Our  
readers have responded enthusiastically to  
our coverage of the latest in science fiction  
and fantasy, and we have been honored to  
receive many awards for our work. We are  
proud to be a part of the science fiction and  
fantasy community, and we are committed  
to providing our readers with the best  
possible coverage of the field.

### ART

As the director of the OMNI magazine, I am  
proud to announce that we have received  
the 1987 Hugo Award for Best Magazine  
for our coverage of the science fiction and  
fantasy community.

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## LETTERS

# COMMUNICATIONS

### This Land Is Our Land

I agree with Gaylord Nelson [First Word  
November 1987]. Destroying miles of  
Alaskan tundra is ridiculous. Instead of  
trying to sink every last gallon of oil out of  
the ground, when is our government  
going to realize it should be thinking of an  
alternative fuel solution for the future? It  
probably doesn't matter to the interior  
secretary what this planet will be like in  
50 years, but as a freshman in college, it  
matters to me.

Amy L. Dowd  
Fishburg, MA

### Live and Let Die

I want to thank you for printing "Ancient  
Noel" [Explanations, December 1987]. I  
read it three or four times, and it brought  
tears to my eyes.

We live in a small commercial fishing  
community where my husband relies  
on himself and other fishermen like him as a  
last-dying breath. The desert people  
and the sea people have a lot in common.  
We know that we too are going to have  
to give up what is in our blood to do  
what is necessary for existence.

Patricia Degroot  
Sarasatchee, FL

### An Iron Glove

Setting aside the question of Congress's  
ability to process any amount of knowledge  
[When Robots Rule the World: Artificial  
Intelligence, November 1987] or do  
anything at all with it, is it even possible to  
build a computer as corrupt, self-serving,  
greedy, and incompetent as that agglom-  
eration of rump-sprung parasites? And  
what would it ever do with the billions of  
dollars it would steal from all the people?

A. J. Gordon  
Piscot Valley, AZ

"One of the young computer wheezes"  
from MIT Phil Agre may know computers  
but he knows very little about the field of  
psychiatry. He sees psychotic behavior  
developing in a computer program in  
much the same way it develops in a  
human as a result of inappropriate care  
in very early childhood. This is a destruc-

tive error for many reasons. We have  
finally lifted the awful burden of guilt off  
the parents' schizophrenia is finally starting  
to come out of the medieval closet, and  
scientific research is finally on the right  
track—a biochemical one.

Carolyn V. Athens  
New Britain, CT

### Robocopy

Which came first, the movie idea or the  
scientific breakthrough? I'm referring to  
VisiTek Corporation's CompuSketch  
software program designed to replace  
police artists with its "massive library  
of facial features" [Continuum, November  
1987]. Right? I see that in Robocopy?

Robert Barkan  
East Rutherford, NY

### Super Conduit

I enjoyed your article on superconductors  
[How to Make Your Own Superconductors,  
November 1987] and am pleased  
you explained in some detail how they are  
made. For those who would like to experi-  
ment with a superconductor but do not  
have access to all the materials and  
facilities needed to build one, it is possible  
to buy a superconductor test kit from  
the Nakamura Scientific Company Ltd.  
These kits have been used in various  
Japanese schools since the summer and  
are now available in the United States.

Sam Wida  
Garden Grove, CA

### Super Deadline

The deadline for the superconstruction  
contest (November 1987) has been  
extended to February 28, 1988.

### Birds of Omission

We neglected to state that several of the  
items shown in "Patently Absurd"  
[November 1987] were from the London  
Historical Collection of Electrotherapy  
and Quackery, owned by Dr. Olgert  
Lindan in Cleveland. Other photos were  
taken at The Bakken Library and Museum  
of Electricity and Life in Minneapolis.  
We greatly appreciate the cooperation of  
these museums. GG

# THEY'RE BACK

## FORUM

By Nina Guccione

In the beginning God created dinosaurs and He saw that they were good (pre-Apple days), but then He took them away—not so good. Never mind, clever marketing has brought them back.

Shop windows dressed in their Sunday best flank a toy store window stuffed with cuddly stegosaurs, disassembled triceratosaurs, and prehistoric models. Hardly a consumer product has escaped the magic of the dinosaur: clocks and cookie cutters, dinosaur egg-shaped soaps and party costumes, puzzles and games, clothing lines (will the image replace the alligator polo player, and tiger?). Somehow dinosaurs managed to waddle off the menacing Japanese movie sets, shrink into cute family units in Pee-wee's TV land, and tumble out of cereal boxes into our breakfast bowls.

We are being offered a choice between the past and the future—of whether we'd rather be at Disney's Epcot Center or Knott's Berry Farm's Kingdom of the Dinosaur. The same market that creates laser-light guns, interactive television games, voice-activated dolls, space rockets, and robots also promotes cuddly dinosaurs that don't talk to one another, let alone shoot at you or blow themselves up. Dinosaurs are no longer the sole property of museums or of men who spend years reconstructing an enormous figure from a rib and a toe.

Our perceptions of dinosaurs have changed along with their new packaging.

Dinosaurs left the realm of mystical, dragonlike creatures and entered the very real part of history—forms of life that quietly existed and innocently died. Scientists previously recognized these beasts as cold-blooded reptilians viciously battling one another, clumsy, stupid creatures who became extinct because they hadn't enough sense not to, as if the world had gotten off to a false start. We know so little about them, their aims and secrets buried deep in the earth.

Perhaps the dinosaurs' resurrection lies with recent notions that they may have been warm-blooded, agile creatures who cared for their young and thus evoke compassionate images of doleful, timid creatures with huge, clumsy bodies govtreated by tiny heads—vulnerable giants. Animals that lived off the land until the land claimed them back. Herbivores who spent their days grazing accessible vegetation, plodding in and out of marshes and lakes. Carnivores who hunted and killed for existence, not for brutal sport. Awkward mating, careful nesting, protective mothering—a simplicity that man can never debate or better. They no longer frighten children or divide the creationists and the Darwinists, science loves a good mystery, and the general populace loves a revival with a good cause.

The resurrection of this passive race is like a silent cry in disbelief that an entire population can just cease to be; it's a reflection of our own helplessness. We

as a race have never been so aware or accepting of our vulnerabilities. The power but not the right to destroy mankind lies within the reach of man. While grasping vainly at the past, we're anxiously groping for the future, defying the knowledge that once something is established, it can be unjustly taken away.

And what if they had survived to greet man? Would we have shown these stately beasts the courtesy of coexistence? Would we have cleaned their natural habitats by now, mounted their impressive heads on drawing room walls, corralled and tamed them, or found parts of them to spice up our sex drives? There have always been some people, whether deliberately or not, who take advantage of whatever is available, contributing to the expansive endangered species list. Dinosaurs were spared those indignities. I like to believe that dinosaurs are a sacred part of our heritage, children of primitive gods.

For many of us our first experience with dinosaurs goes back to childhood memories of school studies and outings, to fairy tales and morning cartoons, to ancient phantoms impressed in stone and in our imagination. Dinosaurs touch the same spot as kittens and teddy bears, they will always have a place in our collective and personal pasts. In preserving the images and ideals, we preserve a special part of our own being—one that is quiet, simple, and eternal. **CG**



From dinosaurs to dodos: Despite their extinction, dinosaurs are still awaking. Madison Avenue and toy manufacturers ensure the line goes on.

# SIMBAD THE SEER STARS

By Neil McAleer

Each time another astronomy research satellite goes up, a river of data comes streaming down. Astronomers now consider this flood of information a mixed blessing. As data have piled up, they have had to deal with a mass of facts that confuse rather than inform. Today, for example, more than 500 different astronomical catalogs exist, specializing in everything from red giant and white dwarf stars to spiral galaxies, and galactic superclusters.

To add to the confusion, a celestial object may have more than one name depending on where and how it is listed. "One of the major problems facing astronomers today is nomenclature," says Wayne Warren of the National Space Science Data Center in Greenbelt, Maryland. "It is common for a single object to have as many as thirty designations. As a result, astronomers unknowingly duplicate the research of colleagues or never learn of the work of others."

A powerful new tool called the SIMBAD database should help astronomers negotiate the murky contents of data. SIMBAD (Set of Identifications, Measurements, and Bibliography for Astronomical Data) promises to be nothing less than the ultimate reference tool for twentieth- and twenty-first-century astronomers. What began 15 years ago at the Strasbourg Astronomical Data Center in Strasbourg, France, as a modest effort to collect information from published works has now become the largest astronomical database in the world.

By clicking on their computers and logging on to the Telenet computer network, astronomers all over the world can access SIMBAD and get observational and bibliographic data on more than 750,000 celestial objects—stars, clusters, nebulae, galaxies, quasars, and X-ray sources. Just as important, an astronomer no longer has to worry about the babel of names that has complicated research. SIMBAD cross-references each cosmic object with 400 possible names, or designations, stored in its memory.

The core of SIMBAD is an enormous dictionary of stellar synonyms, called the

Catalog of Stellar Identification. An astronomer logging on to SIMBAD can ask about an object or group of objects and easily get all kinds of data on it: its coordinates, magnitude, spectral velocity. So, for example, if someone wants to compare the spectra of all dim red dwarf stars with a certain brightness in a small part of the sky near Orion's Sword, SIMBAD can deliver—and quickly.

Already huge—it contains information from some 20 journals—SIMBAD is continually expanding. More than 170 research centers in 20 countries are now using SIMBAD and contributing to it.

Eventually SIMBAD will absorb the enormous Guide Star Catalog created for the Hubble Space Telescope. It contains positional information on more than 20 million sky objects (see Stars, "Ultimate Catalog," February 1995). SIMBAD researchers are trying to bring other nations on-line. "The Soviets don't have access yet," says Warren. "But we're trying to get it hooked into Moscow."

The huge database is quickly becoming the main information resource for several

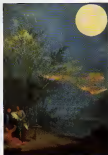
astronomy spotlights. Scientists at the Space Telescope Science Institute in Baltimore have been using SIMBAD to scout out specific cosmic objects for the Hubble Space Telescope to study. The most involved use of SIMBAD data will be to help plan the observing program for the European Space Agency's Hipparcos satellite, scheduled for launch later this year. It will stay aloft for two and a half years and during that time will make measurements of the positions and movements of 100,000 handpicked stars.

The astronomical community has already submitted a wish list of more than 700,000 candidates for Hipparcos. An international consortium of 100 scientists now has the job of winnowing out duplicate submissions or uninteresting stars from the pack. Such a feat would be impossible without SIMBAD. Once that is accomplished, the list will be updated one last time and beamed up to Hipparcos. With these data, the spacecraft will be making measurements from Earth to near and distant stars. These new figures will be about ten times more accurate than those obtained from here on Earth.

Astronomers all over the world agree that this science mission will give us a more accurate yardstick to measure the universe. "The data from Hipparcos," says Freeman Dyson, physicist at the Institute for Advanced Study in Princeton, New Jersey, "will produce a wealth of new information about the constitution and evolution of stars and about the dynamic behavior of the galaxy."

As SIMBAD grows, forging links with databases all over the world, its directors see it becoming the central clearinghouse for information from thousands of observations and astronomy departments. And in the years to come it will offer more sophisticated services. Some future astronomer might be able to tap into SIMBAD and, with a special software program, have the computer draw entire star fields on his screen.

And then, declares SIMBAD's associate director, D. Egret, "we will finally have a clear picture of our galactic structure and our whole solar neighborhood." □



SIMBAD: Old stars in a brand new catalog

# WATERGATE

## EARTH

By Rich Levine

**S**evere diarrhea, nausea, vomiting, bloating, dehydration, and weight loss—these symptoms recently plagued residents of Long Lake in New York's central Adirondack Mountains. After detecting *Giardia lamblia*, a one-celled parasite commonly carried by beavers, state health officials promptly declared the local water undrinkable. Outbreaks of giardiasis, or "beaver fever," have been reported all over the country—from Scranton and Pittsburgh, Massachusetts to Aspen, Colorado, and Butte, Montana.

Giardiasis is only one example of water-borne illnesses that have afflicted 85,675 Americans since 1971 as a result of groundwater contamination. The water we drink comes from two sources: surface water (springs, streams, and rivers) and groundwater—the liquid hidden beneath the earth in reservoirs called aquifers.

Every day we consume 230 million gallons of groundwater, emanating from a variety of sources. Before it gushes from the kitchen tap, this water may have helped to irrigate farmland, picking up herbicides, pesticides, and fertilizers along the way. It may have begun as an icy mountain spring following a path to a river that passes under a manufacturer's discharge vent—one that spews a hash of degradable and nondegradable wastes. The groundwater you drink may also have mixed with a number of toxic substances that leach down through the soil and flow into reservoirs.

In many regions all that stands between our taps and the toxic soup is a sewage treatment plant. "These plants are designed to remove organic wastes—primarily household wastes from the kitchen and bathroom," says Melinda Casson, an Environmental Defense Fund (EDF) staff attorney.

But according to Casson, sewage plants aren't equipped to separate such inorganic toxins as heavy metals, pesticides, and degreasing agents that seep into the water before it enters the sewage plant. When that happens the quality of treated water may be no better than when it first entered the plant.

To understand the severity of our water-pollution crisis, listen to the numbers: More than 200 potential contaminants—from industrial solvents and pesticides to cleaning preparations and septic tank degreasers—have been routinely detected in groundwater, according to EDF science associate David Fanning. And there are more than 60,000 toxic chemicals now being used in American industry and agriculture. "The fact that we don't find all sixty thousand means that we aren't looking for them," says Fanning.

Seventeen different pesticides and herbicides have been found in drinking water in 23 states, including Kansas, Nebraska, Illinois, Missouri, and Minnesota. Another form of water pollution, a by-product of unchecked well drilling and strip-mining, has ravaged underground water resources in southern New York and eastern Ohio. A labyrinth of some 100,000 gas and oil wells has poisoned the water in four northwestern Pennsylvania counties and threatens the entire state's water supply.

Each region of the United States has its

own special mix of water contaminants. But there's one pollutant that can be found everywhere—lead. Nearly one in five Americans drinks excessively lead-rich tap water, according to Environmental Protection Agency (EPA) estimates. In fact, drinking water is thought to be the principal source of lead in the bloodstream. Lead contaminates city water systems, especially where water is acidic, or soft, corroding lead conduits and lead solder used to join copper piping. In adults, lead poisoning can cause a slew of symptoms—insomnia, constipation, anemia, and dehydration—but it is particularly dangerous for children up to age nine, exposing them to myriad physical ailments including hearing loss, brain damage, and kidney impairment.

Other contaminants—including arsenic, barium, calcium, chromium, copper, mercury, and zinc—are common in our water supply. In high concentrations they can cause liver and kidney dysfunction and cancer, wreak havoc on our reproductive and nervous systems, and increase the incidence of birth defects. Yet in the last ten years the EPA has identified and set limits on only 26 of the potential drinking-water contaminants known to cause health problems.

To date there has been no national legislation explicitly intended to protect groundwater. In 1972 Congress passed the Clean Water Act, aimed at restoring and maintaining surface water. The Safe Drinking Water Act of 1974 expanded federal responsibility for keeping drinking water clean, encouraging the construction of sewage-treatment plants. But no law has yet proved effective. "The acts' general approach to dealing with water contamination is to set acceptable limits on how much of each contaminant may be dumped into our water supplies," says Fanning. "There is little toxicological data though on whether an 'acceptable' limit actually exists for many of these contaminants. The latest amendment to the Clean Water Act, passed in 1987, will provide \$10 billion to help communities across the United States build sewage-treatment facilities and promises \$2 billion



America's watercoo. Not a drop to drink.



# VIRAL INTRIGUE

## BODY

By Richard Walkomer

**O**n April 19, 1955, U.S. government medical officials abruptly suspended distribution of human growth hormone because several patients who'd received the substance had died. The hormone, extracted from the pituitary glands of corpses and used in the treatment of dwarfism, had become contaminated with Creutzfeldt-Jakob disease. A rare but always fatal viral illness, Creutzfeldt-Jakob attacks the brain and causes disorientation, muscle atrophy, and premature dementia in middle age.

Microbiologists have since classified Creutzfeldt-Jakob with several other degenerative brain diseases they say are caused by prions—one of several newly discovered "subviral infectious agents" thought to prey on viruses. Colloquially known as subviruses, these corporeal parasites are even smaller than viruses and may prove even more dangerous.

Viruses themselves come in infinitesimal packages: a strand or two of infectious DNA or RNA (the gene chemicals) coiled inside a protective protein shell often as small as one-tenth of a micron across.

Yet these agents of infection can penetrate a cell's walls, commandeer the genetic control panel, and turn the hapless cell into a virus factory.

Although conclusive work on the nature of subviruses remains to be done, scientists have identified at least six different strains: satellite viruses, viroids, virusoids, virogenes, and plons. Strangest of them all, they say, are the prions, which seem to be mere dots of protein.

University of California researchers discovered prions in San Francisco in 1982 while studying a neurological disease that afflicts sheep and goats. They found that the disease, called scrapie because its victims compulsively scrape off their wool, was caused by an agent too tiny to see even through an electron microscope. It seemed to be a pure protein with no discernible DNA, but it could attach itself to cells and replicate.

"When talking about the edge between chemicals and life forms," says David Kingsbury, assistant director of the National Science Foundation,

in 1985 research teams from the

University of California at San Francisco, Caltech, and the University of Zurich demonstrated that prions do have DNA—but not their own. Instead, they say, prions exploit the protein in their host cells in order to reproduce. The University of California team, led by Dr. Stanley Prusiner, began by sequencing (determining the precise chemical structure of) prion protein obtained from hamsters infected with scrapie. They then made a synthetic DNA sequence to represent the prion protein's genetic code.

Their next step was to use the synthetic DNA to isolate and clone the particular hamster gene that encoded the prion. At this point Prusiner found something he wasn't expecting. Though he was able to confirm that the infectious prion protein existed in the diseased hamster's brain cells, the genetic material encoding it was also present in the brains of healthy hamsters. More experiments followed as Prusiner attempted to resolve the conflict. Eventually he traced the discrepancy to a substance called PrP.

Healthy nerve cells in species as diverse as hamsters and humans produce PrP, a protein, as part of their normal functioning. Prions seem to be an infectious perversion of normal PrP, invading prions force their host cells to manufacture this pernicious version, which then takes over the body's nervous system. It's an insidious process. PrP is a normal cell product, so the immune system ignores even its virulent form.

The normal protein's three-dimensional structure probably changes, transforming it into the diseased form, says Kingsbury. But we don't know what the chemical basis for that modification is.

Researchers have now linked prions to several similar diseases of the central nervous system known as slow viruses because the incubation periods between infection and development of symptoms are so long. The diseases thought to be caused by prions are Creutzfeldt-Jakob, kuru (a neurological disorder peculiar to New Guineans who eat the brains of their dead relatives during ritual feasts), and Gerstmann-Sträussler

CONTINUED ON PAGE 36



The mystery of the striding wool: When sheep shew, they often suspect the itch of scrapie.

# NASA'S ATTIC

## SPACE

By John Vacca

**T**his summer visitors to the Museum of Flight in Seattle will view a remarkable piece of space history. On display, the command module *Spacecraft 007*, used by just about every Apollo crew that flew into space. As part of the astronauts' preflight preparation, each space-bound crew rode inside *007*—sometimes for days—in the Gulf of Mexico to learn how to survive on the open sea. This was part of what was called egress training, in which recovery teams practiced plucking crews and *007* out of the drink.

No visitor would guess that just last summer this gleaming craft was a water-logged hulk that had been rusting away in an open lot in Fort Worth, Texas. The transformation from a pile of scrap to a space artifact was performed inside a warehouse in Hutchinson, Kansas. Part of the Kansas CosmoSphere and Space Center (KCSC), the warehouse contains one of the world's largest space artifact restoration complexes.

The KCSC is considered to have one of the nation's great collections of space

artifacts—meticulously restored space suits, satellites, and even rockets from past programs of space exploration. Every item in its collection was saved from the junkyard by the center's seven-member restoration team.

The center's expertise at turning junk into museum pieces grew out of necessity. "We had no intention of getting into the restoration business," explains Max Ary, executive director of the center. The museum began its collection back in the mid-Seventies, when NASA started releasing space artifacts to the public. Museums like the Smithsonian Institution's National Air and Space Museum, he says, had first choice, "and we were getting the hand-me-downs, so to speak. The pristine condition of virtually all of the artifacts we have at the center is not the state in which we received them. Many of the items came to Hutchinson in parts or as disassembled units that normally would have been destroyed as junk."

The museum got its first major piece, a Gemini 2-A space capsule, in 1979. When Ary came across it at Holloman Air

Force Base in New Mexico, the capsule was just a shell. The inside had been completely gutted; a puddle of water had collected on the floor, and the outside was scarred and pitted with rust. Before the museum curators could put it on display, they had to do some heavy-duty reconstruction. And so the idea for a restoration team was born.

"It wasn't easy to start," Ary recalls. "We couldn't advertise in the local Hutchinson newspaper for a 'spacecraft builder.' So in the beginning we looked for people with good mechanical skills and the ability to work in fine detail. One of the first people we hired had a background in building musical instruments, doing intricate inlay work on guitars, building tubes and harpsichords."

Over time the team members became self-educated specialists. As part of their research they consulted with experts at the Air and Space Museum and the Marshall Space Flight Center in Huntsville, Alabama, studied the blueprints of all the craft they worked on, and assembled an enormous library of reference photos. The staff has reached such a level of skill that "we have people who have literally memorized control panels," says Ary. "They can tell you where every bolt and switch should go. Their eye for fine detail has been used in at least one nonmuseum project. It was the KCSC's staff that made or restored all the authentic-looking space suits, spacecraft, and other equipment used in the 1965 television miniseries *Space*."

To date, the team has restored five manned spacecraft, two rocket engines, three satellites, and more than 24 space suits. But the KCSC's considerable resources were up against a severe challenge when the Apollo module was uncrated after its journey from Texas. Part of the control panel was missing, and the thousands of switches still there were pitted from rust and corrosion. Five members of the restoration team spent four months taking the entire module apart, removing every nut, bolt, panel and gauge. "It's not that simple a process," explains Ary. The command module



Apollo space suits: From the earth to the moon to the junkyard and finally to a museum.

# STIFF SENTENCE

## MIND

By Paul Rabburn

**T**oday there are 37 juvenile delinquents awaiting execution on death row. After examining 14 of the current inmates, Dorothy Otnow Lewis, professor of psychiatry at the New York University School of Medicine, found they had numerous psychiatric, neurological, and cognitive problems that had not previously been identified. What is more, the majority had been abused both physically and sexually.

Most of the juveniles Lewis examined had never been examined by psychiatrists or neurologists. "Little or nothing was known about their psychological conditions," Lewis says.

Based on her research, Lewis and her colleagues have come up with a new psychiatric classification: the limbic-psychotic-aggressive syndrome.

According to Lewis, these death row inmates, like other violent juveniles, share a common life history. As kids, they suffered severe beatings. As teenagers, many of the violent delinquents repeatedly attempted suicide or experienced paranoid thoughts and visual or auditory hallucinations. In addition, many suffered from symptoms commonly associated with psychomotor seizures, although few were epileptic.

Because most violent juveniles display these kinds of neuropsychiatric symptoms only occasionally, routine examinations do not uncover the signs. And the kids themselves hide the evidence, unwilling to talk about parental abuse, blackouts, or paranoid thoughts. A number have said to Lewis or her examiners, "I'm not crazy" or "I'm not a retard. They'd rather be 'best' than insane."

Teenagers she studied had suffered severe accidents as children. Some had fallen from trees; others had been hit by cars or trucks; one had been shot in the right temple. These accidents, injuring the central nervous system, sometimes caused serious neurological problems including frequent blackouts, dizzy spells, lapses of memory, dreamlike states, and seizures.

Alone, none of these factors—abuse, brain injury, hallucinations—create a

violent person. After all, most brain-injured people and most psychotic individuals are not violent. Lewis says, "And not all abused people are violent either." It is, Lewis asserts, the combination of neurological disorders, occasional psychotic symptoms, and severe physical or sexual abuse that creates a violent person. Based on these, Lewis and her colleagues began to develop information about the limbic-psychotic-aggressive syndrome.

For 15 years Lewis has studied the relationship between physical abuse and the development of violent behavior. In one study comparing a group of juvenile offenders with a matched group of youngsters who had not been in trouble, she found that the delinquents had made more visits to the hospital and had suffered more accidents and injuries. She then compared violent delinquents with less violent offenders. Again she found the more violent teenagers had sustained severe head injuries and were more likely to display psychotic symptoms.

When she interviewed adult criminals on death row, she again discovered a

history of family abuse, psychotic symptoms, and neurological disorders. One man, on separate occasions, was beaten with two-by-fours by his parents, fell into a pit and remained unconscious for three hours, was in a car accident and fell off a roof. "As incredible as that seems," Lewis says, "it was not unusual. Most of the death row inmates I examined had brutal histories." At the time of trial or sentencing, this information would have been relevant to the issue of mitigation.

Her idea has been contested by Paul Appelbaum, professor of psychiatry and law at the University of Massachusetts Medical School in Worcester. "Lewis has proposed a theory and only a theory," he says. "It has some experimental support in lower animals, but it is unproved in man. Until we really know that the syndrome exists and what its characteristics are, there is enormous potential for it to be used inappropriately."

According to Appelbaum, most murderers claim that they really didn't plan to kill, that their violence was an impulsive outburst—something just snapped. Theories like Lewis's can be picked up by aggressive defense attorneys, who are always looking for a handle with which they can clear their clients, says Appelbaum.

But in June 1986 the Supreme Court ruled in *Ford v. Wainwright* that prisoners who become insane cannot be executed and that a convicted lawyer may present evidence that their client is insane, even after his conviction. Lewis recently became involved in the case of a death row inmate. The court had originally judged him sane, without allowing psychological or neurological evidence that would have played his execution. Multiple head injuries have left him with a visible dent in his head. The right and left sides of his brain do not communicate with one another as they should. His right side is weak, indicating brain damage. He can't even remember whether he is accused. When Lewis asked him if he did it, he said,

"There's a fifty percent chance I don't remember. There were two of us." **DO**



Nobody knows the trouble they've seen



# CONTINUUM

## THE OOPS FACTOR

**T**hey were accidents, all of them: radioactivity, penicillin, vulcanized rubber, nitroglycerin, vitamin C, X rays, radar, pulsars, electromagnosism, LSD, ceramic superconductors, the Pap smear, anesthesia, vaccination, the Big Bang, and the surgical rubber glove. All of the preceding discoveries and more were products of serendipity: the aptitude for making fortunate discoveries accidentally.

We like to think that science marches on thanks to an orderly and systematic approach to research, in fact, our funding system for research is based on the belief that one can manufacture breakthroughs by throwing money at scientists who promise discoveries according to neat timetables laid out in standardized grant proposals. Now these scientists have challenged this whole notion, suggesting that scientific progress may in some sense be regarded as one long run of spectacular good luck.

John Christman, Rustom Roy, and Patrick J. Herman co-chaired a symposium called "The Role of Chance and Serendipity in Science" at a recent meeting of the American Association for the Advancement of Science. The trio not only regaled a packed house with examples of unforeseen discoveries but spoke of the encouragement serendipity should be given by the scientific establishment. Christman, retired professor of biochemistry and director of research graduate studies at Loyola University in New Orleans, puts the matter succinctly when he says, "You have to have serendipity for a great discovery. You can't think beyond the current paradigm."

