

EARTH, WIND, AND FIRE—FUELING THE WORLD

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# ENR

MAY 1991

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# OMNI

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# FIRST WORD

## FUELING THE FUTURE:

If we are to succeed, we must learn from the past and forge realistic approaches that will work.

Admiral James Watson is secretary of the U.S. Department of Energy.



In calling for his secretary to read him history, Frederick the Great would command, "Bring merry war." Such aversion to seeing the truth in history is characteristic of many of the more vocal groups concerned with energy policy today. These groups seem to have little interest in reflecting on relevant history and learning from past experience. But if we are to succeed, we must learn from the past and forge realistic policy approaches that will work in our democratic society.

With the recent release of the President's National Energy Strategy, the debate over energy policy has begun in earnest. Already the voices of the past are coming back to haunt us, proclaiming that there is only one way to affect American energy consumption: government edict. The vociferous call for laws, mandates, regulations, and controls all designed to make Americans do what government thinks is good. Yet history argues otherwise. The price control and allocation schemes of the Seventies and the supply shortages they induced are not among the shining moments of an energy policy history.

President Bush directed the Department of Energy to take a different approach. Rather than in-

tervene in the free market, we've devised a strategy to harness the market's strength. Rather than choose between energy goals and environmental objectives, we have sought to balance them. Rather than more regulation, we are seeking more competition in every energy sector, thereby increasing fuel choices and reducing consumer costs. Rather than demand that Americans change their lifestyles and make do with less, we are advancing the technologies that will lead us into the kind of energy future we want: more environmentally benign, with the economic growth necessary to maintain and enhance the American standard of living.

In developing this new energy policy, we reached out to the American public. Over some eighteen months we heard from 400 witnesses in eighteen separate hearings. We studied some 22,000 pages of testimony in a comprehensive effort to understand how Americans think our future energy needs should be met. Some called for conservation; some called for greater energy efficiency; others called for alternative fuels, advanced transportation technologies, and greater use of renewable fuel sources. Each group was and continues to be sure that its answer is the one "silver bullet" that will meet all our energy challenges.

They are wrong. None of these measures can single-handedly solve our complex energy problems. We will need every one of these initiatives, and more, to meet our future energy needs.

Past decisions have steadily eroded our energy choices. Our current energy system has been shaped by decades of laws and regulatory mandates without regard for their cumulative impact. Project by project, decision by decision, we have eliminated one energy option after another and seriously compromised our overall

energy and economic security.

Just consider. Frontier areas for oil and gas exploration in this country are largely closed to developers. Government at all levels has made decisions on nuclear power that make it virtually impossible for this technology to serve the nation. Multiple demands on water use have led us to sacrifice our hydropower potential. And to assuage local opposition, we have pushed the construction of needed new refineries overseas.

By default, we have made imported oil the energy source of choice. It seems that no risk, how ever minor, is acceptable. Yet ironically by refusing to accept minimal risks associated with expanding and diversifying energy supplies, we create greater risks by increasing our vulnerability to foreign oil producers.

Many in the old school of energy policy would like to institute command and control measures to reduce oil use and oil imports dramatically. There is