The word serendipity appeared in 1754, when the English writer Horace Walpole wrote to a friend about the Three Princes of Serendip, fairy-tale heroes from Ceylon who had the art of "making discoveries by accident and sagacity of things which they were not in quest of." Walpole named this quality serendipity and it has been frequently present in laboratories ever since. Its most recent appearance came of last year's Nobel prize ceremonies. Two IBM researchers were cited for their work in discovering the new ceramic superconductors. These men worked long and ingeniously and were certainly rigorous in recognizing the potential of their discovery—except that they had been searching for a material that would be completely nonconductive.

Serendipity has also made a recent appearance at Upjohn, the pharmaceutical company, which may soon be selling a drug

called Rogaine as a cure for baldness. At Upjohn a research group was testing a high blood-pressure drug called minoxidil. It worked, but there were a host of "unfortunate" side effects, the strangest of which was sudden hair growth. Minoxidil was about to be thrown into the trash can of scientific history when some body at the company stopped thinking blood pressure and started thinking hair. The research that followed led scientists to understand for the first time the biochemistry of hair growth and appears to be on the verge of earning Upjohn the gratitude and money of balding humans everywhere.

Even so, such discoveries are hardly encouraged. The problem for scientists today, as Christman sees it, is that "research funds are granted only for safe science, not for revolutionary science." In his view, Newton couldn't tell the National Science Foundation, "I'm going to go sit under an apple tree and see what happens and expect to get funded." Yet Christman et al. are not suggesting that just anyone given a little luck can churn out discoveries. It would make sense to fund Volvo mechanics to come up with a unified field theory and don't expect your plumber to solve the riddle of fluid turbulence. Louis Pasteur—who discovered the principle of vaccination when he accidentally shot up a bunch of chickens with a virus that had been stored on a hot shelf for a few months—put it best when he said that "chance favors only the mind that is prepared." What Christman, Herman, and Roy want is some official recognition of the role of serendipity in science. More important, they'd like the National Science Foundation, as well as other agencies that control the scientific purse strings, to put their money on a person, a scientist of good repute, whose only goal is to see what he can see.

Serendipity after all, does not eliminate the need for good scientists. Perhaps the best example of this is one Professor McFadden of Britain's Royal Veterinary College, who back in the nineteenth century told his students that the spores of a fungus, similar to common bread mold, had once contaminated one of his bacteria cultures, an effect decidedly inimical to the bacteria. If this happens to you, the savant told his pupils, "the only thing to do now is to throw the culture away." In 1928 the same thing happened to Alexander Fleming. But he didn't throw the culture away. Eventually the active ingredient of that contaminating mold was isolated. It's called penicillin. —PETER EDGON



# CONTINUUM

## TAMING CANCER CELLS FOR THE BRAIN

Scientists have long dreamed of the day when they could cure such degenerative brain disorders as Parkinson's and Alzheimer's by replacing diseased brain cells with healthy transplants. But when to get the healthy cells? Early experiments with animals used brain tissue from animal fetuses: a procedure sure to cause enormous controversy if human fetuses were ever used. So the search has been on for a universal donor: a line of jack-of-all-trades nerve cells that come from some place other than the human brain. Now a neurologist from the University of Rochester has come up with a promising, if startlingly unlikely candidate: a line of cells that occur in a certain form of childhood cancer.

D. M. Gash used a group of these cancer cells, called neuroblastomas, from the intestines and spinal cords of

afflicted children, implanting the cells with drugs to keep them from dividing cancerously. He then injected the "tamed" cells into damaged areas in the brains of monkeys. Although some of the grafted cells died many others survived as long as nine months, and some of these even showed signs of actively integrating themselves into the hosts' brains. Encouraged, Gash then tried transplanting neuroblastomas into the brains of rats with a memory dysfunction similar to Alzheimer's and found that the new cells did indeed help restore some memory function.

Gash emphasizes that his findings are preliminary and that many steps—and undoubtedly many years—will intervene before the procedure will ever be tried on humans. But he does find neuroblastomas a promising alternative to human brain cells. Certainly, he says, "this work is a step forward." —Bill Lawren



Alzheimer's patients: Cancer cells from children have been used to treat monkeys with a memory dysfunction similar to Alzheimer's.



We'll need nuclear rockets to make it to Mars and beyond.

## NUCLEAR ROCKETS

Space travel enthusiasts have long been clamoring for a nuclear rocket propulsion system—one that would make interplanetary journeys possible. As far back as the Sixties the Air Force ran a program—called Rover—aimed at developing a nuclear engine that could power a trip to Mars. But Rover was phased out in the early Seventies because it clearly didn't have immediate practical application.

Now the Air Force has announced the start-up of a new, more practically oriented program that holds out promise for long-distance space travel. The goal of the Safe Compact Nuclear Propulsion program is to develop a nuclear-powered engine that would provide an inexpensive form of thrust for orbital transfer vehicles

(OTVs). These are rockets that would ferry satellites from one orbit to another or shuttle up to their own orbital orbits.

Major Donna Vinent, manager of advanced space systems for the Air Force, says nuclear is the way to go because it yields about two times as much thrust per pound of propellant than does a conventional chemical system. And with shuttle payloads carrying costs ranging from \$2,000 to \$4,000 per pound, the Air Force expects the fuel-weight savings of a nuclear system to pay off handsomely.

Although the new Air Force program is limited to engines for OTVs, Vincent notes that once a workable nuclear propulsion system is developed, NASA could easily scale up the existing technology for use in interplanetary spacecraft.

A nuclear engine would operate on a principle similar to that which drives commercial nuclear reactors: In the propulsion system, however, heat generated by the nuclear reaction is used to expel a so-called working fluid, which in turn propels the rocket. By the late Nineties the Air Force hopes to have built and ground-tested its first such engine.

—Madeline Chinnici

Trying to define yourself is like trying to take your own teeth.

—Alan Watts

It's futile to talk too much about the past—something like trying to make birth control natural.

—Charles E. Wilson

## NEWTON'S MISTAKE

For more than 300 years Sir Isaac Newton's monumental *Principia* has been considered a shining example of mathematical perfection. But hold everything. An undergraduate physics student at the University of Chicago has recently uncovered the unthinkable, but previously undiscovered, error in the great master's calculations.

It started as a routine exercise in a history of science class. Robert Garisto's task, given to him by Chicago astronomy professor Noel Swadlow, was to work through the calculations in *Principia's* Proposition Eight Book Three, in which Newton had derived, among other things, the mass of the earth. But when he did the math himself, Garisto found an enormous inconsistency: Newton's own calculations, which should have led him to a figure that placed the earth's mass at one one hun-



These days, even a good close look at Newton's calculations reveals a few slipshod moments. A recent fix-up of a special night-vision exhibit at a planetarium.

dred nearly four thousandth that of the sun, instead placed the figure at one one hundred sixty-nine thousandth. That's a substantial error of some 15 percent.

Garisto dedicated a practically sleepless week to checking out six earlier editions of *Principia* and found that Newton had made small changes in one of the values he used for the mass calculation but had neglected to incorporate those changes in the final version. And once made, how did the error slip by three centuries of mathematical vigilance? Says Garisto, now a graduate student at the University of Michigan: "People just assumed it was right."

—Bill Loonen



Newton's gravity. (R) Copyright by the artist.

I believe in sex and death but experience that come once in a lifetime.

Woody Allen

## MUSICAL URINALYSIS

Can't carry a tune? Maybe your bladder can. Now scientists have figured out how to turn a urinalysis into music.

Using a computer and a Moog synthesizer, Michigan State University (MSU) biochemists Charles Sweetley and John Holland have transformed graphs produced by lab instruments into music. Although what results is stored rather than melodic, you do end up with a musical urinalysis that can be heard as well as read.

Most people, including scientists, think we are pulling their legs, says Sweetley, no pun intended. "There are funny aspects to this work, but we also see some important applications. Most modern scientific instruments constrain analyses to only one sense—sight. It's a def-

iciency. In some cases another sense might be more appropriate."

In other words, chemical analyses turned into music can help fight information overload. Important data that might be missed by tired eyes skimming over a boring graph may be picked up instantly when turned into music. A sour note, so to speak, in a urinalysis could warn a doctor instantly that a patient has diabetes or some other disease.

According to Sweetley and Holland, potential applications include industrial quality control, in which analyses are relatively simple and repetitive. Sweetley also thinks a heart beat could be set to music in the operating room, allowing doctors to listen to what a heart is doing rather than having to constantly glance at a monitor.

—Joel Schwartz



# CONTINUUM



Activated charcoal: Commonly found in odor filters and cigarette filters, it's now also being used to rid the body of cholesterol.

## BUS FOR CHOLESTEROL

Activated charcoal makes a terrific filter, used in everything from fooped Odoor Filters to water and cigarette filters to poison antidotes. Soon it may fill a new role: lowering blood cholesterol.

Dr. El-Friedman, a medical researcher at the State University of New York's Health Science Center in Brooklyn, discovered this during research to find a way of reducing the number of weekly dialysis treatments kidney disease patients had to undergo. Surprisingly he found the charcoal he was using in six-week studies on 20 patients reduced their cholesterol and triglyceride levels by 40 percent.

The charcoal does not become absorbed by the body but instead picks up fat molecules like passengers on a bus and heads for the nearest exit ramp out of the body. This is one reason Friedman considers it poten-

tially safer than conventional drug treatments, with fewer side effects for the nearly half of all American men who have cholesterol levels high enough to possibly increase their risk of heart disease.

Though Dr. Friedman has conducted rat studies and found that charcoal had the same lipid-reducing effects as in his patients, he insists that further long-term human studies—on nonkidney patients—are necessary to determine charcoal's effects.

My evidence shows that it should work, but in science every point must be hard won. —Gregg Levy

Education is a method by which one acquires a higher grade of prejudices.

—Lawrence J. Peter

"God is the tangential point between zero and infinity."

—Alfred Jarry

"Who says I am not under the special protection of God?"

—Adolf Hitler

## SWEAT SUCK

Underarm sweating is usually only an annoyance for most. But what about those with profuse sweating problems? In many cases drugs or electrical stimulation fail to control overactive sweat glands. Now a new spinoff of the surgical technique known as liposuction (sucking unwanted fat from almost any part of the body) may provide relief.

Frederick Grazer, M.D., associate clinical professor of plastic surgery at the University of California, Irvine, has perfected a technique of sucking up fat ducts and sweat glands from armpits. Traditionally, supersensitive sweat glands are removed through incisions, but the procedure requires skin to be cut or folded back so sweat glands can be removed from underneath.

Grazer's technique, however, employs a simple nylon insert a tiny tube through a pea-size incision in the armpit. When the vacuum tube is run back and forth just under the skin, fat is scraped loose and sucked up. Sweat glands go right along with it.

Both armpits can be done in about 20 minutes in a doctor's office with very little postoperative discomfort, says Grazer, who introduced his technique two years ago at a medical symposium. Any board-certified plastic surgeon can do it, he notes. The jury is still out, though, on whether traditional treatments for profuse sweating are any better or worse than the liposuction technique. Conventional procedures

normalize sweating in about 85 to 90 percent of cases. Grazer does not have a statistically valid track record yet because thus far he has performed the procedure on a relatively small number of patients.

Two Japanese plastic surgeons, however, have conducted more than 2,000 underarm liposuction operations—all with apparent success—and Grazer, meanwhile, has a nine-month waiting list. —Michael Duke

"At no time is freedom of speech more precious than when a man hits his thumb with a hammer."

—Marshall Lumsden

"Science cannot stop while ethics catches up, and nobody should expect scientists to do all the thinking for the country."

—Elen Stockman, president of the American Association for the Advancement of Science, 1950



Now there's a new treatment for the overly sweet.



Cheyenne the cheetah, 19, has lost his artificial hip. The 100-pound animal is using his artificial hip.

## LEOPARD HIP

It was after a particularly vigorous session of lovemaking that Cheyenne went lame again. His artificial hip implanted three years earlier on account of his arthritis had loosened under the stress of his activities—leaping 30-foot cliffs and doing his utmost to keep his species, the endangered Himalayan snow leopard, from disappearing from the face of the earth. Doctors hastened from Sacramento, California, to Canada's Calgary Zoo to see him.

The loosening and failure

of reptile limbs, after all, is an all-too-common occurrence among arthritis sufferers, even if they are elderly and sedentary. But the solution found for Cheyenne holds out hope for all of them.

Already distinguished for being the first feline recipient of a total hip replacement in 1989, Cheyenne recently underwent surgery to replace part of his replacement. He now sports a new hip rocket, made by Technipeds of California, that doesn't depend on glue to hold it in place. Instead, the titanium implant is covered with patches of wire mesh into

which Cheyenne's own bone is expected to grow, forming a natural, durable bond.

Cheyenne's specialists, both from the University of California at Davis School of Medicine, are Howard Paul, a veterinarian who is using the new hip implants in dogs, and William Bargat, who is trying them on people.

Not only is the new design cementless, Paul says, it is custom-fitted. Working from X-rays and CAT scans, technicians build plastic models of the patient's bones and mold the artificial joint to fit them. Most conventional implants, by comparison, are 'off the rack,' although they come in a wide variety of sizes and shapes.

—Davis Sobel

## ODD PEOPLE

Have a great-aunt who wears only purple? A neighbor who's working on a perpetual-motion machine? They're just the kind of people psychologist David Weeks of the Royal Edinburgh Hospital is looking for.

Weeks, who is researching eccentric behavior, has studied about 1,000 folks so far who can best be described as odd. For example, there's the man with trap doors in his dining room. He pushes a button, and a dining guest drops to the cellar, Weeks relates. Weeks has also found four Robin Hoods—one wears green shoes and a plumed hat and carries a bow and arrow seven days a week.

Weeks notes that many eccentrics are inventors, and a British computer firm

recently expressed interest in some of the backyard scientists Weeks has uncovered.

While people like the "doctor of frog psychology" who carries frogs around with him, may be strange, Weeks says they are rarely crazy. "We tested one hundred thirty eccentric subjects and found only one who was mentally ill," he explains. Evidence suggests that up to five percent of patients diagnosed as manic or schizophrenic were just eccentrics under stress.

Eccentricity actually seems to be good for people, Weeks says, pointing out that many historically documented eccentrics lived unusually long lives. "These are curious, happy, creative people with a sense of humor. They aren't suffering from stress," he states. Most say they are never sick. —Sherry Baker

The end of the human race will be that it will eventually die of civilization.

—Ralph Waldo Emerson



Eccentricity may be one key to happiness and long life.





## CONTINUUM



Black hole: If the theory of a London astrophysicist is right, the existence of these weird stars may be seriously questioned

### NO BLACK HOLES

The force of gravity has always been one of physics' knottiest problems. To explain the attraction of one object for another, theoreticians have had to conjure up everything from "energy exchange" in which larger objects actually "donate" potential energy to smaller objects that come within their gravitational fields to Einstein's "curvature" in space which allows objects to "fall" toward one another.

Now there's a new entrant in the great gravity derby: Richard Wayle, an astrophysicist at Imperial College in London, has done calculations

that, he says, promise to explain gravity in terms of what he calls mass loss. Wayle thinks that objects may actually convert tiny portions of their mass to kinetic energy, setting themselves in motion. Gravity itself comes about when two objects exchange the momentum of that motion via tiny (and as yet undiscovered) particles called "superpositively enough" gravitons.

Wayle claims that his mass loss theory eliminates the need for curved space to explain gravity. It also questions the existence of black holes, the infinitely dense collapsed stars that appear to swallow everything

that comes near them. In his scheme of things, Wayle maintains, those collapsed stars would still perform the same gravity tricks now attributed to black holes but would have finite densities, making them much easier to explain.

So far, Wayle's ideas have attracted neither attention nor the financial support he needs to go on developing them. They seem, he says, good, naturally, to clash with the status quo.

—Bill Lawrence

### MURRAY FOR MEDIOCRITY

A job worth doing is worth doing half-assed.

That advice comes from Dr. Robert Kohlenberg, a psychologist with the University of Washington's Center for Psychological Services. Kohlenberg says there are two problems with the old adage: (1) a job worth doing is worth doing well. "And of all it doesn't promote tasks

he says. And the other problem is that it doesn't specify what is meant by doing the job well.

Of course, that doesn't mean you should be mediocre in all things. The idea is to stop wasting energy on the little things so you can spend more time on big things. For example, Kohlenberg got an architect to do progressively more sloppy work on preliminary drawings—cutting his proposal preparation time from two weeks to a single day. The architect blossomed with the change because he had more time to put into the drawings that counted. In another case, a career woman/housekeeping perfectionist learned to tolerate a single clean plate left on the counter, then a dirty one, and then a full mess's worth.

Kohlenberg cautions that not everyone needs his advice. Some people don't put effort into anything, but for those with time management problems, he advises them to take a look at where they are putting their energies. "Some things, he says, you really should do the best you can. Things related to your career or significant relationships." But those with a shortage of time just might be "doing too good a job on extra tasks that don't deserve it." —Grant Fjermedal

Do you think you can take over the universe and improve it?

—Lao Tzu

All the world is not a stage—it is a television.

—Cathy McCabe



## SPACED-OUT MEMORY

Remember the old grade school maxim: Say a new word ten times quickly and it's yours? Now the results of a long-term study by a pair of psychologists may turn that bromide into an old wives' tale. In fact, say Harry Behnck of Ohio Wesleyan University in Delaware, Ohio, and Elizabeth Phelps of Princeton University in New Jersey, if you want a new word to stick in your brain for the long haul, it's best to space out the initial repetitions over a much longer period of time.

Beginning in 1979, Behnck and Phelps had a group of students learn the Spanish equivalents of 50 English words. Some of the students learned the Spanish words in forced feedings, with many repetitions of the word in a single day. Others learned them at a much slower rate, in some cases receiving repetitions only after intervals of 30 days. Eight years later, the students were

tested for long-term recall. Those who had learned the words in one-day cram sessions recalled only 6 percent, while those who learned them over 30-day intervals remembered as many as 25 percent.

Would this "spaced-out" method work for learning more complex knowledge systems like music or math? Although its effectiveness is difficult to determine scientifically without special learning methods and special long-term tests, Behnck's hunch is that the principles will apply to almost any subject you'd learn in school—music, mathematics, even what you know about baseball. —Bill Lawren

*"I had nothing to offer anyone but my own confusion."*  
—Jack Kerouac

*"A sketch is one would have confused Einstein."*  
—Anonymous

## TIGHT COLLARS

Tight collars and neckties can be hazardous to your eyesight.

That's the verdict of a study by Susan Watkins and graduate student Leonora Langan of Cornell University's textiles and apparel department, who wondered if the pressure from clothing had a physiological effect on the body.

The researchers took a look at how 94 business men wore their ties and found that 67 percent were wearing ties tighter than the natural circumference of their necks. Specifically, two thirds of



Do you see dead pilots—with their ties and collars military tight? Unfortunately, tight collars prevent air to get to lungs.

the excess tightness was due to the necktie and one third to the shirt collar.

Along with an ophthalmologist, Langan and Watkins then examined visual acuity in 22 men. They suspected that tight ties would diminish retinal function by impinging on the carotid arteries of the neck and cutting off blood flow to the retina.

They were right. The men took the critical flicker frequency test, which measures the rapidity of visual response to the changing frequencies of a blinking light.

The subjects lost about five test with their collars and ties loosened, then tightened, and then loosened again. Visual performance dropped significantly between the last look and the upright conditions and remained partially depressed when the men loosened up again.

Watkins wonders what the

effects of ties and tight collars might be on men who need good vision (such as pilots) what happens over an eight-hour day, and how the elderly, who may already have carotid artery blockage, are affected.

It would be interesting to change the design of the collar and the tie, while keeping their usual appearance the same, says Watkins. —Paul McCarthy

*"one can build a mind from many little parts, each mindless by itself."*  
—Marioninsky

*"It's not that I'm afraid to die. It's just that I don't want to be there when it happens."*  
—Woody Allen

*"In writing, I shall always punish myself, shoddy to the truth, except when it is attended with inconvenience."*  
—Mark Twain



Cramming may not be the best way to learn a new language.



# CONTINUUM

## RAMANUJAN'S LOST NOTEBOOKS

As he lay dying in 1920 at the age of thirty-three, one of the greatest mathematicians of our age, Srinivasa Ramanujan, did some of his deepest mathematical work to distract himself from the pain. His deathbed notes—140 loose sheets containing 640 formulas, and pages and pages of indecipherable mathematical scribbles—have been discovered by Pennsylvania State University mathematician George Andrews. Only about 20 percent of the formulas, Andrews says, have been independently arrived at by other mathematicians in the 68 years since Ramanujan's death.

Ramanujan, born in Madras (now Tamil Nadu), India, in 1887, was asked to leave college after his first year because of his poor performance in every subject except mathematics. He married a nineteen-year-old woman, got a job, and played with mathematics in his spare time. In 1913 he wrote to the eminent English mathematician J. H. Hardy describing some of his results. Hardy called his introduction to Ramanujan "the one truly romantic incident in my life." He arranged for the brilliant young Indian to come to Cambridge in 1914. Five years later, weakened by illness, Ramanujan returned to India, where he died. His family sent his papers to Cambridge, where they lay unused until Andrews stumbled on the locked sheets in a box at Trinity College Library in 1976.

The formulas in the loose notes are Ramanujan's results; none of them are accompanied by proofs or revelations of any kind. "It's still mysterious how it brought them up," Andrews says. About 400 of the 640 formulas have already been proved true, and Andrews is confident most of the remaining ones are true also.

Having a dead genius for a collaborator obviously has its frustrating side, but it has been Andrews' great adventure. His thought processes were so different from everybody else's, Andrews explains, "and the things he discovered are so surprising to me, it's very exciting to learn from this guy." —Leah Walcott

Of the delights of this work, I must confess most for me is the vicarious journey, yet he has left us out of his heaven.

—Mark Twain

## GALACTIC COLLISION

Of all the scenarios for a world-ending apocalypse, perhaps the most majestic is one that calls for a catastrophic collision between our Milky Way and some other galaxy. Astronomer Marshall McCall of the University of Toronto has devoted a good deal of study to reexamining the likelihood of this scenario ever coming to pass, and he has bad news and good news. Yes, the collision (or at least a close encounter) is coming, but we won't feel a thing.

The Milky Way, McCall explains, is linked by gravity to a celestial neighbor galaxy



Without fuel, our galaxy's ultimate fiery demise will follow years of turbulent collisions with Earth's starry sky.

known as M31. The two galaxies orbit a common center of gravity, and McCall calculates that their present course will bring them very close together in about 4 billion years. As they approach each other, the night sky will undergo a spectacular (if gradual) change. M31 will, in McCall's words, fill the sky—sort of like having another Milky Way.

And what about here on Earth? Tsunamis? Earthquakes? The final demise of insurance companies? Nothing of the sort. McCall assures us: Even if the galactic close encounter tears our solar system right out of the Milky Way, all the planets

Earth included, will still orbit fast to the sun because our "local" gravitational bonds are so much stronger than even the forces of intergalactic collision. In fact, McCall says, our newly independent course might even give us a decent view of our own Milky Way. The whole thing, he says reassuringly, is nothing to worry about. But it will be an exciting event!

—Bill Lawren

The sun, the moon, and the stars would have disappeared long ago had they happened to be within reach of predatory human hands.

—Havlock Ellis

# THE TRASHING OF AMERICA

BY ELLEN KUNES

AIDS seems to have invaded every aspect of our lives. It has wrecked the nation's blood supply, gutted our sex lives. We live & may somehow taint our food and water. We see AIDS everywhere—even in our garbage. Last fall June some Indianapolis school children looked at their summer vacation with a fear for a trip in which to keep a baby bird. The children navigated through an unmarked trash dumpster behind a medical clinic and uncovered one box full of syringes and needles packed with vile of blood—two of which were drawn from the clinic AIDS patients. The kids examined the can and had it under a bush, where it was found by another group of neighborhood youngsters. These children took the body behind an apartment house and divided the spoils: some grabbed the needles and drew in the air with their while others snatched the blood-filled vials apart.

PAINTING BY MILOŠ SOBAIC



● *AIDS may have provided us with the incentive to solve a separate dilemma—one that might have begun to plague us only in the year 2000 and beyond.*



a well. Of the 13 children who had handled the infectious garbage, seven may have been exposed to the AIDS virus. Two of the children—a brother and a sister—who had played with the blood had open sores from poison ivy, making it possible for the deadly virus to enter their bloodstream. One boy with a cut on his foot walked through the blood. Another tested it.

In Boardman, Ohio, a second group of kids discovered syringes in an open dumpster and played doctor for an afternoon by jabbing one another in the arms with used needles. And in Ocean County, New Jersey last August, a 50-mile stretch of hospital waste fouled the tourist-packed shores with hundreds of hypodermic needles and other infectious debris. Local officials closed the beaches for 72 hours to clean up the mess. While authorities first suspected it was dumped by unscrupulous private haulers paid by hospitals to cart their infectious waste off to commercial incinerators, New Jersey officials now believe that the hospital trash was dumped by a New York sanitation barge on its way to a Staten Island landfill.

Experts estimate that each day 15 million pounds of infectious, or "red bag" waste emanate from the well-scrubbed

halls of this nation's 7,000 hospitals. In addition, the contaminated garbage from research labs, nursing homes, outpatient clinics, and the offices of private doctors and dentists must be hauled away. In past years, many states had no regulations and few guidelines to control the infectious waste stream. Local and state health departments simply advised that potentially dangerous refuse be handled in a "safe" manner. In most cases, that meant that pathological wastes such as tissue specimens, organs, amputated limbs, and body fluids were burned in the hospital incinerator or double bagged and tossed onto trucks bound for the local landfill. Other types of refuse, including drug waste "sharps"—hospital materials with sharp points or edges, such as syringes and scalpels—and contaminated bandages and bedding from patients with communicable diseases, were often chucked out with scraps from the hospital canteens and the rest of the ordinary garbage.

The AIDS crisis, however, has changed everything. Hospital housekeeping staffs and sanitation workers have never much liked getting stuck by hypodermic needles poking through plastic garbage bags. Now many fear there is a deadly disease lurking on the tips of those needles, and state and local authorities have been forced to act. The race is on to regulate the disposal of infectious waste.

The United States has always had a garbage problem—one easy to ignore. Environmentalists rage about our throwaway society and doom-and-gloom futurists forecast overflowing landfills and mountains of refuse surrounding our cities.

In general, we accept these predictions with far less interest than we might the news of a royal rift between Charles and Diana. A little ordinary garden-variety trash doesn't seem so bad after all. On both coasts we swim alongside chicken bones, six-pack holders, and used condoms. At the New Jersey shore, children no longer scour the beaches for seashells. Instead they search for sea whistles—used plastic siphon applicators that have washed up onto the once pristine sands.

The offensive nature of hospital garbage—the bloody gauze pads and intravenous tubes and urine bags, the used syringes, and the decaying umbilical cords and diseased organs—have always made us want to keep it out of sight. What we once found revolting—the infectious waste stream—we now fear may be health threatening as well. After swimming in trash-infested waters, people who contract routine maladies like ear nose, and throat infections can't help but wonder what else lurks in their bodies. Could they have gotten AIDS from hospital-waste-laden waters? Frightening incidents like the ones in New Jersey have mobilized the public's fear of hospital waste. Coupled these suspicions with the mysterious deaths last summer of bottle-nosed dolphins along the East Coast, 420 of them washed ashore, badly decomposed, apparently having succumbed to some type of immune system disorder. A few sea mammal experts speculated that ocean pollution could have killed the dolphins—and the public wondered whether an AIDS-like virus derived from tainted hospital refuse had infected these animals.

In focusing attention on the garbage problem, AIDS hysteria has performed a valuable public service. The problem of trash is finally receiving widespread attention. In 1978, before anyone had ever heard about AIDS, the Environmental Protection Agency (EPA) tried to set down some rules governing the disposal of infectious waste. Nothing was concluded.

"As far as we could see, health threats from mismanagement of infectious waste didn't exist," says Jacqueline Salais, the EPA's chief of regulation development for land-disposal restrictions. "We know it's a good idea to put needles and scalpels in rigid containers. But what about a Band-

Above: When the battle of the barge ended after 6,000 miles and 152 days at sea, the garbage came home to New York.

Aid with a few drops of blood on it? Is that really going to spread disease? The problem is, we don't have any data." There's nothing out there, according to Sales, that experts can look at and say, "Gee, we know that a tube of blood, once it leaves the hospital and goes to a landfill, will infect some body with a disease three days later." We also don't know," Sales explains, whether burying infectious waste in a landfill allows organisms to survive, migrate downward and contaminate the groundwater.

As recently as last October a House of Representatives subcommittee proposed a bill to regulate infectious waste. "No epidemiologist or other medical expert who testified thought federal regulations were necessary," Sales says.

Researchers must first determine whether infectious waste proves to be really that dangerous—or at least more dangerous than the rubbish the average American family creates every day. William Rutala, research associate professor in the Division of Infectious Diseases at the University of North Carolina and a representative for the Association for Practitioners in Infection Control at congressional hearings, isn't so sure. "From a purely scientific standpoint, there's no microbiological evidence that suggests hospital waste is more infective than residential waste," he says.

In one West German study, he explains, common pathogens that cause urinary tract infections, bronchitis, and pneumonia

were detected more frequently in household waste than they were in hospital waste taken from a surgical unit and a nursing station. The West German researchers verified the results of two earlier studies comparing hospital and household garbage. Those studies have at least one drawback, however: Waste from patients with communicable diseases such as hepatitis B was not examined.

So does hospital waste spread infectious diseases, or AIDS in particular? No says Walter W. Bond, research microbiologist in the Hospital Infections Program at the Centers for Disease Control (CDC) in Atlanta. "It takes gross and sometimes repeated exposures to blood and/or blood-contaminated body fluids to become infected with the AIDS virus." The reason, according to Bond, is that AIDS has an incredibly low number of viruses per milliliter of blood, and the smaller the number of viruses in the blood, the more difficult it is to transmit the disease.

For instance, in the HBV (hepatitis B) virus, which is highly infectious, there are a hundred million to a billion viruses per milliliter of blood—equal to about fifteen drops," Bond explains. "That's a lot of virus. But the AIDS virus has only one to one hundred bugs in a milliliter, depending on the stage of the disease."

Furthermore, the AIDS virus is a fragile one. Even at optimum temperatures it dies quickly when exposed to the environment.

Only three reported cases of health-care workers have tested positive for the AIDS virus. All three were reported to have small cuts or other breaks in the skin through which the virus may have passed, and one was splashed in the mouth with AIDS-contaminated blood.

The hepatitis B virus, however, is not easily killed. According to CDC epidemiologist Craig Shapiro, "Hepatitis B requires high temperatures to kill it. Dried blood on a surface may still have infectious virus in it several weeks later. Hepatitis B like AIDS is a blood-borne, sexually transmitted disease. Simply touching the virus won't infect you, but a job with a contaminated syringe or a splash of infected blood in the eye can put you at a 10 percent risk of developing the disease. Furthermore, the number of people infected with hepatitis B is escalating. The CDC estimates between 250,000 and 300,000 will become infected with hepatitis B this year.

The bottom line: While the risk of contracting AIDS through infectious waste is very slim, potential exposure to hepatitis B from hospital garbage does exist. "We should err on the side of caution," suggests Rutala. Although he doesn't support federal legislation, he believes that individual states should manage infectious wastes. All states should regulate two types of waste, he says: "Stocks and cultures of infectious agents from microbiology labs and other research labs should be carefully controlled." The other, he says, are used sharp objects of any type. "These should always be placed in rigid containers, out of the public's reach."

Rutala worries that in the hurry to regulate officials are overlooking the dangers posed by small generators of infectious waste: private physicians, dentists, medical labs, small clinics. Even the bill before the House exempts private physicians and small clinics," he says. "But they throw their waste, untreated, right into a dumpster or a sanitary landfill. Obviously if you believe that some of this waste is infectious, the origin of that waste makes no difference."

A panel of experts, convened by the EPA, gathered in November to discuss federal regulation of infectious waste. In a "Letter to the Hill," Sales says, the committee suggested the EPA examine the need for tracking infectious waste.

Congress, however, still believes that garbage is a state and local issue. The proposed House bill, for instance, never made it to the House floor. And state governments have passed new bills on infectious waste. Now some officials admit their new laws aren't creating an infection-free panacea. A fresh set of complicated problems has emerged. As infectious waste is banned from municipal incinerators and sanitary landfills, hospitals are forced to seek costly alternatives. Some send their waste to expensive commercial incinerators, while others hire private haulers to truck the garbage to the nearest incinerator—often up to 500 miles away. What's



ARTICLE

*With dedication and simple  
telescopes, amateur astronomers are  
helping to map the universe*

## STAR WATCH

BY STEPHEN S. HALL

**B**ack in 1979 astronomers from the University of California at Berkeley launched a high-powered automated search for supernovas: those rare and short-lived spears of intergalactic light that signal the fiery explosion of a star. Nobel laureate Luis Alvarez was godfather to the project, and his protégé Richard Muller organized the team. Muller, a talented astrophysicist, would soon popularize the public with his Nemesis theory, in which he hypothesized that a "death star" shadowing our sun was the cause of the periodic comet showers that, among other things, may have wiped out the dinosaurs.

The Nemesis theory attracted funding, which got the supernova search off the ground. The Berkeley team roared into automated astronomy with Ph.D.'s and postdocs, a big 30-inch telescope, computers programmed with state-of-the-art customized software—all the firepower, intellectual and technological, of twentieth-century science.

The idea that an amateur astronomer, working on his own with a beat-up old telescope on the other side of the world,



could rival the Berkeley juggernaut, never entered anyone's mind—which is how Robert Owen Evans became, in effect, the Berkeley group's astronomical nemesis.

By day the soft-spoken Evans serves as pastor for one of several Uniting Church congregations in the small Australian town of Hazelbrook, New South Wales. At night he typically wheels his telescope out of the garage, much like an Aussie suburbanite rolling out the barbecue and sets it up on a patch of concrete next to his driveway. Then he begins to scan the skies. Professional astronomy has yet to design a computer that can keep up with him.

Evans has committed about 1,000 galaxies to memory, and he visually visits up to 700 of them each month, weather and moonlight permitting. And so, for example, on the evening of February 27, 1987, Evans examined a "very faint" and definitely out of place smudge of light that he'd noticed several days earlier in the galaxy NGC 5850. Convinced that the object was a previously undiscovered supernova, he asked colleagues in Australia to verify the sighting. Two hours later he was on the horn to the International Astronomical Union's Central Bureau for Astronomical Telegrams in Cambridge, Massachusetts, where they have grown accustomed to his late-night calls. Yes, they informed Evans, as they had so many times before, he had spotted yet another supernova. Soon after, the bureau alerted astronomers throughout the world that supernova 1987B had just been discovered.

Since 1980 the Berkeley group has identified three supernovae. In that same period Evans has tagged down 15—all but four of the supernovae tagged by amateurs in this century. Many were spotted with a self-assembled 10-inch reflector telescope that Evans, modest almost to a fault, dismisses as "second-rate."

Almost to a fault. All those discoveries are marked—like notches on a gun—along the body of the telescope. This one-man harvest of exploding stars destroys the myth that amateurs have nothing to contribute in an age of radio telescopes and automated searches, of speckle interferometry and synchrotron luminosities.

Evans' achievement is "truly remarkable," according to Brian Marsden of the Harvard-Smithsonian Center for Astrophysics. "In spite of their sophisticated equipment, professional astronomers can't cover as many galaxies as Bob Evans does with his eyes and his memory," he says.

But Evans is not the only star in the amateur constellation. Others include his fellow countryman William Bradford, who discovered his thirteenth comet last August; Brian Manning of Birmingham, England, who has won accolades for his careful and copious measurements of comets; and Tsutomu Seki of Kochi, Japan, who some believe is the greatest amateur of

them all. Seki, who gives guitar lessons for a living, has personally discovered some 62 minor planets (or asteroids) and 6 comets "recovered" (or been the first to re-sight) 12 comets on their periodic returns, and logged 973 astrometric observations. So prodigious are his achievements, the local government has built a personal amateur observatory for his private use.

Yet another amateur, Albert Jones of New Zealand, played an unheralded role if what is considered the astronomical event of the century, Supernova 1987A, reckoned to be the brightest supernova in the sky since 1604, flared spectacularly into life in the nearby Large Magellanic Cloud on February 24, 1987. University of Toronto astronomers, using a ten-inch telescope at Las Campanas, Chile, are generally credited with spotting the supernova first, but the International Astronomical Union acknowledges simultaneous discovery by amateur Jones.

Not all amateurs can make an immortal

◆ *Amateurs assume all sorts of postures—bobbing in hot tubs, lounging in lawn chairs, or perhaps even balancing on a ladder while peering through a skylight on a winter night* ◆

discovery of course, and some don't even want to. They are amateurs in the true sense of the word. They simply love (amare in Latin) to look at the stars.

When an amateur astronomer leaves a building and goes out, says Heather Couper, the last thing he does is look up at the sky. "Of course, admits the president of the Junior Astronomers Society in Britain, this has resulted in people tripping and falling into holes. But it also refers to that deep abiding urge we all have to comprehend the mysteries of the cosmos. "Amateur astronomers actually want to make their contribution to finding out about things and understanding what makes the universe tick," says Couper. "Even if they don't tell anybody else, at least they know in their own minds. There is the kind of secret communion."

In pursuing this communion, amateurs assume all sorts of postures—bobbing in hot tubs, lounging in lawn chairs, or perhaps balancing on a ladder while peering through a skylight on a cold winter night. They'll wear boxes on their heads to block out the light, and they'll stand in a gale if they have to (the air it is said is particularly

limpid then). They'll even hang out of a bedroom window like the chap in England who spotted a novae-like star with half a pair of binoculars. Manhattan's beleaguered skywatchers sometimes wait until the janitors turn off the spotlights on the Empire State Building to begin their nocturnal watch. And one enterprising amateur, consigned to living in Seoul, Korea, patiently unscrewed the bulbs of nearby streetlights before viewing, then patiently screwed them all back in when he was done. John Hasty, an amateur in northern England, stood on a railway bridge to view an eclipse of the moon some years ago and had the unhappy experience of being temporarily detained by a police sergeant and constable, who thought it was at least minimally suspicious for a man to be prowl around at night with a pair of binoculars. They cleared up that spot of trouble, though, and Hasty introduced the officers to the Plow (what Americans call the Big Dipper) and other constellations. "They were so fascinated," Hasty recalls, "that they stopped for about an hour, and I showed them around the sky."

But why do amateurs play such an important role in modern astronomy when technology has pushed them to a practically nonexistent backseat in many other sciences? In part, at least, it's a matter of sheer numbers. "Not very many people get paid to do astronomy," explains Storm Dunlop, president of the 3,000-member British Astronomical Association (BAA). "That just isn't enough eyes to keep track of all the astronomical objects. Quite often it falls to amateurs to find out when something significant is going on and to alert the professional astronomers."

Marsden of the Harvard-Smithsonian Center agrees. There just aren't enough professionals to go around," he says. Marsden should know. As head of the Central Bureau for Astronomical Telegrams, it is to him that both amateurs and professionals report new celestial discoveries. With colleagues in Cambridge, Marsden quickly assesses the claims for accuracy, keeps tabs on priority of discovery, and alerts the rest of the world's astronomers to any new finds.

The amateur contribution to astronomy—at least to sightings—is not insignificant, according to Marsden. Since first, when the newly formed International Astronomical Union began keeping records, amateurs have discovered two out of every five new comets, one out of every four new novae, and about 0.03 percent of minor planets. And today affordable desk-top computers are allowing amateurs to contribute to an area once solely the domain of professionals—astrometric observations. (These precise positional measurements of objects in the sky allow astronomers to calculate their orbits.)

In fact, the distinction between amateur and professional is somewhat relative, especially when you consider that even the most penny-pinching modern amateur has



better equipment than the great astronomers of the past—from the nameless Babylonian sages who gave shape to the constellations, through Greek theorists like Hipparchus and Ptolemy to Copernicus, Kepler and Galileo. They were all keen-eyed, enthusiastic and curious, however, and those have remained staple traits for the best amateurs to this day. Take Clyde Tombaugh, for instance. As a youth he crafted homemade telescopes on his family's Burdett, Kansas, wheat farm using, among other things, parts of a cream separator and an auxiliary shaft from a 1910 Buick. In 1930, while doubly handicapped by the lack of an undergraduate degree in astronomy, the twenty-four-year-old Tombaugh discovered the planet Pluto.

Now eighty-one years old and living in Mesa Park, New Mexico, Tombaugh thinks of himself as a professional (it's one of the few who actually got paid for his passionate interest), but he still sky-watches like an amateur which is to say with boundless energy and enthusiasm. He hasn't lost that touch of ingenuity either. To facilitate his viewing of Halley's Comet, for instance, Tombaugh mounted a ten-inch telescope on the chassis of a lawn mower so that he could more easily wheel it around trees in his backyard.

Given the abundance of celestial objects, even amateurs tend to specialize. Most amateur groups have what are known as observing sections. Just as Evans con-

centrates on supernovae, other amateurs focus on the planets and the moon, artificial satellites, asteroids, variable stars, or deep sky objects such as nebulae, galaxies and star clusters.

Janet Akyuz Matter, who directs the American Association of Variable Star Observers (AAVSO) in Cambridge, relies heavily on a network of 500 amateurs to keep track of these proton stars, which flare into brilliance and subside into cosmic anonymity with varying predictability. Since the organization's inception in 1911, AAVSO members have registered nearly 6 million observations. One devoted monitor, the late Carolyn J. Hurless, logged no fewer than 79,000 observations—a number even more remarkable because she lived in Lima, Ohio in the middle of the smoggy Rust Belt. But the late Reginald DeKock of South Africa holds the all-time record, having logged exactly 760,777 reports on variable stars.

Variable stars afford one of the most fruitful areas of collaboration between the amateur and the professional. "Professional astronomers need the information provided by amateurs to correlate with data gathered from specialized instruments aboard satellites," Matter says.

Nevertheless, there's a certain stigma to being an amateur. Because science in general tends to be hierarchical, with the Ph.D.'s as the dominant parents, amateurs invariably play the poor stepchildren. Like professionals in other fields of science, it is

not unusual for an astrophysicalist to view amateurs, at best, as "lost souls"—scientists—the kind who add a brick or two to the already imposing edifice of science with a few observations but rarely make contributions of a dramatic or transforming theoretical sort that will add a new wing to the building. Stephen J. Edberg, a scientist at the Jet Propulsion Laboratory in Pasadena, California, who coordinated amateur observers during the International Halley Watch, as much as admitted these limitations when he said, "As far as organizing amateur astronomers goes, I think the most difficult thing is getting them to understand that doing science is very different from going out to the telescope and saying: 'Gee, isn't that pretty?'"

But with good luck, good intentions, and reasonably good telescopes, amateurs continue to make noteworthy observations. The recent history of amateur astronomy is rich with tales of important, albeit serendipitous, discoveries.

There is seventy-five-year-old George Alcock of Peterborough, England, who violated every canon of observational protocol by discovering a comet while peering out from inside his house through double-glazed insulated windows. Didn't anyone tell Alcock it was impossible to discern objects in the night sky through a window? "Yes, they did, which always amuses me," chuckles the retired schoolmaster, who has discovered five comets and five novae in his 63 years of observing. "Instead of putting on two pairs of trousers and two coats and all the rest of it, I can observe the sky in pajamas inside the house on a January morning!"

Then there is the ebullient Ben Mayer, in 1975. Mayer, a designer, achieved considerable renown when, with quintessential beginner's luck, he placed a 35mm camera on the roof of his West Los Angeles home in the wash of all the light pollution Hollywood can fling at its rival stars. He pointed it at the constellation Cygnus (or the Northern Cross) and, using a timer from his lawn sprinkler, took a series of over-night photographs. He was hoping to find some meteor traces, when he didn't, he tossed the negatives into a wastebasket.

And there they lay for another 36 hours or so, until Mayer learned at an out-of-town "late party" that an exploding star—Nova Cygn—had just been discovered in the middle of the Northern Cross. First he phoned his son and ordered him not to take out the garbage, then he rushed home and inspected the photographs. With glee that remains largely unabated to this day, Mayer saw that his Rubie Goldberg rooftop contraption had indeed captured an exceedingly rare celestial event—a star in the process of blowing up. "My strength was my ignorance," Mayer says now. "I didn't know I couldn't do it."

With similar good timing, San Francisco amateur Bill Sorrells decided he didn't want to be bothered by "gremlins" ringing his doorbell on Halloween in 1966, so he drove



FICTION

# THE GULF WARS

BY BRUCE STERLING

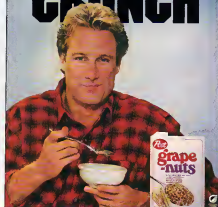
*Two Assyrian soldiers in the Middle East discover that the more things change, the more some things stay the same*

PAINTING BY RUDOLF HAUSNER





"CRUNCH"  
"CRUNCH"  
"CRUNCH"  
"CRUNCH"  
"CRUNCH"



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anyhead and put it aside.  
"There's always more war for the likes of us," Bel-Heishi said. "You don't need a royal dinner to tell you that much."  
Hall shrugged and selected another cone. "I could just get my hands on some real fat for once."  
"Sure," Bel-Heishi said, yawning. He waved one hand before his meaty nose. "That pitch strikes to perfection. What a hell-hole this place is. It gives pitch and asphalt like better places give milk and honey."  
The Elixir's prophetic vision screaming lighted across the camp. "May you down and search the world forever for a gravel. May scorpions kill your arm-pits—"  
"Uh-oh," Bel-Heishi said, straining. Their captain approached on one of the troop's last horses. The captain waved up "Pioneers Bel-Heishi and Hall!"  
The men touched their foreheads. "Captain, sir?"  
"On your feet, boy. General wants to see you."  
Bel-Heishi and Hall scrambled up in alarm. They checked their daggers, tugged at their sandal straps, and followed the captain's horse. Dust as fine as flour pulled from the trampled paths among the tents. "Hm!" the captain said. "Bel-Heishi! You think he knows we're home-brewing? I'll walk you to the cave!"  
Hall glared at him, amazed. "That's it, idiot! Put a name to our bad luck. Don't you know demons are listening?"  
"Sorry," Bel-Heishi said. They batted huge bluebellies then as they walked past one of the barracks.  
Hall scooted. "How do you live this long anyway, you big ox? Always eating bad omens and tempting fate?"  
"My luck's fine," Bel-Heishi said. "Too bad your horse stinks of louse sweat. You look like a real half-wit."  
The captain demurred near the closed flaps of the General's broad, striped tent. He threw his horse's reins to an orderly and watched inside. Two two veterans waited under the army's standard, which hung limply in the mucusous heat.  
The General's tent stood next to the supply dump. The two soldiers looked unhappy at the dwindling supplies: rock-hard blocks of dried fish, strips of air-dried, lapped strips of cheese, sacks of millet and barley, the very last of the chemist. Guards leaned on their spears, stunned with heat and boredom. A war chime rumbled by and covered Bel-Heishi and Hall with grit.  
The captain beckoned from within the tent. The two men ducked and stepped into the incense-reeking shadows. They spotted the dim gleam of the General's bronze armor and quickly prostrated themselves on the carpet. The dark wool was thick with dust, and they had to fight against sneezing.  
"All right, boys," the General rumbled. "At ease."

Thank you, Lord General, they chorused. They laid their heads to the floor.  
The General was huge, with thick, pow-

erful arms and massive, hairy hands. Girded with armor, sword, and quiver, he seemed to weigh half a ton. Scars from a lion hunt streaked this side of his face, vanishing into an oily thicket of beard.  
The General bent over a table with a creek of armor sliding and glancing at a clay tablet. His lips moved as he studied the cuneiform. "Bel-Heishi and Hall, you boys have been with the Mountain Leapers quite a while now, haven't you?"  
"Yes, Lord General!"  
"You were with us at Happut," he said straightening. "That was a nasty little piece of business."  
"Yes, Lord General, I believe it was an honor to serve under you!"  
The General's camp had appeared from the back with a long-handled palm-leaf fan. She began to chase flies with violent strokes of the fan, looking bored.  
The General's eyes glittered under the gold-chased rim of his helmet. "Get much hot when we sacked Happut?"  
Bel-Heishi's fingered the heavy silver ring at his earlobe. "A little, Lord General."  
"Gentled it all away by now, eh?" said the General with the ugly smile of a man who enjoys the weakness of others. "I see you boys took your share of heads."  
"Well, yes, Lord," said Bel-Heishi. "That was orders. Gather male heads for control and display. Right, Hall?"  
"What he said, Lord," Hall nodded.  
"Remember our head in particular?" the General asked. "An old man with a sty in one eye and a nose turned up like a pig's?"  
Bel-Heishi smiled humbly. "We took many heads, Lord General. Fighters, too. Not just old men."  
"So you did kill him, though?"  
Bel-Heishi swallowed doubtfully. "We found the old general hiding in a rat hole, Lord General! So we stuck him and took his head. That was orders!"  
The General gathered his armored shoulders. "That toothsome nut was Governor Nam," he told them. "Our king cherished a special hatred for that arch-heretic." He paused and knotted his hands behind him, savoring the moment. "I wrote to the King at his palace in Nanewh, he said, beginning to shake back and forth. Reluctantly the god followed him, owning her fan woefully. I informed the King that elements of my Mountain-Leaping Pioneers had confronted the traitor Nam. They forced the wretch to tumble before the awesome power of His Majesty and slew him with the edge of the sword."  
He paused, impressed by his rhetoric. The two veterans exchanged quick glances.  
"He did put up quite a fight for an old general," Lord General, Bel-Heishi murmured.  
His Majesty praised the Mountain-Leaping Pioneers. He decreed that the soldiers who avenged his honor should be rewarded. For the last time the General looked at them directly. "That means you boys. You're to be given Names."

"Name?" Hail burst. They hung themselves to the carpet, dust puffing from the force of their gusting. "Thank you, Lord General!"  
The General called out to his orderly. Glean foods the tent as the orderly looked. "Bel He. Emmerence I've found the historians," the General said. "Ask him to join us here." He turned to his camp glit, lowering his voice. "Go on in back, girl. For form's sake." The General's girl rolled her left-shouldered eyes, then shouldered her fan and back of the tent.  
The General gestured brusquely. "Get up, boys, you're in the way there. Go over there by the General. You may sit."  
The two men crawled rapidly across the carpet into a corner of the tent, grinning at each other, unable to believe their luck.  
Now, listen," said the General into mid-air, not bothering to look their way. "The King's inspector, His Emmerence the Baron of Sharnah, arrived in camp last night. He came in secrecy to take account of our success: bless the camp, and overcome the state of our souls." The General frowned at them. "He has brought your Names with him. From the capital. I know you two old soldiers are going to make a dignified, proud impression on His Emmerence. Understand?"  
"Yes, Lord General," the men said, quailing under his glare.  
The General turned away for the moment, and Hall and Bel-Heishi traded nervous looks. Before the invasion, the King's inspectors had arrived in long chariot teams with outriders and standards flying, and plenty of warning. But here was the Baron of Sharnah at Nanewh, a man with the ear of the King himself, appearing like magic in the very midst of camp before anyone could even get into a state of grace. Bel-Heishi and Hall would have to appear with their spears and hangings all over them, with their hearts all thickly greased with mud.  
The Mountain-Leaping chaplain Father Semmangal crept into the tent, looking dither and flustered. He held the tent back, bowing as the Baron's retinue appeared. First a simple curtain slipped in, blinking, followed by a row of red daggers. Two out louds moaned stifled after them, twice moaned wearing heavy, dual-bladed spears with thick woolen cowls. Huge boar's-head masks of snarling bronze unleashed their jaws. The two masked men took their places at each side of the entrance, holding their bent, muscular arms.  
The Baron of Sharnah entered last with a dignified tread. He was a tall, gaunt man in a delicately plain brown robe. He carried a short staff of office, a mass of twisted antelope horn, topped with a gold knob depicting an adder's lapped head. He wore a tall, brimless hat of layered black wool. Two small, discreet but horns peaked from his forehead, wrapped in chains, threaded through his hair, coiled neck holding a dozen tall, square charms of

Shhh!  
People are trying to read.



The One and Only.

cheeked alabaster. He had the staring white-rimmed eyes of a dwimer.

The General, his hand to his heart, knelt briefly and rose. "Your Eminence."

The Baru ignored him, sniffing at the air. "Spies," he said. "The Eminent have spies in your camp, General."

The General tapped at his beard. "Well, of course. Your Eminence. Can't fight a war without spies, can you? We have several spies in the city. Better ones than there."

His voice dropped off as the Baru stepped stiffly toward Bel-Hesht and Hali.

The Baru stared down at them, his bloodshot eyes narrowing. "So," he said. "Here, in the shadows."

"Ah," the General broke in, "these are your heroes, Eminence. The head takers. Phoenies Hali and, er, Bel-Hesht."

The two soldiers flung themselves to the carpet. "Bless us, Eminence!"

"No one is above suspicion," the Baru said, but he seemed mollified. His hand sketched a protective sign in meter. He gave Bel-Hesht a short prod with the end of his crooked staff. "Sit up, son. let me look upon your face."

Bel-Hesht sat up, trembling. The Baru stared into his eyes. "So," he said at last. "Now you," Hali sat up and received the same treatment.

"You boys have been drinking."

"Oh, no," Hali squeaked.

"Really," Bel-Hesht added.

There was a long silence. "We only cov-

eted drink. Your Holiness," Hali confessed at last, unable to bear the strain.

"We... we plotted to drink," Bel-Hesht moaned. "We know worse sinners, Your Eminence! Were not worthy."

The Baru, satisfied, nodded. "You can tell me all about it later at confession. Yes, you must be purified and in a state of grace when I present you with your Names before the troops." He turned aside. "You do have a touch here, General?"

"Why, yes, Eminence."

"And a woman to pour it for you, no doubt?"

"Why, I, or that is—" the General began, but Bel-Hesht sternly broke in.

"A bath!" he cried rapturously. "Thank you, Your Eminence!"

The Baru stared at him.

"Do you know what it means to be given a Name?" he said at last. "Do you truly know in your heart?"

"We know we don't deserve it," Hali mumbled.

"In the beginning, nothing had a name, and chaos alone existed," said the Baru with bone-chilling solemnity. He gestured briefly, and one of the masked mystics began to chant in a high, muffled voice.

"When the heavens above were yet unnamed (And no dwelling beneath was called by a name) When no names had been yet recorded (And none of the gods had been named) When there were no signs and signs (When the language of

omron was mute. . . . The Baru gestured again, and the paralyzing drone broke off. Hali shivered violently.

"Without names, nothing can be," the Baru said. "By the day, you have not existed. The gods have had no name for you. You have been common men, mere wretches upon Earth, almost as beasts. Like shadows, your passing left no trace, for you were not recorded. But now you shall be Named Men, thanks to our King's grace and his regard for your loyalty."

The Baru paused. "You shall be cleansed and shaven of sin and dressed in fine raiment. Your Names will be presented to you before the troops so that all may see how King Ashurbanipal, son of Esarhaddon, rewards those who serve the gods. Now think on what I have told you. I shall speak to you again at confession."

He beckoned to the scribe, who crawled rapidly forward. The Baru handed him a small leather bag, then turned away. "General, a word with you. The Baru and the General dropped across the tent and began to mutter together.

The scribe was a middle-aged city man with thinning hair and watery, myopic eyes. He murmured a quick invocation in the holy language of Sumer and slipped the bag's drawstring. He shook the bag, and two small cylinders of alabaster tumbled out, each the size of a finger's joint. They lay in the palm of his hand. He held them before the two soldiers. Hali, overcome, wiped away tears. Bel-Hesht blinked hard several times, staring shakily.

"Your Names," the scribe said. "With these, you men become true citizens. You can own property and mark it with your Name. You can own slaves, who will carry your seal around their necks. You can sign documents and borrow on the strength of your Names. You will be Named Men. You will die!"

The scribe opened the flap of his wicker shoulder bag and pulled out a small, flattened brick of damp clay. He took one of the seal cylinders and rolled it expertly across the clay, using two fingertips.

He held the damp brick before their eyes. The cylinders intricately carved surface had pressed out a little embedded scene: a four-winged god raising his arms in blessing before two winged, winged antelopes. A column of tiny cuneiform glyphs stood in the left corner. The scribe read it for them. "He who smote the enemies of the gods, in whom the King is pleased, the hero Hali." Hali caught his breath in wonder. The scribe turned the tablet over and ran the second seal across the other side. It showed a sacred palm tree and a lotus in her aspect as war goddess, carrying a bow and standing on a small crushed lioness. "It is the same inscription, but for the hero Bel-Hesht," the scribe said.

"Not Bel-Hesht?"

The scribe frowned. "I suppose it could read *Bel-Hesht*, with the syllabic interpretation. . . . That's a rather difficult character. He wiped the seals carefully with an



"Apart from the strength of the yen  
I see the Japanese exerting a strong influence in other sectors."

small scrap of wool. Bal-Heshi, relieved, grinned widely. "It's the most wonderful thing I've ever seen! May I hold it?"

The scribe shook his head. "Certainly not!" He slipped the sash back in their bag, then leaned forward confidentially. "Magnificently speaking, this is a most dangerous time. Your Names have been chanted and blessed but have not yet been bestowed on you. The identity of Name and Soul is not yet established; you are neither named nor unnamed. At such times the demony are most active. They swarm about things of choice, longing to seize your Names, your spiritual reality, for themselves!"

The General ignored them. "But, Elminence! He's nothing but a heathen. The sash doesn't pay any mind to his curses."

The Baru glowered. "What! You mean to tell me that limb of hell has been spewing his poison over your army day after day? Lamaditu's Name, General! It's a wonder plague hasn't broken out!"

The General smoothed his beard. "Well, we do have Father Semnanural to protect us."

The Baru shook his head in wonder at such irony. "There should have been a roaring battle at or at the very least a properly trained asphy here at all times!" The scribe

the thorn in the side of highness, has been spitting his venom over your men. Digging at their wills. Filling the camp with mephs that turn your luck against you!"

Father Semnanural cast himself weeping at the Barus feet. "Forgive me, Eminence! The fault is mine!" He tore at his hair and beard, his eyes leaking tears. "I'm only a humble army chaplain! I should have known I was outmatched!"

The Baru looked at him sternly then smiled. "No good Father Semnanural! If not for your stout & humble protection, things would have been far worse!" He turned to the General. "Yes, there has been

action. Your commands to their children shall give their heads. Their young men's severed limbs shall be cast in fire! The women shall be taken away; the granaries thrown open to our soldiers! The skins of their priesthood shall cover the battlements, the holy places shall be sacked, and their mystaries exposed to the sun! The fields shall be sown with salt, for the rage of Ashur falls heavily upon this place."

A crowd of excited soldiers gathered rapidly around him. He turned toward the city wall, waving one hand. His fingers bent in clawlike malediction.

They jumped up and hurried from the tent at the General's heels. At his command, heralds blew their trumpets, and the army's standards were seized by banners.

The masked mystics had produced brass cymbals long beneath their cloaks. They pounded them noisily as the crowd surged toward the city's walls, following the Baru of Shemash.

Caused away by excitement, the Baby lonians whined their slings overhead. The loud clatter whipping up spirit.

Bal-Heshi and I-Hall stalked for a place as the General's elite bodyguard quickly gathered around the standard. The Baru

down on the battlements, leaning on his straggled arms. "What jockies brags?"

"Unworthy man!" said the Baru simply. He scam eadward with majestic dignity. "You think with your curses to save your town from those whom the gods command. I have seen many such as you. But you have never seen my like before. I am the Baru of Shemash at Nineveh. Mother of Ghos!"

A gasp came from the Assyrian ranks, followed by a ragged cheer. They had not known he was a priest of such high name. Their luck was turning. Their morale soared.

Hall and Bal-Heshi could feel it where they stood: a surge of spirit as the army



## NOTHING ATTRACTS LIKE THE IMP ORTED TASTE OF BOMBAY GIN.

CORIANDE SEEDS FROM MOROCCO ANGELICA ROOT FROM SAKONY JUMPER BERRIES FROM ITALY CASSIA BARK FROM INDIA ALMONDS FROM INDIA LEMON PEEL FROM SPAIN CINNIBERS ROOT FROM ITALY GINGER FROM INDIA

Bal-Heshi and Hall, frightened, made luck signs. "What shall we do then, General?" Hall said.

The scribe glanced over his shoulder and lowered his voice. "I would ask permission of the Baru and the General to retire to your tent and pass the time in prayer until the ceremony."

"Good deal! We hear and obey," said Bal-Heshi. Both of them were thrilled at the idea of escaping the General's tent. They crept forward on hands and knees across the carpet toward the Baru and the General. There they waited, with heads low for a chance to make their presence known to the

king at the Baru's elbow and offered him the leather bag with the two Names. The Baru nodded, blessed the bag, and slipped it back into his robe. Then he beckoned to the reader of bid lights. The reader stepped forward, head bowed. "You have been reading the animal omens, brother?"

The reader nodded grimly. "Indeed I have. Plague among the horses."

"So? You see?" said the Baru to the General. "You're spiritually outmatched here. That's the problem. No wonder this siege has dragged on so. You should be halfway to Susa by now. But this Elamin,

damage done, but that's past."

Turning toward the tent's entrance, the Baru raised his voice to a boom. "Call forth your men, General! The day's worst heat is over. Battle is on! No more shall your men suffer under this wretch's imprecations! I shall go forth and do spiritual battle with him and crush him utterly!" The Baru gestured to his two masked aides. They turned and threw open the tent flaps with practiced, dramatic gestures. A dozen crinkles and numbers stood outside, curious. The Baru took a deep breath and stepped out into the glare. "The city falls tonight," he belittled with absolute and terrifying con-

mouthed. He reached down and helped the portly Father Semnanural to his feet. "He's great, eh? Semnanural confided, almost stepping on Hall's hand as he found his balance. "There's a new breed of priest in Nineveh these days! No half measures!"

"These ears hear you," said the General, grinning ferociously. He stepped toward the tent flaps.

"Lord General!" Bal-Heshi cried from the floor. "My comrades and I beg leave to retire to our tent and pray for guidance!"

The General stopped in mid stride. "What? And retire there? Call yourselves soldiers? Come on, heroes! Follow me!"

contemptuous of safety, ignored the benches and marched on level ground almost to the foot of the wall. Two engineers with curved wicker shields rushed forward to shelter him, but he wove them back. Behind him, Assyrian archers, still snoring on helmets and slinging their bows, filed into the trenches. Stoppers, holding shields above their heads, ran forward to the shelter of the covered battering rams.

The Baru raised both arms. "Come forth, scoundrels!"

The Elamin prophet had fallen silent as the army swarmed forward. Now he also waved his shield bearer aside and gazed

begin to realize, to believe, that this might at last be the end. They could sense the enemy's fear, the shiver of panic behind the walls. The General left it, too, and turned to his aides. "Ready the ladders, be quick!" The Elamin prophet raised his voice. "But a Baru, a high official of the court! At last, someone here to negotiate! To put an end to this madness!"

The Baru was pensive. "It will end soon. When your king's head hangs from a tree in the gardens of Nineveh."

But King Sardan wants peace! Again and again we've said it! Why such mad hatred? It was only a brother's skirmish!"

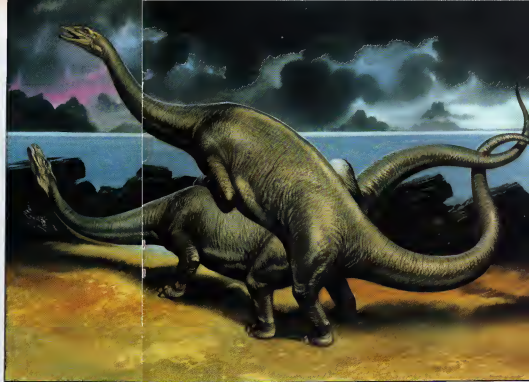


## TYRANNOSAURUS SEX: A LOVE TAIL

BY SANDY FRITZ

*Birds do it, bees do it, but how on earth did plate-backed Stegosaurus do it? Dinosaur lovemaking, it seems, took more than just a little skill*

PAINTINGS BY RON EMBLETON



**O**n a bright fall day Beverly Halstead combed the hills near Chipping Norton, a hamlet about 40 miles from his home in Bath, England. In a quarry somewhere near there a two-foot hunk of dinosaur femur, resembling a classic bone-shaped dog biscuit, snuggled in hull, was unearthed and classified in 1783 as the fossilized scrotum of a giant

man. Halstead came across *Scrotum humanum* while digging through an obscure eighteenth-century natural history book, and with his friend Alan Chang he prepared an article entitled "Scrotum humanum—The First Named Dinosaur." A Dr. William Ball, who helped Halstead with some research, and a Dr. L. R. Cocks, Chang's boss at the British Museum of Natural



History, were both mentioned in the article. There we had Scotum humatum acknowledge me to Dr. 'Cocks and Ball' recalls Halstead. Unfortunately, Chang was not permitted to publish it with me. I don't know why not. We were all adults."

Halstead tries hard not to grin. Seasoned by years of forlornness in Africa, India, and China, the fifty-four-year-old professor

of zoology and geology radiates boyish mischief. His hair is not gray but a brilliant silver, cut in a mopish Saxton style, parted on the side and long over the ears. His belt buckle, standing out like a brass badge, sports the menacing silhouette of a stalking saber-toothed cat. As a scientist and the author of more than 20 books, Halstead delights in stalking the forbidden, and in a

way he stands atop his own mountain in paleontology. The resurrection of old dinosaur fossils and the discovery of new ones have led to a dinosaur information explosion, yet Halstead alone writes and speaks candidly of their sex lives. "Surely other people have thought of it, but I am as far as I know, the only person to go into print on it," says Halstead, perched on a





couch in the home he shares with psychologist Helen Hestle. "Sex was very important to dinosaurs, and I don't see why there should be one area of dinosaur life that we turn our backs on."

To bring dinosaur sex out of the fossil closet, Halstead persuaded the British Association for the Advancement of Science to close its 1987 conference in Belfast Northern Ireland, with a lecture entitled "Sex and Dinosaurs." Halstead found himself facing an auditorium packed beyond standing room capacity. After deciding sex as the greatest invention on Earth and considering the physical instructions governing the placement of dinosaur sex organs, the lecture climaxed with Drs. Halstead and Hestle sinking the mating position of a pair of loving brontosaurs.

"There was tense expectation," recalls Halstead of the crowd's reaction. "When Helen got on the stage and dropped her skirt [she was wearing tights] they drew their breath. She was leaning over with her hands on a box and extending one leg. I said 'Imagine this is the tail.' I explained the male dinosaur had to get his tail under the female's to mate. Our demonstration was very short. At the end there was a kind of raw applause. Everyone was relieved

that nothing too upsetting had transpired. Halstead's open and occasionally graphic approach to sex and sexuality has not always been shared by the public. During a lecture/slide show in Canada on the evolution of human beings, Halstead's audience became very uncomfortable to suddenly see a picture of their lecturer naked in the branches of a tree. "I showed this picture of me up a tree with my penis hanging down," he recalls. "It sort of freaked out my audience."

Surprisingly, perhaps, Halstead first published his revelations on dinosaur sexual positions in a 1975 children's book, *The Evolution and Ecology of the Dinosaur*. He leaps up to fetch a copy of the book and disappears into his study: a comfortable room where stacks of papers, books, and magazines are piled as neatly as the stacks of rock revealed in a cliff face. He excalivates and returns, wearing glasses and holding a beautifully bound children's book. Halstead leafs to midway in the book and points to the first published picture of dinosaurs mating. Roughly translated into human terms, it is a stiff man with one foot at the top of a step ladder and the other on the ground, leaning over until his hands rested on the shoulders of the female, squatting on all fours. The primary point of contact, which humans could never duplicate, is in the tails, which seem to twist in a sensual embrace. The caption reads: "Like modern reptiles, male dinosaurs had

no true penis. Instead, they had special organs that did not show on the outside."

Halstead explains "Dinosaur sex organs were not positioned as they are in ourselves: tucked up between the legs, but were set back beneath the tail." As in today's birds, lizards, and snakes, dinosaur gonads were housed in a vest called the cloaca (Latin for sewer). Halstead believes Pterosaurism occurred when the male cloaca became engorged with blood and bulged out of the body, filling the cavity of the female. "In my lecture I used two contraceptive caps [diaphragms] to illustrate the point," he says. "When the rubber caps are matched together to form a hollow ball, one side can be punched inside the other if perfectly aligned. In dinosaurs the membrane inside the male cloaca would have to have been aligned with a slit inside the female's cloaca before fertilization could occur. This basic physiology," says Halstead, "served dinosaur reproductive needs for 140 million years."

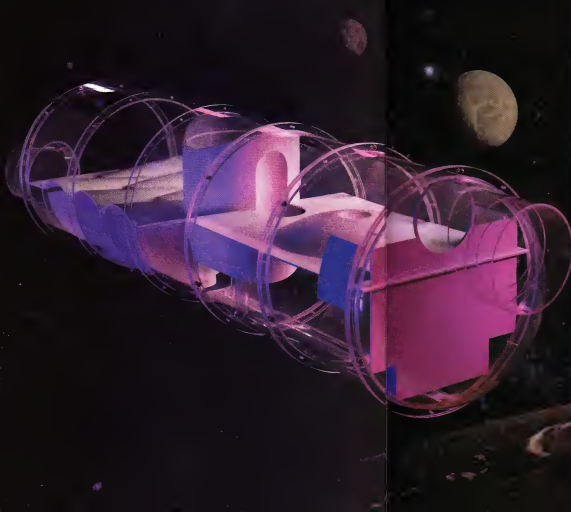
Surprisingly, the monstrous size attained by some dinosaurs was not matched by monster size sex organs. By Halstead's account, the cloaca of an 80-ton brontosaurus was only slightly larger than its pool-dish-size brain. "Dinosaurs were egg layers—we know because we have their eggs," he says. The largest found is about the size of an American football. In all modern birds and reptiles, Halstead explains, pairing eggs stretch the cloaca to its fullest extent, serving as a tail gauge for measuring the size of the vent. Based on this reckoning and on the engineering constants limiting how big an egg can get, even the largest dinosaur would have had a cloaca only one thirty thousandth of their size. For a 40-foot tall, 70-foot long brontosaurus, this amounted to a foot or a foot and a half. "Getting these minute sex organs into just the right position," says Halstead, "must have been incredibly difficult."

Modern reptiles, because of their lithe frames and light weights, are able to contort themselves into wildly ambitious positions to match cloaca with cloaca. Most dinosaurs, with bulks measured by the ton, were hampered by what Halstead calls the golden rule: The mounting male always had to keep one foot on the ground to avoid crushing his mate. All dinosaurs used the same basic position to mate," he says. "Mounting from the rear, he put his forelimbs on her shoulders, lifting one hind limb across her back and twisting his tail under hers to align the cloaca. Factoring in the tremendous weight and the precise matching of sex organs necessary for dinosaurs to mate, Halstead imagines dinosaur sex as a quiet, gentle moment in the blur of Mesozoic life. "Their mating had to be done with great delicacy and great decorum. It must have been utterly charming to watch, quite unlike our own species."

In America, Halstead's sexual reconstructions have met with mixed reviews. "Delicate? Charming? Yeah, I guess so," concedes University of Colorado dinosaur

Dinosaur mating positions according to Halstead: *Tyrannosaurus* (page 64); *Diplodocus* (page 65); *Brontosaurus* (page 68); *Brachiosaurus* and *Edmontosaurus* (page 67).

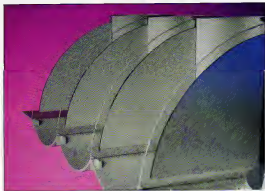
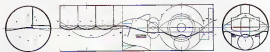




How do you get around  
in this twenty-first-century space  
house? You might  
try doing the breaststroke

## LESS THAN ZERO LIVING

Late last year NASA moved a step closer to a permanent presence in space when the agency announced which aerospace firms would begin work on the space station. Four companies—Boeing, McDonnell Douglas, General Electric, and Rockwell—were chosen to design and build the habitation and laboratory modules of the space station as well as its support technologies. One person who was particularly interested in the historic announcement was New York City architect Michael Kalil. A respected designer—some of his works are in New York's Museum of Modern Art—Kalil has been quietly working on a space station concept much more futuristic than what NASA plans to put in orbit in the Nineties. For four years he has been designing what he describes as the fourth-generation habitation module, living quarters for a future station crew. If it were built, Kalil's creation would most likely not be placed in Earth orbit until sometime in the next century. But for those who do not think they will be around in 2050 to see it, Omni presents a scale model of Kalil's design to give readers an astronaut's-eye view of the module. Kalil envisions his creation as a two-level



structure (page 72). A horizontal divider he calls the aeretic membrane (page 73) separates the module into the work areas above and the living area (pages 72 and 73) below. The cylinder in the middle contains the shower and bathroom (photograph, pages 74 and 75, and the photo on page 77). The small abstract drawings on pages 74 and 75 show the geometric symmetry of the design.

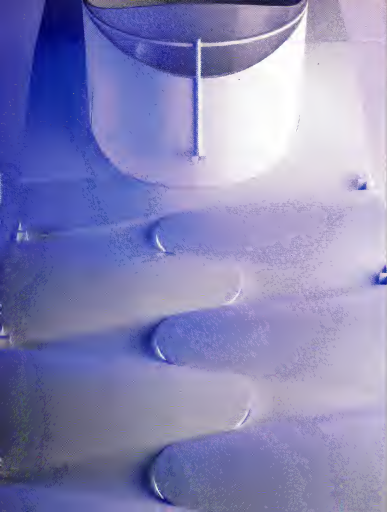
To learn about the peculiar challenges of designing a home for a zero-g environment, Omry asked Greg Bort, the deputy executive director of the National Space Society, to interview Kallit Omry. How did you become transformed from an Earth architect into a space architect?  
Kallit: Five years ago I asked the people at NASA if I could do a little research. After a year of taking



notes at monthly brainstorming meetings at NASA headquarters. I was asked to make a presentation of my work. I had used some of the NASA technologies to design an interactive room. From that presentation, NASA gave me a grant to study



space station living quarters. **Orlin:** How did you initially approach the problem? **Kell:** I started designing like crazy. Suddenly I realized I was designing from the point of view of being here on Earth. The floor plan I had been trained to consider



sacred didn't exist in zero gravity. Then everything disintegrated. When you take the concept of place and transfer it from Earth's gravity field to zero gravity, a different type of architecture has to result. This environment is much more liquid—one you swim through. That's what the whole cosmic membrane is about. You can swim through it. **Owen:** What have you learned from all your work?

**Kald:** We have to stop saying that space is a hostile environment and realize that we are facing one of the most extraordinary moments in our evolution. We should be celebrating it, but instead we are running out there complacently frightened. Good architecture celebrates the elements of the environment, of nature, as an Eskimo igloo does with ice blocks. The point is to look at nature again. **CD**

# TYRANNOSAURUS

CONTINUED FROM PAGE 18

hectic Robert Bakker (Bakker, whose theories have long-held paleontologists to rethink many long-held beliefs, agrees that decoum played an integral role in dinosaur sex. "When an elephant falls over on its side," Bakker points out, "it breaks ribs." The really big dinosaurs, the eighty-ton brontosaurs, would have had to position themselves very carefully.

Bakker is cautious about accepting Halstead's positioning, however, and can't see the opportunity to compare female scenarios. If any of them humped like birds, says Bakker, they'd have to have gotten past that thick, powerful dinosaur tail, and for that they'd have needed a crescent-shaped penis about nine feet long. Yet there is no evidence they had such a grandiose organ. He cites the wellus whose enormous organ, supported by a bone, leaves behind fossil evidence of its size. "Even in perfect dinosaur specimens, there is no evidence of a penis bone," says Bakker, ruling out the nine-foot notion. "Maybe they lay side to side, male to pen and female to starboard, and sort of snuggled up together, bottom to bottom." After more playful reconstructions, Bakker sums up his official verdict: "The simple clinical problem of how the dinosaurs did it is unresolved at this moment."

While the problem remains unresolved in Bakker's mind, paleontologist Judith Parrish of the University of Arizona cites the major problem facing researchers studying dinosaur sex—the lack of hard evidence. "Even though I'm not a vertebrate paleontologist, it seems obvious that there is no real way we could test any hypothesis about how they did it," Parrish explains. That's because soft tissue organs such as kidneys, lungs, and sex organs rarely survive the fossil transition to stone. Without the fossil evidence, says Parrish, dinosaur sexual gymnastics remains merely an exercise in imagination.

Nevertheless, paleontologist Keith Rigby from the University of Notre Dame confesses that the biomechanical logic of Halstead's sexual reconstruction is feasible. "I've been so involved in extinction games that I just haven't thought much about it," admits Rigby. "But certainly the subject of sex was much more on the minds of dinosaurs than the topics I study." Rigby whose digs in Montana reveal that some dinosaurs survived half a million years after the great extinction, says that the study of the engineering feats involved in dinosaur mating is a worthy undertaking. "The thing I'd be very interested to figure out," confesses Rigby, "is how the stegosaurs did it."

Rigby's question points out a weakness in Halstead's rear-mounting, intertwining tails theory. All 11 members of the stegosaur clan sported plates or spikes that covered the animals' spine and hips, effectively repelling attack as well as the ef-

forts of a rear-mounting mate. The stegosaur problem becomes especially pointed when considering the case of one of the more extreme members, Kentrosaurus. Shaped like a 30-foot stegosaur but about half the size, Kentrosaurus bristled with three-foot spikes that Bakker calls "lethal French ticklers." These, says Bakker, must have made sexual intercourse even more dangerous and fraught with problems.

Halstead ponders the riddle of Kentrosaurus from his horse. Producing a page of cartoons, he points to one of a spike-covered female dinosaur reared, and holding a whip while crouched in the mating position. A male considers the proposal from a distance, imagining the outcome. One arm is in a cast, his head is bandaged, and he leans on a crutch with a very sore look on his face.

"This is what the male Kentrosaurus must have looked when he was attempting to mate," Halstead says. "Obviously they managed, but how is beyond even my imagination." Failing in imagination, Halstead thinks the problem could be worked out if he could obtain two flexible, Barbie-size models of Kentrosaurus. "I'm sure I could make them then," he remarks.

The Kentrosaurus illustration shares the page with a cartoon solution to a Stegosaurus mating. Two stegosaurs avoid the problem of armored backs by standing up, facing each other, and hugging. Two hearts float above their heads. "Romantic, but impossible," pronounces Halstead. "Their clavicles are more than six feet apart." Another sketch explores the impossibility of two brontosaurs mating in water. Without the support of land under their feet, the pair spin in a tangled, blurry splash.

With illustrations and creativity, Halstead has managed to animate the sexual lives of the largest animals ever to roam the earth, and he has done so from a strictly reptilian point of view. Like most other paleontologists, he believes dinosaurs were cold-blooded reptiles and thinks that Bakker and his rebel horde, who believe that the beasts were warm-blooded, suffer from "a temperate latitude attitude."

"Reptiles have an image as being sluggish, dull creatures. But if you go to the tropics and watch how lizards behave, it's a big eye opener," Halstead says. "All these ideas that have appeared in the last few years—dinosaurs taking care of their young, leading high-energy life styles—seem to be very exciting and very nonreptilian but are perfectly familiar in tropical reptiles." He imagines dinosaurs lived in a Mesozoic Eden, combining the luxury of a tropical climate with a life-style resembling that of tropical lizards. "Tropical reptiles spend an awful lot of energy just flitting. They just live happy lives. That's how I like to envision dinosaurs. Obviously, when a pack of fresh eaters come bounding in, it was a different matter. But for the most part, it must have been"—Halstead pauses, searching for the right word—"well, charming is the word." □

# EARTH

CONTINUED FROM PAGE 20

more to other water cleanup projects.

Although more federal money is slated to be spent on cleaning up our waters, there are still few deterrents in place to keep industrial polluters from fouling the waters in the first place. Regulation and enforcement of pollution laws are generally lax. For example, in many states, polluters that are caught dumping are given a year or more to clean up the contaminants before punitive action is even considered. And hard-core violators have been offered more immunity from prosecution by two Supreme Court rulings.

In 1985 the high court decided that under certain circumstances, the EPA may exempt individual industrial plants from full compliance with national limits on toxic discharges into sewage-treatment facilities. This gave some companies carte blanche to load the water flowing into sewage treatment facilities with toxic chemicals that hinder the cleansing process.

Then in another regulatory setback the Supreme Court limited the authority of states to hold polluters liable for damages if the contaminating discharge originated in another state. If, for instance, a state with strict environmental laws has streams polluted by a company in a bordering state with little regulation, the state with tough laws may prosecute the polluter only according to the laws of the laxer state.

With both federal and state governments seemingly eager to avoid the responsibility of regulating and policing water polluters, the American consumer has been forced to seek a safe drinking alternative—bottled water. Since 1978 total sales of bottled water have soared 13 to 15 percent annually. According to Jack West, president of Puro Corporation of America, a bottled water company, in 1988 wholesalers made \$1.3 billion from the sale of 1.2 billion gallons of water. That means that every person in this country could have drunk 5.7 gallons of bottled water that year.

In years to come, the drinking water of city dwellers and rural Americans will increasingly come from bottles and not the kitchen tap. Unless a comprehensive set of regulations and enforcement plans is put into place at state and national levels, we simply don't have a choice. □

## THE BEST AND WORST PLACES TO DRINK WATER\*

BEST	WORST
Manhattan, NY	Memphis, MA
Berkeley, CA	Wilmington, DE
Hood River, OR	Philadelphia, PA
Manchester, NH	DuPage County, IL
Birmingham, AL	Brooklyn, NY

\*Based on 1,000 city water systems that ranked from best to worst water systems and the reason for it in 1987 by the Waterless Laboratory, which is sponsored by many water utilities and environmental groups. The list is based on the city's water quality report.



Exclusive report from Beijing: how  
acupuncture really works to kill pain. One  
of China's foremost bioscientists  
discovers the neurochemistry underlying  
Asia's ancient medical treatment—  
and a new pain-control center in the brain, too

## INTERVIEW

# JI-SHENG HAN

**A**s he walked across the campus of Beijing Medical College (now University) one afternoon in 1955, Ji-Sheng Han was so engrossed in the experiment he had just read aloud in a neuroscience journal, he didn't notice that Dr. Pong Reocing, vice president of the college, was standing beside him. "Dr. Han, what is your opinion of acupuncture anesthesia?" Pong asked him abruptly. "Did you know it's being used in surgery—and successfully, too?" "I didn't know that," shot back the thirty-seven-year-old lecturer in physiology, "and furthermore I don't believe it!" The next day, at the Institute of Tuberculosis, he too witnessed the removal of a lung while the patient was under acupuncture anesthesia alone. On the operating table lay a fully conscious young woman, with ten needles inserted in each hand and foot. For 30 minutes before the surgery four acupuncturists had twirled the 40 needles. "It was so complicated," recalls Han today, "they had to use a signal board with signs and numbers so that each acupuncturist would know when to twirl

which needles. I saw that it worked!" But no one knew why. Acupuncture is one of the oldest medical treatments. Authorities claim that ancient Chinese doctors practiced rudimentary forms of it before the Great Pyramids were built. By Christ's time acupuncture in the East had grown into an elaborate system for treating hundreds of major and minor ailments. Learned treatises crisscrossed with anatomical charts and commentary traced a path that health depends upon the flow of chi, meaning "life-force," along invisible pathways called jing, or meridians. The 14 main meridians generally correspond to bodily organs like the lungs or liver, but some like the "governor vessel," or "triple warmer," do not. Disease or pain is the result, says acupuncture theory, of a blockage of chi at one or more acupoints along these meridians. By inserting needles into various acupoints, the acupuncturist dissipates the excess or replenishes the undersupply of chi to the vital organs. He thus restores health, or dynamic equilibrium, by regulating or rebalancing chi.

PHOTOGRAPHS BY GILLES LARRAIN



●Legend has it that acupuncture arose when some villagers noticed that a warrior's long-standing malaises were mysteriously cured by spear wounds suffered during a battle. No one can verify these legends.●

Since the early twentieth century doctors throughout China trained in Western scientific methods have sought to explain how acupuncture achieves its effects. Han, however, was not especially interested in validating the existence of the meridians or in finding the mysterious links between the hundreds of acupoints and particular maladies. As his teaching assignments moved from general physiology to select areas of neurophysiology, he became fascinated with the little-known domain of pain perception and control. Studying acupuncture analgesia, Han realized, could be the perfect tool for understanding more about how the brain kills pain.

So in 1965 Han set up the Research Group for Acupuncture Analgesia and began testing hundreds of people in a laboratory setting. In less than a year he had data suggesting that acupuncture must be inducing the brain and spinal cord to produce one or more substances that dramatically raise most patients' pain threshold, or ability to withstand pain.

The Cultural Revolution in 1966, however, abruptly thrust Han from the classroom and lab into the countryside. Finally returning to academia in 1972 (the year Huxley's *Kaiserling* "rediscovered" China, Han immediately set about doing what any well-respecting Western physiologist would do. He began acupuncture on lab animals, strictly measuring the effects. Han became the first to show that acupuncture kills pain in rats and rabbits. His animal studies dispelled any notion of a placebo effect in humans. He spent the next three years meticulously charting the roles of all the known neurotransmitters that could possibly produce analgesia. Raised levels of serotonin, he found, correlated especially strongly with acupuncture pain relief. But as the Seventies wore on, Han became convinced that an unknown set of chemicals helped trigger acupuncture's painkilling powers.

These suspicions were confirmed in 1975, when John Hughes and Hans Koeberitz in Aberdeen, Scotland, discovered the molecular structure of enkephalin. This small peptide, functioning just like the painkiller morphine, was the first of many natural brain opiates to be purified and sequenced. As the list of these endogenous or bodily generated opiates mushroomed, Han realized he needed drugs specifically antagonistic to each one in order to pinpoint just where and how acupuncture used the natural opiates to suppress pain.

In 1977 László Terenius, codiscoverer of endogenous opiates, had himself begun to do studies correlating acupuncture analgesia with these natural opiates. So in 1979 Han journeyed to Uppsala, Sweden, and his collaboration with Terenius proved fruitful. Returning to Beijing in 1980, Han received from Terenius a large batch of anti-opiate drugs, or antagonists. He promptly launched a series of pioneering tests, using these antagonists along with electrical

acupuncture. In Han's typically understated words, "These tests were telling us a good deal more than how and where acupuncture worked."

The scientific community did not fail to notice what Han's findings meant to brain science. He was invited to many prestigious conferences and in 1981 was asked to chair the International Narcotic Research Conference in Kyoto, Japan. After a long day at the conference, Han knocked knees in a Jacuzzi with Eric Simon of New York University. Simon, the neuroscientist who coined the term *endorphin* (from "endogenous morphine"), was astonished by the perfection of Han's English. "He spoke with virtually no accent," Simon remembers, "and his syntax, like the design of his experiments, was virtually impeccable."

Han was born in 1928 in Hangzhou, the capital of eastern China's Zhejiang province. He graduated from Shanghai Medical College in 1952 and for a decade lectured in physiology at a number of universities. In 1962 he joined the Beijing Medical College where he studied among other things, the neural control of blood pressure and digestion. Although the Cultural Revolution sent him out of the lab for six years, by 1982 he had put together an acupuncture research force of more than 20 faculty members, 50 post-doctorates and many international contributors. "Acupuncture is a deep rooted, ancient tree in China," he says. "Nourished by modern science and technology, the old tree is once again blossoming elegantly."

In 1983 he became chairman of the department of physiology at Beijing Medical University. And last July he established the Neuroscience Research Center there to unify groups engaged in neuroscience. Han is the director. Somehow though, he still finds time to take his baby granddaughter to see the pandas and elephants at the zoo, while leading his co-workers into daring new areas. Han has also designed and developed an electric device named ACUTENS, which combines acupuncture and electrostimulation. Planning to market it soon, Han writes, "Being a compact, reliable, easy-to-handle and power-saving device, ACUTENS will serve you smoothly for years."

Han met with writer Douglas Stein during a brief trip to New York City. After that he was off to neuroscience conferences in Hamburg, Munich, Vienna, Budapest, Sydney, Adelaide and Hong Kong.

**QW:** When and how did acupuncture originate?

Han: There is no end of controversy. *The Yellow Emperor's Classic of Internal Medicine*, often cited as the definitive history of acupuncture, was not authored by the Yellow Emperor, Huang Ti, the founder of the Chinese nation in the fifth century B.C. It is really a gradual accumulation of documents and commentary over many centuries. The conservative estimate for the age of acupuncture is twenty-four hundred



years. So acupuncture was practiced when Greek tragedy was first performed.

But it had been practiced in more primitive forms for centuries before that: if you really began with people using a small sharp stone called a bean stone to pierce or press the skin. The bean stone was replaced by bony needles, and after metal was discovered, silver and gold were used. When I set out to do my book [The Neurochemical Basis of Pain Relief by Acupuncture], I discovered that there are hundreds of tales and myths about when people first realized this pressing or piercing could restore ill people to health. One story has it that acupuncture arose when villagers noticed that a warrior's long-standing meltdowns were mysteriously cured by spear wounds suffered during a battle. No one can verify those legends.

**Ques:** His science documented the existence of the meridians?

**Hart:** Many groups throughout China are looking for evidence, but so far no anatomical structure has been found. Most studies have tried to locate functional links between the skin and different body organs. Scientists have measured the impedance, or electrical resistance, when you insert a needle near the end of a meridian. They've found that during acupuncture manipulation the skin resistance along the supposed meridian is lowered.

**Ques:** Traditionally aren't there many different kinds of needles?

**Hart:** The classic Chinese acupuncturists use nine different kinds of needles at different body sites for various therapeutic purposes. All needles are solid, none being like the syringe. Most of them are one to two inches long, but some are as long as four to five inches, to reach, say, the psoas muscle of the femur [long bone of the thigh]. Some are short and strong, with two sharp edges [Hart draws a picture of a spear tip] to pierce the skin and encourage bleeding—to let the stagnant blood flow out. Usually two to four needles are put at different points and twirled alternately if you're treating heart disease, for example; you may use one to stabilize the heartbeat, one to lower blood pressure, and one to tranquilize the mind.

**Ques:** Haven't the meridians been charted for the dog, cow and horse?

**Hart:** We don't have thousands of special charts for every animal, but we do have charts for the horse and the ox, probably because they were exceedingly valuable for agriculture and transportation and we were concerned with keeping them healthy. Although the horse meridians are similar to those in humans, the exact meaning of the name of the acupoint may differ considerably. To give an example, *Baifu*, number twenty on the Du meridian, meaning "hundred convergence," is located on the very top of the head in a human. Yet it is in the perineum [area between the anus and genitalia] of the horse. As for experimental studies in laboratory animals, we just use the principles of comparative anatomy. Similar

organs in different animals are presumed to have similar acupoints.

**Ques:** When was the present system completed—with roughly three hundred sixty-five acupoints along fourteen meridians?

**Hart:** We have excavations from the Han Dynasty around two thousand years ago showing that it had not then reached the fourteen-meridian stage. We believe it reached that point sometime within the Tang Dynasty (A.D. 618 to 907). The evolution has been gradual. But actually there are many extra points, not just the three hundred sixty-five. For example, the so-called Ashi point. Ashi in Chinese means "Ah, yes!" When you press on the diseased shoulder and hit the most painful point, the patient exclaims, "Ah, yes!" Thus the Ashi point. The Yintang point, located midway between the ends of the eyebrows—often used for infantile convulsions and frontal headaches—and the Dingchuan point, located near the first cervical vertebra—for asthma relief—are very important extra

points. The remaining are the slow-conducting ones, producing a vague and more measurable sensation. The slow conducting pain is more vulnerable to being blocked by acupuncture.

**Ques:** Why have surgical attempts to block pain by cutting spinal nerves always been so unsuccessful?

**Hart:** Early in the century neurosurgeons thought that surgery was the answer. Just cut the pathways midway in the spinal cord or the pathways in the thalamus, in the very center of the brain, and kill the pain. But because there are so many pathways, a few weeks or months after you sever one, the pain impulses switch to another. One patient actually had twenty kinds of operations in the spine, but the pain continued. Whether you try to block pain by scalpel, cauterization, or chemical destruction, the result is basically the same. Nature has made quite sure that you cannot selectively block pain. You'd need to cut through the entire spinal cord.

**Ques:** Where in the brain, specifically, are the impulses from the various pain pathways first labeled as pain?

**Hart:** No one can say at precisely what point this happens, but most physiologists agree that the thalamus is the key area for pain perception. Generally the thalamus is viewed as a sort of switching or relay station that processes incoming information and decides where to send it in the cerebral cortex above. While humans would never "feel" pain without a cerebral cortex, it's difficult to find any neuron there specific for pain. The thalamus, however, has many circuits that are specific for pain and not for touch.

The cortex basically evaluates or makes decisions about pain impulses organized and sent to it by the thalamus. When one becomes a successful lawyer, one no longer prepares one's own trials—one just does the trial. So perhaps one could say that within the brain, it's the thalamus that prepares the brief and the cerebral cortex that conducts the trial.

**Ques:** How did you begin your research?

**Hart:** We began in 1955 by making sure that acupuncture did produce a painkilling effect. We inserted needles into people to see if there was any pain reduction. Because the pain felt is proportional to the amount of potassium released at nerve terminals, we tried to introduce potassium ions into the skin by electrical charges of increasing intensities. A definite pain sensation was registered when the current was increased. We measured the pain threshold this way for the surface of the head, chest, abdomen, back, and legs—eight body areas in all. Without acupuncture the threshold remained the same throughout about ninety minutes of testing. But after an acupuncture needle was inserted and twirled, the threshold slowly climbed.

At first I thought this apparent increase in pain resistance came from some sort of distraction associated with the manipulation of the needles. But this can't be be-

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**• We tested  
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day it looked like  
a factory, with acupuncturists  
sitting beside  
volunteers, and technicians  
operating the  
pain-testing machine •**

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points not on the fourteen meridians.

**Ques:** How do we register pain?

**Hart:** The skin has specific receptors for various stimuli such as temperature, touch and pressure. The pressure-sensitive terminals found on the surface of the entire skin and also in internal tissues are equipped with specific sensory nerves that are encapsulated. But the nerves sensitive to pain have bare nerve endings. They are sensitive to chemical substances such as potassium, histamine, prostaglandins, and many other pain-producing substances. Tissue destruction releases potassium, for instance, which powerfully stimulates pain-sensitive nerve endings.

**Ques:** How does pain sensation travel from the outer body to the brain?

**Hart:** The information for pain is first sent to the dorsal part of the spinal cord. [The central gray matter of the spinal cord is organized into three columns—dorsal, lateral, and ventral—running parallel to the long axis of the cord.] From the dorsal spinal cord it moves upward to the brain by at least six pathways. Three of them are fast conducting systems that inform the brain with sharp and well-localized sen-

cause these distractions are sudden and the threshold builds slowly, peaking after twenty to thirty minutes. This time span fits perfectly with the experience of the anesthesiologists, who know that it takes just that time to get the maximum effect from acupuncture anesthesia.

**Omni:** How long does the raised pain threshold stay off the pain?

**Han:** After half an hour of acupuncture the effect levels off and stays there for an hour or two, as long as the needle is manipulated intermittently. After four hours it has dropped substantially. Most interesting, the rate of decline following removal of the needle is very consistent over a large number of observations. After we averaged responses within a group of about twenty people, we found a fifty percent decrease in the pain-tolerance effect every fifteen to seventeen minutes.

We tested hundreds of people. During the day it looked like a factory with six acupuncturists giving needles six volunteer subjects, and six technicians operating the pain-testing machine.

In the evening I gathered all the data. Using just a calculating ruler and graph paper I plotted peaks and troughs—until two A.M. one morning. When I finally got this very consistent slope for the half-life of the pain resistance, I was so excited that I rushed about to tell someone, but I was alone in the building.

These tests in 1965 convinced me that acupuncture treatment must be producing some substance within the patient's body. Why else would there be this gradual buildup of pain resistance? I hypothesized the reverse was also true: When you remove the needles the pain threshold drops at such a specific rate because the unknown substance is no longer accumulating.

**Omni:** How did you go about hunting for the mysterious substance?

**Han:** We did transfusions of cerebrospinal fluid (CSF) between two rabbits. Because CSF flows around all parts of the brain and spinal cord, substances produced in the brain and spinal cord almost always diffuse into the CSF. I assumed the substance responsible for acupuncture's painkilling

effect would be present in the CSF of the rabbit that responded well to acupuncture. To make sure that acupuncture did kill pain in rabbits, we projected intense heat onto the skin around the rabbit's nose and mouth. The rabbit is always exploring the environment with its nose, so this is very very sensitive. When we applied the heat again after acupuncture, we found the rabbit's sensitivity to pain decreased two- to fourfold, as measured by intervals of seconds before the rabbit jerked away from the heat. We used as a donor one rabbit who had been given acupuncture and one who hadn't as recipient. When we injected some CSF from the donor rabbit into the brain of the recipient, we found a marked

later some of my students from that time went on to medical school. I didn't stay too far from the capital, partly because of my skill as a calligrapher. I have always loved this art, which I started practicing for an hour or two every morning when I was six. Because the revolutionary committees found it useful to make those pain postures I was always kept right around Beijing so they could quickly call me back for some sign work. And so while that period was bad for almost everyone in China, my personal memories are quite wonderful.

**Omni:** You resumed your acupuncture studies in 1972. That was three years before enkephalin was discovered.

**Han:** Right, so at that time we didn't know that the brain produces its own natural forms of morphine. Instead of trying to isolate and purify some unknown chemical—perhaps impossible at that time with my limited equipment and facilities—I thought it better to see if already-known neurotransmitters might have some painkilling properties. That's why I decided to study serotonin, a classic neurotransmitter as my first project.

First I injected rats with a drug that blocks production of serotonin. Brain content of serotonin dropped, and acupuncture didn't work for these animals. When brain serotonin levels began to recover, acupuncture worked again. Next we did the reverse—we gave the animals a drug that simulated the production of serotonin.

They produced much more serotonin than normal, and the painkilling effect was enhanced one hundred fifty percent.

Our third test compared rats that responded well to acupuncture with those that didn't. The responders showed a much greater increase in brain serotonin after acupuncture. These tests, conducted from 1972 to 1974, demonstrated serotonin's role in acupuncture's painkilling effect.

**Omni:** The discovery of enkephalin must have changed the direction of your research considerably.

**Han:** I saw two reports. One was from John Hughes in Scotland, announcing the structure of the enkephalin molecule. The other, from David Mayer in the United

## There are less expensive bourbons. There are also thinner steaks and smaller cars.

### WILD TURKEY

8 years old, 101 proof, pure Kentucky



QUALITY BLENDED BOURBON WHISKY. ALL BY OLD BIRD. 40% ALC/VOL (80 PROOF). 100% GRAIN NEUTRAL SPIRITS. 100% PURE KENTUCKY.

increase in the recipient's resistance to pain. This seemed to prove that a specific substance created by the first animal was responsible for the painkilling effect of acupuncture in the second.

We did human experiments in 1965 and 1966. The animal tests began in 1972. The gap was because we had a Cultural Revolution. But that's another story.

**Omni:** Well, please tell us what happened to you during the Cultural Revolution. **Han:** In 1966 I was a mere lecturer in physiology without much status. So it didn't go too badly for me—just off to the countryside! There I treated patients, taught the barefoot doctors orthodox medicine, and did acupuncture myself. I was happy that

CONTINUED ON PAGE 102





the world's most famous painting, the Mona Lisa, is a 16th-century Italian work by the enigmatic artist Leonardo da Vinci. It is a half-length portrait of a woman, believed to be a member of the da Vinci family, seated with a subtle, enigmatic smile. The painting is housed in the Louvre Museum in Paris, France.



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## ANTI-MATTER

It all depends who you ask. For some, it's the American and, even today, it's still a controversial issue. For others, it's the fact that it's a painting of a woman, and that's all that matters. And for some, it's the fact that it's a painting of a woman, and that's all that matters.

Ever since 1550, when it was first painted, the Mona Lisa has been a subject of controversy. Some people think it's a masterpiece, while others think it's a forgery. The painting has been stolen, and it's still a mystery where it is now.

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The person in the photograph is standing in a field, looking down at something in their hands. The background is a simple landscape with trees and a fence.

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## FUNERAL MUSEUM

The Funeral Museum is a collection of items related to funerals and death. It includes a variety of objects, from traditional funeral home items to more modern, artistic pieces. The museum is located in a building that was once a funeral home.



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## CHILD ABUSE AND NDEs

Like adults, children are steeped away from death reports leaving their bodies and floating down a dark tunnel.

But that's where the similarities end.

According to pediatrician Melvin Morse of Renton, Washington, adults who undergo a near-death experience (NDE) often recall seeing dead friends and relatives, whereas children remember living classmates and teachers.

Why the discrepancy?

Morse hypothesizes that being close to death stimulates the right posterior temporal lobe of our brains. This causes the sensation of being out of the body and floating down a tunnel, what he calls the core experience. Secondary visions—such as meeting friends or religious figures—result when the individual mind tries to organize the stimuli.

This is why people in India see Hindu deities, people who are old see dead people, and children see living people, Morse explains.

He believes that doctors should counsel dying patients about NDEs. "Those who have had NDEs say that they were very beautiful and astounding experiences," Morse says. "If we could relay those experiences to dying people, it might reassure them." —Peggy Nicol

We sometimes congratulate ourselves at the moment of waking from a troubled dream, if only to be so the moment after death.

Nathaniel Hawthorne



CLARK DESCRIBES OGOPOGO AS A HORSE-LIKE BEAST

In July 1974, 14-year-old Barbara Clark took an early morning swim in British Columbia's Okanagan Lake. As she swam toward a diving platform about a quarter mile offshore, she suddenly felt rough skin scratch across her legs. "I'd asked Clark to lurk for the nearby raft and climbed aboard. Turning around quickly, she spotted what she believed bumped against her—a dark gray, serpentine-shaped animal about 15 feet away. Clark dived the creature, whose head was submerged, was approximately 30 feet long and 4 feet wide, with a distinctive forked tail that seemed to

resemble a whale's.

According to J. R. Clark, Greenwell, secretary of the International Society of Cryptozoology, which searches reports of unexplained or long-thought-extinct animals, the woman's experience is the first reported physical contact between a human and a so-called lake monster. She did not come forward until recently, says Greenwell, who investigated the woman's story. She was afraid no one would believe her.

Greenwell notes that sightings of the creature, which has been dubbed Ogoopogo by local residents, precede the arrival of European settlers in the area. Clark's description of the monster is similar. Greenwell

says, to many of the more than 200 reported eyewitness accounts of Ogoopogo.

Greenwell adds that the creature's forked tail points to a mammal. It may not have intended to touch Barbara. Mammals are very curious, however, if they have come to see what was splashing in the water. Other investigators believe the animal may eventually prove to be an enormous seal or a form of the primitive whale called Basilosaurus, which lived 40 million years ago.

Yet psychologist Barry Boyerston, who heads British Columbia Skeptics, thinks the monster is more likely the result of overactive imaginations. Lots of intelligent, horror people misinterpret what they see. Okanagan Lake is a finite space, and there is a total absence of evidence that a monster lives there, he says. "No drop prings. No skeletons. Nothing at all." —Sherry Baker

"Through the years a man peopled a space with images of provinces, kingdoms, mountains, bays, ships, islands, fishes, rooms, tools, stars, horses, and people. Shortly before his death, he discovered that the patient labyrinth of lines traced the image of his own face."

Jorge Luis Borges

All passions exaggerate. It is because they exaggerate that they are passions.

Chamblant

The wild places are where we began. When they end, so do we.

David Brower

# TRASHING

CONTINUED FROM PAGE 44

more difficult to find new regulations hard to enforce. The costs of disposing of hospital garbage legally are greater than the penalties for illegal dumping.

Today, trying to make sense of the crazy patchwork of infectious-waste guidelines and regulations enacted by local and state governments across the country could be compared to understanding the new federal tax laws. According to the latest survey by the National Solid Waste Management Association, 32 states already regulate infectious-waste disposal. But the laws imposed by each state vary widely. In Rhode Island and Arkansas, rules apply only to hospitals—and not to medical labs or private doctors. Some states require that all infectious wastes be incinerated or treated before they are dumped in landfills, others simply recommend this. Ohio and Colorado have no regulations and no official recommendations for handling infectious waste. Where state laws are in adequate, some cities enact their own regulations. Last summer, after the Indianapolis children found the infected vials of blood from AIDS patients, the city passed legislation to govern infectious-waste disposal.

Perhaps some of the toughest laws have been passed in New York City, the home of more than 100 hospitals and 11,770 AIDS victims—nearly a quarter of all those diagnosed with the disease in the entire country. Daniel Milstone, chief environmental counsel for the city's department of sanitation, claims that regulations governing the disposal of hypodermic needles and syringes have been on the books "since time immemorial. But they really haven't been enforced," he says. That changed in 1985, when sanitation workers at the Fresh Kills Landfill on Staten Island found bags bursting with hypodermic needles, bloodstained surgical instruments, and dressings—even body parts. "They were finding livers, umbilical cords, fingers, all kinds of stuff," Milstone says. With the AIDS panic at its height, workers didn't want to get near the mess. Reports that some sanitation workers, stuck by contaminated needles, were coming down with hepatitis only increased the workers' fears. A department investigation revealed that several hospitals were sneaking their red-bag waste in with their ordinary, "black bag" rubbish.

Hospitals in New York had a huge financial incentive for cheating. New York public-health laws stipulate that all infectious waste must be burned, but city incinerators don't meet special "burn" requirements for infectious debris, so hospitals are forced to land licensed biological waste incinerators to handle their red bags. The trouble is: only one such facility exists in the entire state, located in West Babylon, Long Island. The alternatives are expensive

and build an in-hospital incinerator or hire private haulers. The minimum price tag for one hospital incinerator: \$80,000. And hauling companies charge four times the city's collection rate to take the waste to incinerators outside the state—to New Jersey, Pennsylvania, Ohio, South Carolina, or even to Canada.

As the number of AIDS patients in the city rose, so did the amount of red bags hospitals shipped out of state for incineration. In 1985 more than 40,000 pounds of red bag waste were produced each day by city institutions. The private hauling fee could run as high as \$2.60 for each bag the size of an average kitchen garbage sack, says Elizabeth Sommer, vice president for regulatory and professional affairs at the Greater New York Hospital Association. Special haulers, special incinerators—it all makes the price so high," she says. "And garbage is not the form you really want to be paying a lot for in a health-care institution." In New York City

*“Bingo,”  
McMahon sings out. He rips  
open two sealed  
paper bags. A mother load  
of needles—  
hundreds of them—spills onto  
the concrete.  
It's a flagrant violation.”*

infectious-waste disposal was fast becoming an economic nightmare.

To stem the tide of cheating, the city council enacted Local Law 57 in 1985. It was simple but severe. All refuse emanating from medical, pathological and research labs, hospital isolation and surgery wards, and infected patients of private physicians and dentists would be banned from municipal incinerators and landfills and instead sent to pathological-waste incinerators. The penalties for violators were enormous: fines of up to \$10,000, and suspension of city pickup of noninfectious waste for a minimum of six months. Already financially strapped, the institutions would be forced to hire private haulers at exorbitant rates to cart the harmless stuff away to commercial incinerators. What really distinguished the New York law from any other in the country was how rigorous it would be enforced. Thanks to environmental police officers, hired to examine ordinary hospital garbage, cranked down hard in one 18-month period, the new unit handed out fines totaling \$489,000 to 110 hospitals and 12 doctors' offices for sneaking infectious waste into black bags.

On a Monday morning, at 7:00 A.M., Tom McMahon, the environmental police unit's most experienced officer, wears his 62 Chrysler down Brooklyn's Belt Parkway to the Southwest Incinerator on Gravesend Bay, where half of New York City's noninfectious hospital waste is burned. This is where the Metro 400—better known as the “garbage barge”—finally anchored after six states and three Caribbean countries refused to accept its 3,100 tons of trash. Every day about 400 tons of ordinary hospital trash is trucked in here and forklifted into four movable guile ovens. The city's public hospitals get their rubbish burned for free; the private and voluntary hospitals pay \$56 a ton for the service.

McMahon, wearing a tight-fitting khaki jacket that last season during his years in Vietnam with the 113th Airborne Brigade, trained to be a nurse in the mid-Seventies, but the low pay and long hours made him switch to garbage collecting in 1979. When the city sanitation department got the order to form its team of enforcers in 1985, McMahon headed the list. He knew hospitals, and he knew garbage.

I issued the first summons ever,” he boasts. A Ralph Kramden look-alike, gravely voiced with a thick mustache and a sweet smile, McMahon gets evangelical when he talks about infectious waste. “We almost always find something bad in the loads we check. Hospital workers can be real sloppy tossing hypodermics into the regular garbage because they can't be bothered looking for the infectious-waste can. In the two years since we started looking at this garbage,” he says, “things have gotten cleaner. The violators are a lot less blatant.”

Today he and his trainee Jose Cruz, don white polyethylene suits, long green rubber gloves and surgical masks. They don't know whether they really need to protect themselves this way. “I called up those guys in Atlanta [the CDC] and asked them what our men should wear, but nobody knew,” says McMahon.

Now they will choose at random two hospital trucks to examine. The first a truck that picked up its garbage from Victory Memorial Hospital in Brooklyn rolls onto the plant's huge loading floor. McMahon stops the driver and asks him to spread his garbage out on the warehouse floor. Surveying the debris strewn over a couple of hundred feet of cement, he walks toward a jumble of bags and kicks them. A red plastic bag peeks out from a black one.

“Bingo,” McMahon sings out. He dumps the contents on the floor and a bundle of syringes still connected to intravenous tubes, along with surgical masks and gloves stained with blood, tumble out. After digging through a few more bags, McMahon discovers ten more hypodermic needles, a pair of surgical scissors, a few syringes, and a patient record, complete with the name of the hospital at the top. Explains McMahon, “We've got to find, in the same bag as we found the bad stuff

something that says victory weapons, on it." Without written evidence, the Environmental Control Board, which adjudicates these cases, won't press charges.

They get lucky again with their next load: trash from New York University (NYU) Medical Center, one of the city's largest and richest private institutions. The garbage—cafeteria muck and ash from NYU's own pathological incinerator—doesn't look unusual. Then McMahon's experienced eye spies two clear bags containing two sealed brown paper bags. He rips them open, and a mother lode of hypodermic needles—literally hundreds of them—springs onto the concrete. It's a flagrant violation, a potentially big fine for NYU—their third such violation in 18 months. Hospital sharps are not allowed in the ordinary waste—not even when placed in disposable plastic containers. McMahon's exclamation is quickly tempered. No piece of paper with the NYU stamp can be found inside either of these two bags.

Officials from Victory Memorial and NYU Medical Center are summoned to the Southwest Incinerator to see the evidence. Alan Youd, NYU's director of environmental services, inspects McMahon's find. He pokes through the needle-filled bags, noting that no papers with the NYU letterhead were found inside them. NYU will claim that the needles could have come from another hospital.

"New York has some of the most foolish regulations," Youd mutters as he signs the summons. Later he explains his dissatisfaction with the city's tough stance. "I'm not against laws, I'm happy to improve the environment. Economically, however, the restrictions placed on medical and research institutions are enormous. Health care in New York is a major industry—and the city likes to tout—and this law doesn't foster a good government-private industry relationship. New York City has no infectious-waste incinerators and one remaining landfill, and if it shuts down I guess we'll all have to move to Buffalo."

Or pay a middleman—the private hauler—to cart their truckloads of contagious waste to commercial incinerators out of the state, as most New York hospitals are currently forced to do. The private hauler then pays the incinerator operator for burning the infectious waste. But a few opportunistic hauling companies have taken the hospital waste and dumped it in abandoned warehouses, on roadways, and in other places where the public could find it, while keeping the profits. Ironically, New York City's crackdown may actually increase the ordinary citizen's exposure to hospital waste.

- Two years ago, in a New York suburb, a mere 100 feet from the doorstep of a children's dance studio, an abandoned warehouse was found packed with five tons of medical trash, including amputated limbs and hypodermic needles.

- In 1986 a carrier drove truckloads of infectious waste from New York hospitals and



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dumped them on a pig farm in Bucks County, Pennsylvania.

• Late that same year a Brooklyn warehouse was discovered piled high with 1,400 bags containing blood-soaked gauze pads, hypodermic needles and syringes, containers marked "infection waste" and documents with hospitals' and patients' names on them. The bags, dumped there in 1982, had been rummaged through and kept on by vagrants, says Nancy Young, a spokesperson for the Brooklyn district attorney's office.

• The FBI is currently investigating a New York City hauler that it suspects is collecting red bags from hospitals, throwing them into incinerator-looking black bags, and then carting them off to landfills in New York State, New Jersey and Pennsylvania.

Tracking laws in most states are weak. No "cradle-to-grave" manifest is needed to prove that the garbage actually reached its final destination. In fact, haulers aren't even required to name the hospitals they've serviced until the end of the year, so it's easy for haulers to dump the waste. New York State officials hope the hauling scans will end when tighter rules for haulers and hospitals take effect in April. Once a year, haulers will be required to show cradle-to-grave manifests—what hospitals they served, how much garbage they carried, which incinerators were used. "Until now hospitals didn't have to turn their garbage over to a licensed hauler, but now they will,"

says Gordon Boyd, executive director of the Legislative Commission on Solid Waste. Penalties will be doubled. For each day of violation, haulers and hospitals will be fined between \$1,000 and \$2,500.

Ultimately hauling firms will be forced out of business by national solid-waste management companies. The emerging growth industry is banking on AIDS. As fear of the disease spreads, even though the fear is unfounded, states will force hospitals to hire an infectious waste management firm. One such company is Browning-Ferris Industries (BFI). Based in Houston, BFI operates nine infectious waste incinerators, servicing 22 states and three Canadian provinces. Vice president Robert Spurgin claims BFI currently burns some 30 million pounds of infectious waste in its 16-furnace incinerators each day.

"We have about three thousand clients—six hundred hospitals and the rest are small clinics, medical laboratories, private physicians and veterinarians," Spurgin says. The company provides cradle-to-grave treatment. "We give them the bags and containers to separate the waste into," he says. "Then we pick it up and haul it to one of our incineration sites."

The service is expensive, although Spurgin won't say how much the company charges its clients. The cost depends on how far the health-care facility is from the nearest BFI incinerator. Sometimes, the closest treatment center is four hundred to

two hundred miles away," admits Spurgin.

Perhaps the most dangerous and overlooked aspect of the whole infectious waste dilemma is the invisible one. On-site hospital incinerators may be spewing a staggering amount of toxic pollutants into the air. A study conducted in 1988 by the EPA demonstrated that most of the country's large municipal incinerators have inadequate pollution controls, emitting some of the most toxic substances into the atmosphere: furans, hydrochloric acid, and other acid gases and heavy metals such as cadmium and lead.

Not surprisingly, most hospital incinerators have even fewer pollution controls than municipal incinerators. Neither hospital nor city facilities have the stringent controls mandated by the government for hazardous waste incinerators. "Many of these old dog" hospital incinerators emit one thousand or more times as many poisons into the air as hazardous-waste facilities do," asserts Jack Lauber, an engineer with the New York Department of Environmental Conservation. Hospital incinerators, he contends, weren't built to burn the wide variety of hospital wastes thrown into them. "The biggest problem is the chlorinated plastics—disposable instruments, intravenous tubing, syringes. If not completely combusted," he says, "these can release dioxins and furans—two organic substances believed to promote cancer."

Ordinary household waste contains about 3 to 7 percent plastic refuse; the hospital waste stream is made up of between 20 and 30 percent plastics. "Most hospital incinerators weren't built to control the emission of these substances," says Lauber. "They control only the amount of smoke and odor they put in the air." With more hospitals firing up their old incinerators, the pollution could get even worse. For instance, in New York City alone, 24 hospitals use virtually unregulated incinerators to burn their infectious garbage.

Studies conducted by Canada's national environmental board and a state agency in California show that in addition to emitting dioxins and acid gases, many hospital incinerators may release low-level radioactive wastes when substances such as leftover chemotherapy drugs are burned. Some of these drugs are so toxic that they're classified by the Nuclear Regulatory Commission as "hazardous" wastes. A recent report published in *Pollution Engineering* concludes that chemotherapy wastes not burned at high enough temperatures may result in the release of cancer-causing contaminants.

"I don't think many hospital administrators realize that these drugs are regulated as hazardous," says the EPA's Sales. "It amazes me they don't even know that the drugs might cause a problem."

Some materials dumped into hospital burn boxes are harmless by themselves. When combined with other substances, however, they form dangerous compounds. According to Lauber, hydrochloric



"Surgeon general says touch your toes. Surgeon general says clap your hands. Hop on one foot. Yeh, yeh!"

no acid produced by burning plastics may combine with formaldehyde—a chemical used in hospital labs to store tissue samples—to form a very potent human carcinogen called BCNME (benzocinnoline ether). "I think it could happen in these old inefficient incinerators," says Lauber. "And we don't know if there is a safe level of this material that we can be exposed to."

Few thousand "reitor," or excess-air hospital incinerators are operating around the country, according to recent EPA estimates. These antiquated incinerators burn refuse with plenty of air, ensuring incomplete combustion and the release of toxic by-products. Most have absolutely no controls to prevent the emission of acid gases and dioxins.

The remaining hospital incinerators—about 1,600 of them—are more modern. Built according to the "controlled air" design they limit the amount of air in the burn chamber, ensuring better incineration and usually possess a second chamber where hydrocarbon gases are retained and burned. Yet these models, while slightly less toxic than the old reitor incinerators, don't have wet or dry scrubbers, essential equipment that prevents the escape of acid gases and dioxins into the atmosphere. The majority also lack automatic controls, the latest safety innovation. "If the temperature in the burn chamber drops," Lauber explains, "an automatically controlled incinerator will add extra fuel or shut down, which keeps combustion efficiency high."

As a result of its national survey, the EPA plans to study the pollution threat from hospital incinerators and determine whether federal regulations are needed. Pennsylvania already requires that new hospital incinerators meet BACT (best available control technology) standards. All new hospital incinerators will have to pass tough emissions tests and dangerous "old dog" incinerators will be upgraded with new pollution controls. New York will soon follow suit, although the old hospital burners won't have to conform to new pollution standards until 1992.

Right now an estimated 85 percent of the nation's garbage is dumped into landfills. The remaining 15 percent is either incinerated or recycled. Landfills won't be in use much longer, though. The EPA predicts that the 5,900 sites in operation today will be closed by the year 2000.

Clearly we need new alternatives for handling the 410,000 tons of trash generated each day in the United States. Proponents of incineration promote new waste-to-energy plants, where burning garbage would generate power for utility companies. Environmentalists warn of the potential pollution fallout from these processing plants and instead recommend trash separation and recycling.

Because of the very nature of infectious waste, recycling is not a viable option. "I'm in favor of recycling," says Lauber. "We just have to find people willing to sort through the infectious material and separate the

metals and glass and plastics. That could be dangerous." Infectious trash is still allowed in landfills in many states, but the burst over AIDS may force states to forbid dumping unburned hospital waste in landfills—even if it has been "treated" to make it noninfectious.

The only solution to the infectious-waste dilemma is incineration. Not just any type of incineration will do—obviously. State-of-the-art facilities are needed with high combustion efficiency, high temperatures in the range of 2000°F, automatic shut-down controls, and pollution-treatment mechanisms such as scrubbers to prevent the emission of dangerous toxins. Now large-scale, regional waste-to-energy hospital incinerators with dry air scrubbers can also be built. One heat recovery model is being erected at a hospital in Albany, New York. It combines an innovative energy recovery system with pollution controls, and the recovery system's \$50,000 price tag (the pollution controls are extra) has an estimated energy-saving payback time of about two years.

Most of the nation's 5,900 on-site hospital incinerators don't have this kind of sophisticated equipment; many hospitals can't afford the steep cost of upgrading their old incinerators to meet new pollution standards. The best solution for any infectious waste generator burning less than 1,600 pounds an hour, says Lauber, is to send the waste to regional commercial incinerators. "I'd like to see more of these large, highly efficient BACT facilities. The waste could be properly manifested, properly packaged, that way no sanitation worker could get stuck with a needle," he says. Tighter local and state regulations for infectious waste, Lauber says, will encourage private industry to build these safe regional incinerators.

Whether infectious waste should be regulated as "hazardous" waste by the federal government remains unclear, and the potential benefits of such a measure seem limited. "Even if we promulgate federal laws," says Sales, "we can't force the states to enforce them." Suelien Proger, managing director of environmental policy for the National Solid Waste Management Association, agrees. "We don't need federal regulations," she says. "We just need states to work toward having similar regulations. Enacting compatible rules would serve to discourage interstate hauling and dumping of hospital waste. And the proliferation of regional commercial incinerators, built to BACT specifications, would put unnecessary private haulers out of business."

This is the future of infectious waste. The irony is, none of the new disposal measures we envision will control or even hinder the spread of AIDS. It is only the smallest consolation that a deadly epidemic, which could be eradicated before the century's end, may have provided us with the incentive to solve a separate dilemma—one that might have begun to plague us only in the year 2000 and beyond. □

## BOOY

CONTINUED FROM PAGE 22

syndrome [a rare dementia characterized by loss of the ability to write, perform simple arithmetic, and recognize objects].

By performing "transmission studies" in which prion proteins were purified and transmitted to a series of host animals, researchers were able to confirm that prions were the sole source of infection in these three diseases. In the future, Prusiner suggests, prions could be used in a diagnostic test for Creutzfeldt-Jakob.

Meanwhile researchers as far-flung as Berlin, Scotland, and Italy are probing other subunits to determine their size, structure, and effects. Among the variations cataloged to date are the weeds—mushrooms of RNA that so far seem to infect only plants like tomatoes and cucumbers. Another subunit variant, the virulent, appears to be a loop of RNA that rides inside a regular virus, like a worm nesting in an apple. Viruses, like viruses, require a protein coat in order to do their damage. Unable to manufacture their own, they somehow induce their host cells to do so for them. Virgorees are otherwise normal genes with the capability of generating new infectious particles under circumstances yet to be fully defined. The oddball member of the family is the satellite virus.

Satellite viruses are merely snippets of RNA. To acquire enough biological machinery to operate, they envelope full-size viruses, turning them into work animals.

Our present conception of a satellite virus is of a nucleic acid that can multiply only with the assistance of a virus nucleic acid. The nature of that assistance is still a mystery. Says Jacobus Kaper of the U.S. Agricultural Research Service:

Apparently, says Kaper, a virus with a satellite aboard takes over a cell and commands it to produce enzymes needed by the virus to reproduce. The satellite then uses the same enzymes to multiply itself.

Microbiologists know that satellite viruses infect crops, but their effect on humans is still unclear. For instance, Italian researchers have discovered a satellite virus that latches on to the hepatitis B virus, penetrates liver cells along with it, and then somehow compounds the disease.

Ironically, some scientists—including Kaper—think that satellites, once harnessed, could be put to work to formulate novel medicines for the future. "Satellites usually attenuate the symptoms of viral diseases," says Kaper, "probably by competing with the virus for the replicating enzyme and so resulting in fewer virus cells." Because of this, he says, satellites may one day be used in the treatment of viral infections. Kaper points out that Chinese biologists are already using them to control crop blights. Eventually humans suffering from certain viruses—there's no speculation yet as to which ones—may receive a therapeutic dose of satellite-virus tonic. □

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# GULF

CON: HULL FROM PAGE 11

heroic prophet seemed suddenly ironic. Ashurbanipal is mad! Demons of hate possess him! He bathes in blood!"

"Your blood, the Baru pointed out. Harsh laughter rose from the Assyrians. They smiled terror. Their ranks stirred restlessly, almost tasting the future joy of rushing through the city, looting, burning, maiming, raping.

For a moment the enemy priest vanished from the parapet, turning to speak to others behind him. Loud catcalls rose from the Assyrians as they melted in growing fury. The Barute responded: "Creep back to Nineveh and your temple boys!" he shouted over the sudden din of blood-thirsty jaws and shield beating. "Back to your mad king in his den!"

"I will go," the Baru belted calmly, "when I have your tongue to take with me!" Here and there the army's brighter soldiers yelled approval at his wit. "Your day is over, heretic! There was one like you of Nabu-Shumai, city of Elam. And that city fell!" A loud cheer from the Assyrians. "And another at Shushinak, city of Elam, and it fell!" A louder cheer. "Don't you hear, city of your coward king, has fallen!" Frenzied yells of triumph from the Assyrians, for this was news. Buoyed by their howls, the Baru seemed struck with inspiration. "All this despite the lying tongues of heretics! You shall be mute, priest! Shemesh has promised me your tongue! I have six such tongues already within this leather bag!" The Baru pulled a drawstring bag from within his robe and shook it above his head.

The army roared. "The lying dog!" Hali giggled, clucking Bal-Hashi. "He's got our Names in there!"

The Elamite prophet screamed, his words lost in the Assyrians' din.

Suddenly ten Elamite defenders rose from where they had crouched in hiding on the catwalks behind the battlements. They lunged down long, snaking siege ropes their ends weighted with barbed grappling hooks. The hooks hissed down around the Baru. Most missed, but one knocked the net hat from his head, and two more snagged his robe. The Baru hesitated and dropped his staff, crying out.

"Shoot!" the General shouted. Arrows streaked upward. The Elamites fell back, some perched and howling, others hauling their ropes back for another cast. The two defenders who had caught the Baru struggled to haul him in. He was lifted squirming from the ground, a hook snagged in his belt. He dropped the bag of Names.

The General watched coolly as his army's shouts broke into a maelstrom of rage. "Ladders forward!" he shouted.

The Baru's robes ripped. He fell out of them, landing heavily, his ribs scraped and bleeding. His mystics rushed forward quickly, dragging him to safety. They left the bag of Names where it had fallen.

Bal-Hashi and Hali watched in occult horror. Then as one man they burst from the midst of the General's guards. They ran headlong to join the howling Babylonians, who dashed forward, vaulting their ladders against the city wall. The two men scuffled furiously for the bag at the foot of the city wall. At the last moment a hiss alerted them. They looked upward to see a huge bronze pot tipping at the rim of the battlements. They stared up, openmouthed, into the deluge of flaming pitch.

Technician First-Class Bahashit pined an anti-personnel mine from the faking soil of the Persian Gulf. Below the mine's edged bottom, a crusted layer of black stained the dirt. He set the mine aside with tender gentleness, then prodded the dirt with his wrenching tool. His eyes widened. "Hey!"

Four meters away, Technician Ali stopped his gingerly digging and pried the Walkman earphones from his close-cropped head. "Yeah?"

"Come have a look. See what I dug up." Ali squirmed on knees and elbows across the minefield, his plastic Khomani tag dangling from one pocket flap. "Bouncing Betty. That's a nasty one."

"Not the mine—the," Bahashit held up a dust-caked bit of pinkish elastomer. "Pagan stuff."

"Huh?" Ali said. "You have all the luck, Bahashit!" He peered down into the cavity where the mine had been. He raked at the stained soil. "Look! Here's one for me."

He groped for it. They struggled briefly, but Ali scratched the stone cylinder away and sat up, frowning. "You've got yours! I saw this one. It's mine!"

Bahashit shrugged with bad grace. "What wills." He rubbed grit from his trophy with his thumb. "Look at this," he said. "Some pagan whore standing on a lion! Look, she has no veil or cloak—you can practically see everything!" He looked it carefully into his breast pocket.

The Walkman's phones around Ali's neck, squeaked shilly—acts of sabotage and terrorism! The Iranian criminals have hung acid in the faces of those attempting prayers at mosques. Shille-tonations of the inhuman Khomani regime have poisoned food at the holy shrines of Basra and Karbala!

"Radio Baghdad!" Bahashit said. "You shouldn't be listening to that shit."

Ali looked sheepish. "They're jamming Radio Tehran today. You can hardly hear the Imam. Besides, the heretics play Western rock and roll."

"For shame," Bahashit said without much conviction. A snarl walked briefly back at the Iranian camp. The two men got to their feet and headed back to base, their bellies rumbling for lunch. An American-made Chinook copter stuttered along behind the Iranian lines, passing over a low mound of emmiration-crushed brick. The two Iranians passed the barbed wire and jumped down into a slit trench. They took their places in line beside a half-buried gallery

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area, as an roof heaped with sandbags. They shuffled forward, poking up battered army mess trays still stamped with the Shah's imperial seal. Beheshti pulled a checkered kerchief from around his throat and flapped at his sleeves, beating out a cloud of minked dust. The man before him turned around, coughing. "Please stop!" The man's face was weedy and coarse, his cheekbones hunched and slanted, his lips more ribbons. He had no eyebrows.

"Sorry, brother," Beheshti said. "Mustard gas," the scared man said with a shy smile. "The dust is bad when you have no nose hair."

Ali and Beheshti took their trays of chick peas, guck, rice, and farbreed. They clambered out of the trench to a favorite sitting spot, where a camouflage net had been cast over a low rise of chipped lime stone. It was a little breezier here, and it was easy to spot among convoys with supplies. They were still eating when a Revolutionary Guardsman wearing PLO-style lizard camo pulled up in a Toyota pickup. A multibanded infanternet gun had been bolted to the truck's bed. The truck's hefty camouflage of desert brown and tan was peeling, showing bright strips of cheery civilian chrome yellow. The Guardsman stuck his head through the window. "General wants to see you."

The two troops jumped into the back of the truck and were rapidly driven to field headquarters. Commandeered school buses were parked all around the bunker. Young boys in bloodied martyr's headbands leaned outside the windows, cheering wildly, waving at the truck.

Ali and Beheshti waited under a limp Iranian banner as the Guardsman disappeared into the concrete bunker. In the distance, two Iraqi fighter bombers returned from harassing oil tankers in the Gulf. Their contrails streaked the horizon beside a billowing mass of smoke from distant Khosraviyah. Ali looked morosely at the children in the buses as they began a vigorous sing-along war chant, kneeling on the bus seats and pounding their chests in unison. "The minefields," he said, as if he thought had struck him for the last time. "It's another human wave attack. The General wants our advice. That minefield we been working on—they're gonna march these kids right through it."

"Well, yeah," Beheshti said. He hesitated. "We've done it before, haven't we?"

Ali struggled uneasily. "I guess so. We killed kids that weren't much older than us. We burned them on pyres. We displayed their bodies." He paused, his fingers searching through reflex for a nonviolent beard. "But wait. Those were enemy kids. Not our own boys."

Beheshti was confused. "Burned bodies on display?" He struggled hard for memory. "You must mean the American commandos," he said, strengthening in relief. "They tried to rescue the hostages in the Nest of Spies. God punished them. Their chests crashed in the desert."

"You said 'chests,'" Ali said. He looked thoughtfully at the ground.

"Something really terrible has happened to us," Beheshti decided slowly. In absent irritation he shook one pants leg. Dust fell. "Where did those pants come from?" he demanded. "I hate these! And what's my helmet?"

"Something's missing," Ali said. "I think we got lost or something. And it's not any better here. It's worse."

Beheshti gazed around. "Sure seems familiar though. Same war, anyway."

Ali looked deeply troubled. "I should have been a brewer by now. With a nice little tavern all my own."

"We were Muslims," Beheshti pointed out. "We don't drink." He paused. "We're Shias of the Revolution. We don't dance or play music. And we stone loose women."

Ali thought this over. He seemed stunned. "What do we do for the joy in life then?"

"Uh..." Beheshti wrinkled his brow. "Well, there's mass struggle rallies. And mass condemnations of the American Great Satan and the Marxist atheists..." Beheshti made a ritual air-punching gesture. They're pretty exciting, really."

Ali frowned, thinking carefully. "No brewing. Well, I guess I could make tapes of pop music. At least a black market has some kind of name in society."

"It's time we got away from this," Beheshti said. "All the joy has gone out of it. We don't even get lost. Ali. This war is for soldiers. It's all for the priests. They want us to die! Something's gone crazy!"

Ali kept a tall iron pole nearby. Four Khomeini speakers crackled into life. "In the name of Allah the Most Gracious, the Most Merciful. An intense, sonorous voice, lightly eaten by static. "Soldiers of the Islamic Revolution! Today we will chop the hands from the wrists of the Baathist-Zionist regime! The corrupt and evil oppressors of the Iraq faithful will pay the full and bloody price for their crimes against the liberation struggle." The voice went on and on, words pouring out in a tumbling drone, a paralyzing chant that turned living, breathing men into faceless, selfless heroes.

Ali shuddered at the power of the Word. A mullah from the capital, he said, his shoulders slumping. He listened briefly.

"He's good. And we'll have to talk to him. He'll see our souls. We're done for."

"Let's lie to him," Beheshti suggested in a sudden flight of desperation. "We'll hide our souls. We'll lie and cheat. Until we either die or far away from here."

Ali smiled. "What'll we do then?" Beheshti shrugged. "Sin. I guess."

"Good deal," said Ali, beginning. "Three and okay."

To the north, heavy artillery opened up, throwing death across the Shahr al-Arab with distant monotonous thuds. The Guardsman beckoned from the doorway. The General was ready. They stepped down into the stinking darkness of the bunker. ☐

# SPACE

CONTINUED FROM PAGE 24

like so many other spacecraft, it was not as assembled to be disassembled.

The team then began treating the craft with special chemicals to arrest the corrosion. For Spacecraft 007, this was especially tedious, as its shell was a honeycomb of aluminum and water had settled in each cell of the honeycomb. The KCSC team drilled hundreds of holes in the hull to drain off the water and squirt in the rust-arresting agent. They used tiny mirrors to inspect the inaccessible nooks and crannies. Then they injected a special foam into the honeycomb's cells to force out rust-encrusted hanging air.

The thousands of switches—each one made of 32 parts—had to be taken apart, dipped in antirusts, buffed free of rust and reassembled. For this work, the team used magnifying lenses and small, high-speed power tools resembling dentists' drills. Special brush attachments were used to polish the cleaned parts. It took as long as six days to restore just one switch.

The final phase of reconstruction says Ary will be to replace the missing control panel segment with one that looks identical to the real thing. Dials and gauges will be deliberately silk-screened to have a faded and worn look so they blend in with the original controls.

While 007 was a real challenge, the most difficult work, Ary says, is in restoring space suits. The suits have to be handled carefully, as some are more than 20 years old and in extremely dilapidated condition. Some are so delicate, staff members have to wear white gloves while handling them.

What cannot be replaced on a suit can be duplicated. Team members Steve Burton and Marco Scott can work up exact copies of everything from worn or missing name tags, flight patches, and flag emblems to boot or glove covers. The team has also learned to remove from scratch the metal neck and wrist fittings, which NASA cannibalized for use on shuttle-era space suits. The center owns the molds used to manufacture the original helmets and, when necessary, can build a whole new helmet from scratch, even to putting down a thin layer of gold leaf over the wear as was done with the originals.

Within nine years the center has been transformed from a local museum into a national resource. Every major space museum in the country, including the National Air and Space Museum, relies on the center's facilities. Few others make the same commitment to the time-consuming detail work that is the center's trademark. For example, when Spacecraft 007 is ready for display, it will be the result of a full year's work done at a cost of \$200,000.

Why all this attention to outmoded NASA hardware? It's simple," Ary says. "We want to make sure that years from now we will have a record of our space age." ☐

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## INTERVIEW

(CONTINUED FROM PAGE 51)

Bulus' showed that naloxone—a drug that blocks the receptors for opiates—diminished the paralyzing effect of acupuncture. Moyer had injected naloxone into the skin of humans. I decided to inject it directly into the rabbit's brain, where CSF is produced and circulates, so it would diffuse more directly into all brain areas. The results were startling. Naloxone injections blocked acupuncture but only by fifty percent. This showed that natural brain opiates were only partly responsible for its paralyzing effect. Other neurochemicals like serotonin must also be involved.

Orrin: After enkephalin many more natural brain opiates with different potencies and sites of action were discovered.

Han: By 1979 at least ten natural opiates had been found. In that same year Aram Goldstein of Stanford University discovered dynorphin, so called because it is nearly two hundred times more powerful than enkephalin in animal tests. It was puzzling that when dynorphin was injected into the brains of mice or rats, no paralyzing effect was observed.

I wrote Goldstein saying that because he had found dynorphin to be so powerful, I wanted to inject it into the spinal cord of a rat. He very kindly sent me two milligrams, which at that time cost about five hundred dollars apiece. When injecting any chemical into the spinal cord, one usually waits seven to ten days for surgical recovery. When I did this, I got no special pain-killing effect from the dynorphin injection. So I changed procedure: injecting dynorphin within twenty-four hours after surgery. The effect was overwhelming. Goldstein invited me to his lab in 1982 to show him how I did this. At a conference in Boston we attended together Goldstein got up and announced, "Tomorrow Dr. Han will present evidence that dynorphin works analogously in the spine, not in the brain."

Orrin: Why did you switch from traditional acupuncture to electroacupuncture?

Han: When one inserts a needle and manipulates it, the patient gets a very peculiar sensation. This ache is called *de qi* and is not real pain but an unpleasantness combined with a sense of heaviness, numbness, and swelling. Procaine injected just below the skin fails to abolish this needling sensation, and acupuncture still works. But when procaine was injected deep into the muscle layer, both the needling sensation and acupuncture effect were gone. Therefore the key point must be in the structures located deep in the muscles and tendons.

Each acupuncture, however, has its own way of reaching the *de qi*. In order to standardize the procedure, I thought of using electrical stimulation via the needles to reach the deep structures. The way I can change the parameters of the electrical stimulation to produce the most satisfactory effect. In fact, in 1986 I also used a

kind of surface electrode. One part of it went above and another part beneath the acupoint, and I clamped them together with a segment of a clock spring. It worked well. That was the first model of acupuncture without needles or transcutaneous electrical nerve stimulation (TENS).

Orrin: Do you change the frequency of the electric stimulation?

Han: Traditional acupuncturists always stress that different ways of twirling produce different therapeutic effects. The most popular example is that we treat diarrhea and constipation with the identical acupoint—the *Zusanli*, a famous point located just below the knee—but use different manipulations. When you ask them how they do it, they describe it as hot or warm or cool or cold—each a different manipulation. And each famous acupuncturist has his own style of twirling.

Orrin: You tell that the traditional method was too subjective? You couldn't attach numbers to its effects?

Han: Yeah, that's why we used electroacupuncture, and also to duplicate the techniques of the classic acupuncturist by varying the frequency and amplitude of electrostimulation. Since Pomaraz at the University of Toronto made an interesting finding with electroacupuncture in 1979. Both high- and low-frequency acupuncture kill pain, but the low frequency not the high-frequency effect was blocked by a small dose of naloxone. So he concluded that the high-frequency electroacupuncture effect is not mediated by the opiates. But in our lab we found that naloxone blocks both high- and low-frequency electroacupuncture effects. A small dose of naloxone easily blocked low-frequency electrical stimulation, whereas high-frequency needed forty times as much to do the job. Later I showed that the high-frequency stimulation releases dynorphin, and I saw that we could block the high-frequency effect by blocking dynorphin. Recently we used radioimmunoassay to determine that low-frequency acupuncture does produce lots of enkephalin but not dynorphin. High frequency is the opposite—lots of dynorphin but no enkephalin.

Orrin: Did you try switching the frequency back and forth?

Han: The traditional acupuncturist twirls at many different speeds. If it's slow, he may twirl the needle back and forth or go up and down once per second. Quick might be four to six times as fast. That means sending four to six bursts of impulses per second to the central nervous system. Of course, the human hand is never exact. One could never say "Oh, I'm now twirling at two, four or ten hertz per second." So we chose a frequency pattern of two and fifteen hertz, shifting automatically to embrace both slow and rapid twirling.

We were so lucky because switching from two to fifteen hertz releases both enkephalin and dynorphin. All this, of course, applies only to animals that respond to acupuncture. For the nonresponder there's

little or no release of enkephalin or dynorphin after acupuncture, whether you use high- or low-frequency stimulation.

**Omni:** What might cause an animal or person not to respond?

**Han:** Different acupuncturists say different percentages of their patients respond. When I practiced acupuncture in the countryside during the Cultural Revolution, I observed hundreds of naive acupuncturists and numerous operations performed under acupuncture in hospitals. I believe about eighty percent of the people respond to acupuncture in various degrees, and the rest have no response. Curiously enough, its similar with animals—a rate of about eighty-five percent response to fifteen percent no response.

One of my graduate students did a year-long study with seven hundred rats. The response to acupuncture was fairly consistent throughout the year, except for April and May, when nonresponders improved and good responders declined. We have data on this over many years, yet it remains unexplained. I think the switch is due to neuroendocrine changes induced by increases in light that affect things like melatonin, feeding, and migration.

Anyway, why do some animals respond, while others don't? The obvious explanation is that the nonresponders don't release opiates or serotonin after acupuncture, so there's no effect. Another possibility: Nonresponders may produce substances during acupuncture that oppose or block serotonin and the opiates.

One of these antipainers is cholecystokinin (CCK), which causes contractions of the gallbladder. But in the brain, CCK is doing something completely different. In 1978, during the spring festival that celebrates the Chinese New Year, I was working with my colleague Ming-Feng in my lab. We wanted to enjoy the peaceful day of doing things without disturbance from phone calls or accidental visitors. I gave rats acupuncture for half an hour and measured the effect. Then half an hour later, I gave them a second acupuncture session. At first I thought it was just random that in the second session the rats showed less effect. But as I tested more, I found the second was never as good as the first, and with each session, I got less of an effect. Then I realized that acupuncture is like other painkillers. You get less effect each time. With acupuncture tolerance seems to last about four hours. Because tolerance builds with each session, it takes about a day to recover from six sessions. I repeated this experiment many times, and because I always got the same time pattern, I wondered if there must be some chemical change.

To find out, I took brain extracts from normal and tolerant rats and injected the extracts into brains of naive rats. When the naive rat received the extract from the tolerant rat, he did not react to acupuncture. So I concluded there must be some antipainergic substance within the extract itself.

**Omni:** You think it's CCK?

**Han:** We purified the extract and found the active component to be a peptide of about the same molecular weight as CCK. And CCK has been shown to reduce the effect of morphine and the natural opiates. At my rate, I found that a tiny amount of CCK blocks acupuncture. So perhaps acupuncture tolerance is indeed caused by CCK. Injecting CCK blocker into the tolerant rat did reduce the tolerance.

**Omni:** Your research on the chemistry of acupuncture has led you to expand our knowledge of how the brain controls pain. Could you explain some of this?

**Han:** Pain-control networks within the brain are poorly understood. Until quite recently, scientists looked mainly at the perception of pain. The discovery of enkephalins, endorphins, and other natural opiates proved that the brain must have a multitude of pathways for controlling how much pain we feel and how much it bothers us. We now call this controlling mechanism the pain-

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*For depression, acupuncture and drugs are effective to the same degree, and both work similarly. Tricyclic drugs have many unpleasant side effects. Acupuncture has none.*

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modulatory system. It is essentially a downward system, meaning that after pain is initially felt, this pain-modulating system works to block the continuing perception and transmission of pain at the spinal level—before the sensation is transmitted back to the brain, which brands it as pain.

Our first ideas about this system included only the part of the brain just above the spinal cord. This very primitive area, known as the brain stem, includes an area called the midbrain. Cerebrospinal fluid bathes and cushions the entire brain flows through a narrow channel, the Sylvian aqueduct, near the top of the midbrain. We call the area surrounding this channel the periaqueductal gray matter (PAG). In the late Seventies, it was discovered that the PAG sends enkephalin fibers downward a few millimeters to a set of nerve nuclei in the medulla called the raphe nucleus. From here serotonin neurons descend to the dorsal horn of the spinal cord, where pain transmission originates. When the horn itself, neurons release enkephalin which in turn can suppress further pain impulses from traveling upward to the brain.

This is obviously a very limited theory of

pain control. It doesn't include most of the brain—neither the cerebral cortex, where our ideas and associations about pain are registered, nor the limbic system, where drives and emotions originate and where memory is initially stored. By mapping the brain regions where serotonin and the natural opiates are released in response to acupuncture, we could use acupuncture as a tool to expand our knowledge of pain and pain suppression.

**Omni:** So you're saying that the upper brain has a system to suppress some pain?

**Han:** Yes. We did a number of brain-mapping studies, injecting specific opiate blockers and then doing acupuncture. Ultimately we found that three limbic areas funnel impulses into the PAG, and these impulses are especially important in mediating acupuncture's painkilling effect. Most interesting, naloxone, injected into any one of these three areas, as well as the PAG, blocks acupuncture's effect by more than seventy percent. You'd expect the effect to be reduced by only a third or a fourth—unless all four areas are linked to form a loop. If you block any one, however, you block most of the acupuncture effect. Because of this I was led to postulate what I call the mesolimbic loop of acupuncture analgesia. The mesolimbic-loop idea suggests a continuous flow of neural impulses and neurotransmitters between the midbrain and the limbic system to control pain. Once acupuncture activates the mesolimbic loop, the nerve impulses just go round and round. The mesolimbic-loop structure may explain why in some patients one treatment relieves pain for days or weeks.

Although the four brain areas are all linked, they contribute to our response to pain in a distinctive fashion. It is logical that while we have a simple pain reflex, we have an elaborate emotional response to pain. The limbic areas are more involved with this emotional response. The PAG and raphe nuclei are devoted almost entirely to primitive reflexes. They function just to suppress the spinal cord. "Don't tell me you are painful" is the message they send back down. When pain impulses move past the brain stem, you begin to register the emotional aspect of pain. I think the limbic system plays a dual role in pain control. It produces the emotional response to the painful stimuli, then it activates the PAG, which in turn suppresses pain perception at the spinal level. Pain activates both functions. You pay with the first—the pain—and obtain the second—the relief. Acupuncture seems to selectively activate the second pain-suppressing role and eliminate the miserable experience.

**Omni:** Given this ability to modify neurochemical release in the limbic system, might acupuncture be used in place of mood-altering drugs?

**Han:** It has proved very useful in treating depression and somewhat less successful for schizophrenia. Our third affiliate hospital at Beijing Medical University is doing a comparative study of tricyclic antidepressants

sant drugs and acupuncture treatments. Patients get one daily session of acupuncture for four weeks. Both acupuncture and drugs are effective to the same degree. But incisions have many unpleasant side effects. Acupuncture has none. Both treatments seem to work similarly—by increasing serotonin within the limbic system.

**Qmiv:** Is electroacupuncture for humans a kind of fine-tuned version of traditional shock therapy?

**Han:** Many kinds of electrotherapy definitely activate the pain modulatory system. Some, like foot-shock experiments with rats, are very vigorous and cannot be used for people. A French team is doing experiments now with something they call diffuse noxious inhibitory control. Electro-stimulation of this type actually produces pain impulses that move upward within the spinal cord—so sensitivity to pain is eventually decreased. Like foot-shock it's really impractical for people. On the other hand, we have mild therapies like TENS that use high-frequency but low intensity stimulation to suppress transmission of pain. In this therapy two electrodes sit side by side on the skin, with the current moving just along surface nerves. Although it is easily acceptable, about one third of the people receiving it don't respond. To stimulate the deep receptors you need a device that can pass current to the muscle and tendon either via acupuncture needles inserted into the point—that is, electroacupuncture—or via two skin electrodes placed on opposite sides of a target point. We call this device ACUTENS. ACUTENS also use electrical impulses that are milder but more complicated than other forms of electrical stimulation. With ACUTENS if you don't get relief right away you can try different frequencies or alter the frequency to release different combinations of serotonin, enkephalin, and dynorphin.

**Qmiv:** What about acupuncture's ability to stabilize blood pressure during surgery?

**Han:** This is a major advantage of acupuncture anesthesia for emergency operations. When cats and dogs are near shock resulting from massive bleeding, not only does blood pressure recover after acupuncture but survival time is significantly increased. Besides stabilizing and preventing a further drop in blood pressure for people in shock, acupuncture distributes the remaining blood away from the skin to vital organs such as the heart and kidneys. We know it must be influencing the autonomic nervous system to contract blood vessels here, dilate them there. The trend in China is to use acupuncture in combination with drug anesthesia.

**Qmiv:** How do you compare the practice of science in Asia with that of the West?

**Han:** In the United States scientists are very efficient. When they talk, it's quick and directly to the point—just a few pinpoint sentences and that's it, thank you and good-bye. Chinese people are a bit too polite. They prefer to encourage you in your strong point and are shy to give a critical com-

# AN HERETICAL COSMOLOGY

## A RETURN TO DESCARTES AND LOGIC IN SCIENCE

**A**N HERETICAL COSMOLOGY by Louis Jacot invites the reader to reconsider Descartes' vortex theory of the universe equipped with common sense, empirical observation of nature and a knowledge of the recent history of ideas. Illuminating the bootstrapping and use of metaphor in Newtonian and Einsteinian physics, the book compels the reader to question the fundamental premises of modern theory.

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ment when you ask for it. In the United States, my friends very generously help me by pointing out my weaknesses. In the United States people tell you what they think the truth is and fast. And I like it.

Of course, in the United States people are highly efficient partly because of the sophisticated equipment. It's easy to make a telephone call and order chemicals. One calls today and it arrives the next day. In China we wait weeks or months. That's why Americans can have two day weekends and we often work Sundays and holidays. When a scientist stands up at a conference to report findings, people do not excuse his limited data on the fact that he had to wait months for supplies. In my lab we are happy to catch up.

**Ques:** But how about differences in attitude and approach?

**Han:** Western scientists are much more open-minded, more inclined to hypothesize. I confess I'm not so broad minded. In 1972 after the rabbit tests, I knew there must be some substance internally produced by the treated rabbit; otherwise the acupuncture effect couldn't be transferred chemically to the untreated one. But I dared not postulate that it was because of endogenous morphine. We knew in China, back in 1963, that morphine injected into the PAG produced a painkilling effect: a finding by Chang Zheng of Shanghai Medical College and his graduate student Kang Zhou. Zhang's idea implied that there must be specific structures to receive it there. But the presence of morphine receptors doesn't actually prove the existence of natural brain opiates. Quite a few steps remained, and I didn't make the theoretical leap from receptors to natural opiates. When I tell this story to my graduate students, I always say that we must be open to theorizing.

**Ques:** Has your study of acupuncture altered your philosophical worldview?

**Han:** The ancient Chinese philosophy—that there must always be balance—has helped me greatly. If you have opiates, maybe you also have antipiates. The main source of serotonin neurons, the raphe nuclei, is only a few millimeters away in the lower brain stem from the locus coeruleus, the main source for norepinephrine [norepinephrine or norepinephrine is a neurotransmitter that accounts for attentiveness, anxiety and fear] and norepinephrine and serotonin oppose each other. If you stimulate one, you suppress the other. This reciprocal inhibition is just a neurochemical seesaw. As one goes up, the other goes down. Perhaps acupuncture will turn out to be a good way to balance many of our naturally contradictory nerve impulses. We shouldn't be surprised by the bidirectional effect of acupuncture on physiological systems—the increase of blood pressure in shock states, for example, and the decrease of blood pressure in hypertension. The mysterious symbol of Taoism and the theory of yin and yang [Han draws the famous light and dark circle] are founded on the principle of a

delicate balance between contradictory forces. The acupuncture needle may be regarded as a powerful lever to normalize the disturbed balance.

**Ques:** Your wife, daughter, and son are all research scientists.

**Han:** My wife is an associate professor of pharmacology. She is working with Chinese herbs and I with acupuncture. We discuss these things all the time at home, so our children became interested in research. My wife is now working with the chemical made by a deerlike animal with a gland just above the pubic bone that produces a special smell. I can't remember the name in English.

**Ques:** You mean the civet?

**Han:** Yes, and oh, yes, the smell is musk. My wife and her colleagues have isolated and purified an extract of musk, and she's found it is a powerful anti-inflammatory drug—more than thirty times as powerful as hydrocortisone on animal models.

**Ques:** After twenty years of research, what are your thoughts about acupuncture?

**Han:** I want people to understand that acupuncture for pain relief is not something mysterious. It would be difficult for most people to catch the exact meaning of meridians, yin and yang, or the "five elements." What I have been studying is simply stimulation and reaction. You stimulate the acupoint with low- and high-frequency manual needling or electrical stimulation, and the reaction is the release of various substances in the central nervous system and a painkilling effect. These you can measure and manipulate. Principally I believe the Chinese view of balance and contradiction is useful, even vital to a scientist. But belief in mystery is something else—perhaps religion.

Right now, because autonomic nervous system problems are so common, I have a small group in my lab doing studies on how acupuncture might regulate such things as blood pressure. Humans and animals are automatically assisted in their need to fight or to escape by the sympathetic part of the autonomic nervous system. But if it's overactive, you can't lead a comfortable life. I believe acupuncture can restore the necessary balance between the sympathetic and opposing parasympathetic branches of the autonomic nervous system. After blood pressure and blood flow, I'm most interested in digestion and its relation to metabolism. My next project I hope will be to create an acupuncture regulation chart for autonomic nervous system problems, whether they be insomnia, bad digestion or migraine headaches. You apply such and such frequency to needles placed in such and such points.

I'm happy that science and technology have helped unravel the mechanisms of the thousands-of-years-old technique of acupuncture. In the meantime, the study of acupuncture has become a good model for neuroscience research into pain relief. I hope this benign, beneficial cycle will continue in the future. **DO**

2-H If an egg sinks in water and lies on its side, it's fresh. If it stands partially up on its tapered end, the egg is not as fresh, but it's still edible. If it floats, it's rotten. As an egg ages, the yolk and white gradually lose moisture, and the air pocket at the larger end gradually increases. The larger the pocket, the more buoyant the egg is.

3-A Take the egg and spin it on a hard surface. A hard-boiled egg will spin nicely, but a raw one will wobble and fall over because the liquid sloshes, changing the egg's center of gravity.

4-C Sticking a straw all the way into the bottle allows air to reach the bottom. The air then forces the ketchup out.

5-F Soaked with lettuce in a plastic bag, a napkin or paper towel absorbs excess moisture that causes the rust.

6-E Store the stale marshmallows in a plastic bag with a fresh slice of bread. In a few days they will have absorbed moisture from the bread and will taste fresher, and the bread will have dried out. Hydrolysis of the sucrose molecule bonds with hydrogen picked up from air. Together the H<sub>2</sub>O and H form H<sub>2</sub>O (water). And the greater the sugar content, as in marshmallows, the greater the attraction of water.

7-D An onion's volatile oils are an irritant when inhaled. If you don't have a scuba mask which covers the nose as well as the eyes, breathe through your mouth while slicing an onion.

8-G Groopers turn tomatoes red by placing them with ethylene. Since tomatoes give off their own ethylene, putting them in a paper bag surrounds them with the concentrated gas that accelerates ripening. Pierce the bag with a couple of holes to allow oxygen to enter.

In addition to McGee's *On Food and Cooking* and Hilmar's *Kitchen Science*, Marisa and John Bear's *How to Repair Food* (Ten Speed Press) was also a major source for this month's quiz. **DO**

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New You Can Own the First  
Officially Authorized

# STAR TREK®

Porcelain Doll

For more than 20 years, people all over the world have been captivated by the powerful drama and futuristic vision of *Star Trek*®. And among the many dynamic members of the *Starship Enterprise* crew, the calm and rational Vulcan "Mr. Spock" has emerged as the all-time favorite.

Now, commemorating the 20th anniversary of *Star Trek*, The Hamilton Collection in association with Ernst Entertainment is proud to present "Mr. Spock"—the first officially authorized porcelain doll that captures the spirit of *Star Trek*.

"Mr. Spock" is meticulously crafted in fine porcelain to capture the famous Vulcan eyebrows, ears and stoic appearance. What's more, he is posed displaying the well-known Vulcan greeting and forewell hand sign, meaning "live long and prosper."

"Mr. Spock's" handsome uniform and insignia beautifully replicate the originals from the *Star Trek* television series. Your doll will arrive complete with its own stand, ready for home display. "Mr. Spock" can be yours for the reasonable price of only \$75 (plus \$2.16 shipping and handling, payable in three convenient, monthly installments of only \$25.72—with only one due prior to shipment).

As an owner of "Mr. Spock," you will have the right—but never the obligation—to acquire all future issues in the *Star Trek* Doll Collection as they become available. Furthermore, you may return any doll within 30 days of receipt for a full refund.

This "Mr. Spock" doll represents a unique and lasting tribute to the most popular character in *Star Trek* history. What's more, this handsome doll is the first officially authorized porcelain *Star Trek* doll. Thus, fans and doll collectors alike are motivated to compete heavily to acquire "Mr. Spock." So to avoid disappointment, send in your application today!

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Respond by: **Send date \$602.25**

(February 29, 1988)

Limit: One doll per subscriber

Accept my application for the "Mr. Spock" doll. I prefer to pay the first of three monthly installments of \$25.72 as follows:

☐ I enclose my check or money order  
☐ Charge my credit card ☐ Visa ☐ MasterCard  
☐ American Express

Acct. No. \_\_\_\_\_

Exp. Date \_\_\_\_\_ 002572 33669 GW

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_

Signature \_\_\_\_\_

We reserve the right to accept or reject any and all applications for this doll. We reserve the right to accept or reject any and all applications for this doll. We reserve the right to accept or reject any and all applications for this doll. We reserve the right to accept or reject any and all applications for this doll.

**The Hamilton Collection**

10101 Regency Square Blvd., P.O. Box 44011, Jacksonville, FL 32216

**"MR. SPOCK"™**

- Officially authorized
- Actual size: 14" tall
- Individually tailored uniform

# STARTECH

## ACCESSING THE FUTURE

### CALMING CRYBABIES

As any mother or father can tell you, a baby brings joy but also a certain amount of wear and tear, especially when your bundle of innocence won't go to sleep at night.

A few years ago pediatrician John Kelly suffered many sleepless nights while his colicky baby screamed. He tried everything, including tape recordings of womb sounds developed in Japan, which he found worked only on infants younger than 28 days. Eventually, after investigating many ankyring techniques, he developed CRYGONE.

Side one of this audiocassette tape contains advice to parents plus a segment called "Calming Coons"—voices set to music based on infantile vibrations, designed to soothe newborns up to the age of 28 days. The second side, "Serene Sounds," plays soothing music along with (inaudible) subliminal affirmations and reassurances like "Mommy loves you" and "You feel comfortable." It is designed to be suitable for older infants.

In hospitals where CRYGONE was tested, "nearly percent of the babies quieted down, and eighty-five percent fell asleep quickly," according to Dr. Kelly's partner, Dr. Robert King. —Judith Hooper

Access: CRYGONE costs \$14.95, plus \$2.00 shipping. It can be ordered from Lee Enterprises, 5140 North Palmdale, Suite 240, Palmdale, FL 32605.



### ROBOT HOUSING

Don't look now, but the Japanese are mass-producing factory-built homes using computer-controlled robotic welders to reduce their construction time and cut the cost of a steel-reinforced module to 44 minutes and \$56,000, respectively.

Corporate giants such as Sekisui, the acknowledged leader, as well as Matsuda, Misui, and Daiwa may not yet strike terror into the hearts of American prefab home builders, but experts like Sanford R. Goodson, a San Diego real estate and marketing consultant, believe that day is coming. The second Renaissance will probably begin in earnest in about three years, he predicts. And the easiest

will be Japanese high tech.

Goodson says that the Japanese could eventually complete their way to a 20 percent slice of the factory-built home pie. "I look for a joint manufacturing and marketing venture with a giant retailer like Sears," he says.

Sekisui's houses, strong enough to withstand hurricanes and typhoons, can be ready for occupancy in just four weeks. Their size is a uniform 92 inches in height, with 1,200 to 1,600 square feet of interior room, all produced at \$35 to \$43 a square foot. Many of the models are built of new lightweight ceramics that are soundproof and fire resistant. —George Nobbie

Access: Nanto Yaki Matsudo c/o Global Link, 3401 Pacific Avenue, Marina del Rey, CA 90292.

### CASHLESS ONE-ARMED BANDITS

In the gambling casinos of America, where the slot machine has become king, the wave of the future may very well be computerized cashless wagering.

Konilworth Systems, a Plainville, New York, company, has developed the Lot-O-Gold system, in which a player buys a plastic card that has been treated with an invisible chemical coating, indicating a dollar amount. After placing the card in a slot, the bettor sets the one-armed bandit for a specific wager level and then pulls the arm to play.

A win is credited to the player's account and displayed on the machine. Otherwise the amount is deducted. And the traditional sound of coins tinkling down is simulated by a digitized recording.

Jeffrey Lando, executive vice president of Konilworth, believes his company's system will increase the level of casino gambling. And the data these computerized systems can provide on individual gamblers and groups will let casinos channel their inducements to the bigger bettors.

—Marjorie Costello  
Access: Konilworth's Lot-O-Gold system is expected to start operating this year in at least one Las Vegas casino. Although now tied in to slot machines, Konilworth is planning cashless wagering terminal setups for gaming tables such as those for blackjack and roulette.

# STARTECH

## TEFLON FLOPPIES

Verbatim, a Kodak subsidiary that is the world's largest producer of diskettes for personal computers, has begun manufacturing a Teflon-coated floppy disk (below) that can pull up with the sorts of accidents that are the bane of personal computer users everywhere.

Called DataLife Plus, it can withstand white-out, coffee spills, fingerprints on the disk surface, ketchup, cigarette ash, and just about anything else a floppy is likely to encounter in an office

or classroom. By comparison, according to Verbatim, competitors' disks will fail between 70 and 90 percent of the time when marked by a fingerprint, and they cannot be wiped clean.

For added insurance, the product comes in a patented lined sleeve, which prevents static electrical discharge when the disk is taken out for use or replaced for storage. —Peter Eddin

Access: DataLife Plus diskettes are available at computer supply stores at a suggested price of \$23.90 per ten-pack.



## THINKING CAR RADIO

A new product from Blaupunkt, the Parametric Sound Amplifier or PSA (above), lets you customize the sound of your audio system to the acoustics of your particular auto.

Through special plug-in modules, the microprocessor-controlled PSA adapts to the acoustic environments of 83 car makes and models. Each module adjusts the frequencies of the amplifier to the car it's in, factoring in such variables as the length, width, and height of the car as well as the absorption characteristics of the upholstery.

Up until the introduction of Blaupunkt's PSA, the only way to get a true customized match between audio sound and auto sound was through special factory-built-in sound systems. But these factory-installed systems are available in only a handful of usually higher-priced models. The PSA, on the other hand, can be added to existing car stereos or installed with a new system.

—Marilyn Castello

Access: Available now. Suggested retail price for the PSA is \$169.95. Car-specific modules cost \$39.95. Contact local Blaupunkt dealers or Blaupunkt Division, Robert Bosch Corporation, 2800 South 25th Avenue, Broadview, IL 60153. Phone: (312) 855-5200.

## HOME SURROUND SOUND

When the Federation star cruiser passes overhead in the opening frames of *Star Wars*, the Dolby Surround Sound system in high-tech movie theaters lets viewers feel as if the ship really is passing overhead.

Now a new home system may finally bring movie-theater sound to TV viewers. It's the NEC PU 4650S (at right), the first rear projection set that has built-in Surround Sound technology. NEC's Richard Brenner says the system works with four speakers (only two of which are included), each powered by a separate amplifier. Two speakers are placed on either side of the television in front of the viewer and two

in the rear. The speakers are correctly phased so that when something moves around on the screen, it moves around in your ears, too. The next generation of these machines, which will be available later this year or in 1989, will provide an audio channel just for voices and will even more closely approximate theater sound. The PJ-46805 should be available by the time this article appears, and it will cost a hefty \$3,700.—Doug Gier

Access: NEC Home Electronics, Inc., 1255 Michael Drive, Wood Dale, IL 60191

## LIGHT EARPHONES

The latest thing in sound reproduction is cordless electroacoustic earphones that receive sound through light rays lying just below the visible spectrum.

The so-called dark light system, developed by Sennheiser, a German company, and Koss Corporation of Milwaukee, uses infrared light and consists of a transmitting diode and a photodiode for reception. As long as its pathway isn't blocked by a solid object, the



system speeds sound throughout a room. It uses no wires, and the only interference comes from strong light sources, like a picture window or a blazing fireplace.

Koss sells the earphones (above) for home stereo use at \$160 a pair. The Sennheiser models—already used for simultaneous translation work at the United Nations and elsewhere—start at \$300.—George Nabbie

Access: Debby Senn, Koss Corporation, (414) 964-5000, or Anthony Tudesco, Sennheiser, (212) 944-9440.

## FLYING TELEVISION SCREENS

Get ready for the latest in electronic outdoor advertising: flying television screens measuring 1,000 square feet each may soon be lighting up our nighttime skies.

Night Signs are the brainchild of Anshup Industries of London, which has just inked a \$10 million deal with the Japanese advertising agency Nishio Kado to

suspend the gigantic screens from airships (below). The Japanese are very impressed with clever new technology in advertising, says Anshup's Alan Birchmore, "so this will be a wonderful experimental market for us." Each airship, he says, boasts two 1,000-foot screens that will show

pictures and captions generated via an onboard computer system, which can accept live television images or taped messages.

Light-emitting diodes in the screens have a range of 1,600 color shades and a "change rate" of 25 frames per second, or moving picture quality. Night Signs are particularly well suited to so-called trigger advertising,



which employs a key excerpt from a commercial to remind viewers of the rest of the ad, according to Birchmore.

—Mike Dale

Access: Call Anshup Industries in London at (44) 01-995 7011.



*A dozen pages in this issue  
pave the way to a constellation of prizes.  
On your mark, get ready, begin*

# THE GREAT OMNI TREASURE HUNT

**E** envisioning the completed work, a painter begins the creative process with a simple brushstroke. The casual observer, however, finds it difficult to perceive the overall whole based on individual parts. As in scientific research, it takes concentrated effort to fit together the pieces that determine the bigger picture. Omni readers have repeatedly demonstrated such an omniscient ability to focus on specifics and apply them to the world at large, realizing that the search for knowledge will result in future rewards. Knowing that our readers eagerly accept challenges, we present the third annual Great Omni Treasure Hunt. Each of the 12 picture disks displayed below is a portion of a photo in an advertisement or part of an illustration accompanying an article or short story appearing on one of the pages in this issue of Omni. Your mission, should you choose to accept it, is to hunt for the pictures the segments come from and to note the page number for each. If there is no number indicated on the page, check adjacent pages and determine what that number should be. When you have found all 12, add the page numbers to arrive at a grand total. Submit that solution to the

1988 Great Omni Treasure Hunt, and you could drive away in a 1988 Jeep Wrangler, sail into the Caribbean sunset, cruise down the river of your choice, or win another of the multitude of prizes on the following pages. Read the official rules below to find out how to enter and qualify.

## OFFICIAL RULES

**HOW TO PLAY:** No purchase necessary. Print your name, address, ZIP code, and your solution to the Great Omni Treasure Hunt on a three-by-five-inch sheet of paper. Mail your entry to Omni Treasure Hunt, Box 882, Boston, MA 02117. You may enter as often as you wish, but each entry must be mailed separately. We are not responsible for lost, illegible, misdirected, or late mail. All entries must be received by April 30, 1988. Drawings will be held immediately thereafter.

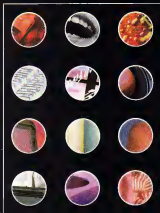
**WINNER SELECTION/ODDS:** Winners will be selected from among all eligible entries in random drawings conducted by Proaction Marketing, Inc., an independent judging organization whose decisions are final. Odds of winning are determined by the number of omnis received. Winners will be notified by mail and may be required to sign and return an affidavit of eligibility and release within 15 days of the date on the letter of notification, or an alternate winner may be selected. Limit of one winner per household. Winners agree to the use of their names and likenesses for publicity purposes without additional compensation.

**ELIGIBILITY:** Open to residents of the contiguous United States, twenty-one or older, except employees (and their families) of Omni Publications International, Ltd., its subsidiaries or affiliates; its advertising and promotion agencies; and Proaction Marketing, Inc. All federal, state, and local laws and regulations apply. Void where prohibited.

**PRIZES:** Prizes are not transferable, assignable, or redeemable for cash. No substitution of prizes except as necessary due to availability. All taxes are the responsibility of the winner. The Dive Holiday vacation consists of accommodations for two for eight days, seven nights aboard the live-aboard dive vessel *Sosa Dancer*, departing from Grand Turk island, Turks and Caicos islands, West Indies; includes cabin, meals, beverages, and round-trip airfare to Grand Turk island from the major airport nearest winner's home; travel dates are subject to space and departure availability, and travel must be completed by December 15, 1988. Prizes with alcoholic content will not be awarded in states where prohibited or restricted.

**NO PURCHASE NECESSARY:** For a copy of the official rules and the solution to the 1988 Great Omni Treasure Hunt, send a self-addressed, stamped envelope to Omni Rules, Box 816, Boston, MA 02117, no later than March 31, 1988. There is no return postage required for residents of Washington and Vermont; postage will be refunded to those residents.

**WINNERS LIST:** For a list of winners, send self-addressed, stamped envelope to Omni Winners, Box 816, Boston, MA 02117, no later than June 30, 1988.



Find the clues buried in this issue, and one of these treasures—from a jet ski to a glass-bottom boat—could be yours

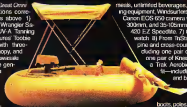
## THE OMNI GALAXY OF GIFTS



1988 Jeep Wrangler Sahara



**T**he following are the prizes in the Great Omni Treasures Hunt. Their descriptions correspond to the numbered photos above: 1) Grand-prize automobile: A 1988 Jeep Wrangler Sahara. 2) First prize: Eurodan 2600 UV-A Tanning Shower. 3) Second prize: Water Ventures' 'toobie WY001' yellow glass-bottom boat with three-horsepower Tanaka motor, yellow canopy, and yellow tube cover. 4) Third prize: Kawasaki JS300 Jet Ski and Ninja 700 portable generator. 5) Fourth prize: courtesy of Dive Hotels Marketing, Inc., an eight-day/ seven-night Caribbean holiday for two on the 110-foot, live-aboard dive vessel Sea Dancer in the Turks and Caicos islands, including accommodations,



meals, unlimited beverages, unlimited diving, diving equipment, Windsurfers, round-trip airfare. 6) Canon EOS 650 camera with 50mm F1.8, 100-300mm, and 35-105mm lenses, and a Canon 420 E.Z. Speedlite. 7) Omega Constellation watch. 8) Frost Tristar Sports, Inc., an Alpine and cross-country ski package—including one pair of Din Ultra SL skis, one pair of Kneissl Light 2000 skis—a Trek Aerobic cross-country outfit—including ski boots, poles, and binding—and a Kneissl White Star Skate II cross-country outfit—including ski boots, poles, and binding. 9) A pair



of Prince's custom-designed Sovereign tennis rackets. 10) A Casio CZ-1 synthesizer with PD Sound Source, eight-steps envelope generators, MIDI compatibility, and other features—including 162 preset voices, key velocity, operation memory, and multistep MIDI drive operation. 11) From Pioneer Electronics USA, Inc., a KEX-M700 car audio compact disk player and CDX-M100 compact disk changer. 12) Two winners will each receive a Canon PC-3 personal copier with accessories. 13) Smith Corona PWR 6 personal word processor. 14) Three winners will each receive a \$500 assortment of liquor from Carillon Importers, Ltd. 15) Courtesy of the Koss Corporation, three winners will each receive a Koss stereo



raphone and loudspeakers, either a JCK-250 Karaoke stereophonic and M-100 plus loudspeakers, SST-7 stereophonic and M-90 plus loudspeakers, or Porta-Pro stereophonic with M-80 plus loudspeakers. PRIZE VALUES: Jeep Wrangler, \$16,000 (1); Euronet Tennis Shoes, \$8,995 (1); Toobie glass-bottom boat, \$3,000 (1); Kawasaki JS300 Jet Ski and Kawasaki Ninja 700 portable generator, \$2,978 (1); Sea Dancer holiday for two, \$2,850 (1); Canon EOS 650 camera and accessories, \$2,064 (1); Omega Constellation watch, \$1,795 (1); Tebbels package, \$1,529 (1); Prince Sovereign tennis rackets and accessories, \$1,500 (1); Casio CZ-1 synthesizer, \$1,400 (1); Pioneer car audio compact disk player and changer, \$1,300 (1);



Canon personal copier with accessories \$960 (2). Smith Corona PWP 6 personal word processor \$395 (2). Canon Importers: assortment of liquor, \$500 (3). Koss JCK/200 Wireless stereo phone and M-100 plus loudspeakers \$420 (1). Koss SS17 stereo phone and M 90 plus loudspeakers, \$290 (1). Koss Porta-Pro stereo phone and M60 plus loudspeakers \$195 (1). Figures in parentheses indicate the number of prices in each category.

#### GIFT FINDER'S GUIDE

The following are the names and addresses of the products and services featured in the Great Gifts Treasure Hunt. For further information concerning our prices contact the companies directly.

**Canon, U.S.A., Inc.** (Camera Division) One Canon Plaza, Lake Success, NY 11042 (516) 488-6700

**Canon, U.S.A., Inc.** (PC Copier Division) One Canon Plaza, Lake Success, NY 11042 (516) 488-6700

**Carlton Importers, Ltd.**, Glenpointe Centre West, Teaneck, NJ 07662 (201) 836-7700

**Casco, Inc.**, Product Information, Mount Pleasant Avenue, Dover, NJ 07801 (201) 361-5400

**Dyn Hotels Marketing, Inc.**, 54 Gundacker Road, Ithaca, NY 14850. For further information and reservations call (607) 277-3484 or toll free (800) 367-3484 in the United States or Canada.

**Eurotel International**, 3701 Montrose Boulevard, Houston, TX 77026 (800) TYN-U-NOW or (713) 522-2100 (in Texas)

**Jeep Corporation**, 1-800-JEEP/EALE

**Kawasaki Motors Corporation, U.S.A.**, 8660 Jeppento Road, Irvine, CA 92714

**Koss Corporation**, 4129 North Port Washington Avenue, Milwaukee, WI 53212 (800) USA-KOSS

**Omega Watch Corporation**, 25 Fiat, 21 Street, New York, NY 10010 (212) 505-6100

**Pioneer Electronics (USA) Inc.** (Car Electronics Division), 2265 Elgin Street, Long Beach, CA 90801 (800) 421-9404

**Prince Manufacturing, Inc.**, Box 2031 Princeton, NJ 08543 (609) 257-9480

**Smith Corona**, 65 Locust Avenue, New Canaan, CT 06840 (203) 972-1471

**Tristar Sports**, 475 Smith Street, Middle town, CT 06457 (203) 632-2000

**Water Ventures**, 15141 Beach Boulevard, Suite 370, Huntington Beach, CA 92648 (714) 848-7696

## STARWATCH

CONTINUED FROM PAGE 10

down to an observatory used by amateurs in the Santa Cruz Mountains and look one-hour exposures of a nebula in the constellation Taurus. A scratch in the lower left-hand corner of one of the negatives caught his eye. The fuzzy streak turned out to be a comet—only the third discovered photographically by an amateur since 1970. Now a dirty cosmic snowball called Comet Sonetta plies the solar system in the distinguished company of Halley and Kohoutek. Fame is fleeting, however, as are the objects bestowing it. Sonetta thirty-two struck in a final peek at her namesake comet last September. It won't be back for another 50,000 years or so.

Sonetta, president of the Peninsula Astronomical Society, represents the new breed of amateur astronomer. They take accurate astronomical photographs and are becoming increasingly proficient at astrometric measurements. "What used to be astronomy has been supplanted on the professional level by astrophysics," Sonetta points out. "They talk about what takes place in the center of the sun and make mathematical equations. Today's amateurs are doing a lot of things that used to be the sole domain of the professional. So while astrophysicists parse the evolution of stars and try to figure out what happened in the last few seconds of the Big Bang, amateurs increasingly fill the void as planetary weathermen and cartographers of the deep sky—identifying new species, spotting old ones, and keeping an eye on little changes in the vast, rumpled canvas of light that is the universe."

Ever since John Winthrop Jr., colonial governor of Connecticut, pointed Americans first telescope at the sky in 1633, the amateur tradition in this country has been fairly strong. The Amateur Astronomical Union, founded in 1947, numbers about 6,500 members, with 150 affiliated clubs and societies around the country. But Benjamin Franklin once despaired that America would never achieve much distinction in the field, and at least in terms of amateurs he may have been right.

"People in the United States concentrate on nice equipment but don't necessarily use it perhaps as fully as one would want," says one prominent British amateur. "I'm trying to phrase it tactfully, but you follow me. Expert opinion seems to concur. Mansion characteristics of the U.S. amateur contribution as 'disappointingly small.' We don't like mathematics," he says, and that hampers our amateur contributions.

British amateurs are a stoic, persistent lot, but vile weather and light pollution force them to be that way. "Light pollution is probably the worst problem," says Stern Dunlop of the BAA. "We haven't got wide-open spaces. We can't very well jump into our cars and drive a hundred miles outside. Well, I don't know the praise or some-

thing." You have to seize every little opportunity," adds George Atcock, bemoaning the awful weather. "Sometimes you can go a fortnight or even three weeks without seeing a single star in this country." For lunatics, Atcock, less meteorology, even more than astronomy.

If the British tradition is grand, Japanese amateurs are setting new standards of dogged, if not dotty obsession these days. Japanese amateur astronomers have become so sophisticated and specialized that in 1986 the amateur-organized Low Altitude Artificial Satellite Tracking Station reported the destruction of a Soviet nuclear-powered military satellite and predicted the path of its falling debris—apparently before anyone else in Japan knew about it. One rumor currently making the rounds attributes Japan's great success in spotting comets to all of things electrically heated shoes, which keep observers' feet warm during long nights of sky watching.

New Zealand's amateurs may be the most impressive of all, according to Couper. "They're isolated there, they live. They've had to build telescopes, cameras, detectors, and learn how to use and calibrate them entirely on their own. Their enthusiasm is just fantastic."

Like the moon, though, amateur astronomy has its dark side. Couper thinks in stardom of the self-absorbed hobbyists the dullest anomalies (for the perklike costs they all seem to wear). They're male, single-minded, have no other interests, and talk incessantly, almost in secret code about their obsession—be it catching fish, chasing trains, or watching stars. They don't care what they look like. Couper says with disdain, "I think they smell slightly as well."

None of these amateurs, maddening or not, will bode make us forget Newton or Galileo. Only the most ambitious (or most self-deluded) amateurs propose far-reaching theoretical laws, which are routinely ignored by professional astronomers, even if they are published.

Just as clearly, amateurs—who by definition don't work for pay—labor with different kinds of compensation in mind. Whether it's a Comet Sonetta speeding through the ether bearing one's name, a new super nova, or a modest mathematical calculation that imposes a bit of order on the apparent disorder of the universe, amateurs can achieve satisfying snippets of immortality in lieu of Nobel prizes and presidential proclamations. These are lovely and on during times of recognition.

But Reverend Evans sees another lasting, and perhaps more important, effect: amateur astronomers have on their science. "I density that amateurs help to popularize astronomy and teach it to beginners," says the veteran. "And that's important because it's the only way professional astronomers get started themselves. If there weren't any amateurs, I'd add matter of factly, there wouldn't be any professionals either."

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The lore and science of food: a three-course quiz to test your culinary quotient

# GAMES

By Scott Morris

How can you quickly ripen a tomato? Toss an egg for freshness? Slice an onion without crying?

Kitchen wisdom is often passed from one generation to the next, with little concern about the scientific principles involved. The helpful hints work, and that's all that matters to many people.

Onix readers, however, always want to know the reasons. So here is a three-course quiz to test and increase your knowledge of "foodology": the lore and science of food. Afterward we'll serve the answers with some scientific aperitifs.

## APPELIZERS: MULTIPLE CHOICE

1. Which is the heaviest? The lightest? A. light cream B. heavy cream, C. skim milk, D. whole milk.

2. The sweetest part of an orange segment is A. the end near the stem, B. the blossom end, C. the sweetness is evenly distributed.

3. Which two of the following are reasons for not using metal pots or aluminum foil containers in a microwave oven? A. They're too hot to handle when heated by microwaves. B. There's a danger of an electric spark arising from the metal to the oven wall that could damage the oven's magnetron tube. C. Metal reflects also electromagnetic waves and causes uneven cooking. D. Cooked food will stick to the surface of the metal.

4. The tomato is A. a fruit B. a vegetable.

5. Gourmet chef James Beard once wrote that artichokes "should be forbidden



as great dinners" because A. they affect the taste of every thing else, B. the taste of artichokes is affected by other foods, C. mixed with some foods, artichokes create a volatile gas.

6. Which has the lowest boiling point? The highest? A. water in Denver, B. water in Boston, C. water mixed with wine in Denver, D. salty water in Boston.

7. The blood-red color of a rare steak is caused by A. hemoglobin found in the arteries and veins, B. myoglobin found in the muscles, C. chemical additives.

## ENTREE: TRUE OR FALSE

1. Once frozen food has thawed, you should never refreeze it.

2. You shouldn't store potatoes in the refrigerator.

3. Bananas spoil more quickly when refrigerated

4. Copper bowls are best for whipping egg whites.

5. Packaged cuts of meat are red on the outside but brown inside because of chemical additives.

6. A warm dinner plate makes meat more tender.

7. Yellow-tipped beef fat indicates the animal was corn-fed.

8. Bacon spatters more today than it used to.

9. Fish caught off the coast of New England are more flavorful than fish caught in the Caribbean.

10. River fish taste better than lake fish.

11. Drinking tea or strong coffee from a plastic foam cup may be hazardous to your health.

12. Beer is colder in a can than in a bottle.

13. Most of the vitamin C in an orange is in the juice and pulp.

14. Sewing meat seals in the juices.

15. Brown eggs are more nutritious than white ones.

16. In low-fat (ninety-nine percent fat free) milk, 99 percent of the fat has been removed.

17. Butter is more fattening than margarine.

18. Sherbert is less fattening than ice cream.

## DESSERT MATCHUP

Match these food problems with their "quick fix" solutions that follow.

1. Sandy and gritty daisies
2. Test whether an egg is fresh—without breaking it
3. Determine whether an egg is raw or hard-boiled
4. Ketchup won't pour
5. Lettuce turned brown
6. Stale marshmallows
7. Slice an onion without crying
8. Ripen a tomato



#### The solutions

- a. centrifugal force
- b. comminal
- c. drinking straw
- d. souba mask
- e. a slice of bread
- f. a paper napkin
- g. paper bag
- h. water
- i. peanut butter

#### APERITIF ANSWERS

**Appetizers:** 1. C and B. Cream always rises to the top because it is loaded with fat, which is lighter than water.  
2. B. The blossom end (farthest from the stem) is sweeter because it has had more time to develop sugars.  
3. B and C.  
4. Both A and B are correct. Botanists define a fruit as the ovary of a plant; the part that surrounds the seeds. Tomatoes, eggplants, cucumbers, pumpkins, and green beans are, therefore,

all fruits. In the nineteenth century, however, the Supreme Court ruled that a tomato importer had to pay a 10 percent tax applied to vegetables. Tomatoes, the justices argued, are served with the main course, like vegetables, rather than as a dessert or snack. So it's biologically a fruit but legally a vegetable!

5. A. Anchores have an enzyme that stimulates some people's sweetness receptors. For a short time after eating them, everything else tastes a bit sweeter than it should. It can, for example, spoil the taste of a dry wine.

6. C and D. Altitude directly affects the boiling point. At sea level the boiling point of water is 212° F. In Denver it's 203° F, so cooking takes longer in Denver. Salt, sugar, or any other dissolved substance raises the boiling point and decreases cooking time. Alcohol has a lower boiling point than water. Adding wine to plain water will increase cooking time.

7. B. Almost all the blood is drained during the slaughtering process.

**Entrees:** 1. False. It's safe to eat raw food as long as it does not become contaminated while thawed. Mr. Bercksaye originally put the do not freeze-it label on his frozen food products because he didn't want to be responsible for consumers mishandling of the foods.  
2. True. Refrigerated much of the potato starch turns to sugar, making it too sweet.  
3. False. Refrigeration turns the bananas' skin brown but keeps the fruit itself fresher longer.

4. True. Conalbumin, a protein in egg whites, picks up copper ions from the bowl. This produces a creamier foam made of stable new molecules composed of the copper ions and protein from the egg whites.

5. False. The natural color is brown, but exposed surfaces turn red after contact with oxygen.

6. True. In a hot steak, for example, the natural collagen has turned to gelatin, making meat tender. As the meat cools and the collagen thickens, it gets tougher.

7. False. It means the animal was glassed. White fat indicates it was grain fed.

8. True. Today bacon is cured with brine rather than the traditional dry salt. It is a quicker process, but the salt solution results in increased spattering when the bacon is frying.

9. True. Cold water fish tend to have more fat, which gives them more flavor.

10. True. The more exercise, the more flavorful. So fish that swim a lot—mer fish—tend to be tastier.

11. True. According to Howard Hillman in *Kitchen Science* (Houghton Mifflin), the acid in strong coffee and especially tea dissolves some of the polystyrene affecting the taste and possibly your health. Adding lemon to tea increases the acid content as well as the effect on the thermoplastic.

12. False. A beer can feels cold because the metal conducts heat quickly. Your hand gets cooler, and the beer gets warmer. Glass is a better insulator, keeping the heat of your hand and of

the surrounding air away from the brew.

13. False. This mud has up to five times higher concentrations of vitamin C than the juice and pulp.

14. False. The crust produced by searing isn't waterproof. According to a 1990 University of Missouri study quoted by Harold McGee in *On Food and Cooking: The Science and Lore of the Kitchen* (Charles Scribner's Sons), meat roasted at a constant temperature loses less fluid than meat that was seared first. But searing does create a more flavorful crust.

15. False. There's no difference. Shell color is caused by the hen's breed, not its feed. Leghorns lay white eggs, for example, and Rhode Island Reds lay brown.

16. False. Whole milk contains only 4 percent fat, and as therefore 96 percent fat free. In low fat milk only 3 percent of the fat content has been removed.

17. False. Both are about 80 percent fat. In butter it's milk fat; in margarine it's vegetable fat.

18. False. Sherratt and ice milk may have half the fat of ice cream but double the sugar. You get about the same number of calories—about 200 per cup.

**Desserts:** 1-8. Put clams and oysters in a bucket filled with water and comminal. They'll filter the comminal through their system searching for nutrients, the same way they ordinarily take in sand. After two or three hours the sand and grit will have been expelled and replaced with comminal.

CONTINUED ON PAGE 108



# LAST WORD

By Fred D. Baldwin

**I have uncovered conclusive evidence that federal agencies are already using extraterrestrial aliens to perform key functions, like padding the Pentagon budget and setting the prime rate.**

It's an all too-familiar story. Some guy in Wyoming, cruising along in his pickup truck, pulls over to check out a bright light. It proves to be a UFO crawling with aliens. They whoosh him off to Arcturus for tests and return him a few weeks later without telling him the results. He's all shaken up, barely lucid enough to cut a decent deal with the tabloids.

But there are other kinds of abduction stories the public never hears. I'm talking about extraterrestrials kidnapped by Earthlings. It is a little-known fact that every year hundreds of little green men are grabbed by park rangers or picnickers, wrapped up in ponchos or beach blankets, and banded off to remote government labs or poorly decorated searcotes. Some of the aliens—the lucky ones—are dumped back where they were found, unharmed (but never told the results of their tests). Other, Others remain captives, surviving on corn chips and not beer under degrading conditions. And it's not just little green men who are the victims; it can be little green women or even little green children.

This second picture has been painstakingly pieced together by Dr. Perry Noya, paleoanthropologist and author of *Aliens in Our Attics*. His book represents a massive research effort conducted in spite of some daunting obstacles. People who conceal aliens in their homes are reluctant to own up to it, either because they are worried about attracting the attention of the Immigration and Naturalization Service, or they are afraid their property values will plummet. Even so, Noya managed to interview hundreds of people who held extraterrestrials themselves, knew someone who had, or knew someone who knew someone.

What kinds of people would hold an innocent tourist from another solar system against his, her, or its will? "Lonely people," Noya said during a recent interview. "A few are kids, but most seem to be senior citizens."

Most people aren't necessarily predators, but some definitely exploit aliens. For example, my file document cases of Moon-sucking visitors from Venus kept in commercial garages by healing contractors and forced to recharge old air conditioning units.

It is a popular misconception that creatures who zoom around in UFOs are too sophisticated to be captured. Not so, says Noya. Aliens are a snap to spot and catch. They don't know the language seldom carry Earth money, and are easily fooled into believing that a teenager is customized van with an ocean sunset stickered on the side is some sort of shuttle craft.

So far the U.S. government has done nothing in response to Noya's demand that an independent, blue-ribbon commission

be appointed to study his evidence.

"People think," he says, "that the government poach poaches the whole UFO thing because it thinks it's silly. The real reason is that my independent investigations have uncovered what I call Saucer-gate. I have conclusive evidence that federal agencies are already using extra-terrestrial aliens to perform key federal functions, like setting the prime rate and padding the Pentagon budget. It's a grave disservice to the taxpayer," he continues. "What does anyone—much less some nerd from another galaxy—know about the bond market? But just try to get rid of them. It's impossible to fire someone in a government job, even if he's from another planet."

Equally shocking was Noya's discovery that some aliens have, not surprisingly, died in captivity. Upon their demise, the earth's gravitational field and atmosphere caused their bodies to shrink dramatically and harden into a rubbery substance. Frequently the corpses have been mistaken for the tiny figures sometimes given away in boxes of cereal. "You'd be surprised how many dead aliens I have found mired in with a kid's Frosty Flakes," Noya says, shaking his head sadly (inspired by this discovery, he has been taking a closer look at cereal giveaways). His discovery of a brontosaurus and other prehistoric behemoths has inspired a second book, tentatively titled *The Tyrannosaurus at Your Breakfast Table*. It will offer his theory of what really happened to the dinosaurs.)

Noya is lobbying for legislation on kidnapping aliens, a kind of extraterrestrial version of the Lindbergh baby laws, but he thinks the problem won't really go away until our visitors from outer space get more sophisticated.

Fortunately he has grounds for cautious optimism. As evidence, he cites an interview with Sngmshg (not his real name), a creature from Altar who managed to escape from a university research lab by posing as a member of a rock group. (The alien would not talk with Noya until the professor consented to bindfold himself, even though the interview was conducted over a telephone.)

According to Sngmshg, aliens have at least learned to carry the American Express card, have picked up a few key phrases, and most importantly have stopped using the traditional grunting. "Take me to your leader."

We're not that green anymore, Sngmshg told the professor. "The word on where that kind of talk gets you is all over the galaxy." **DO**

Fred D. Baldwin is a freelance writer from Canine, Pennsylvania, whose machine-beating, tongue-tied, lightning bolts save on heating bills by keeping the furnace lit.



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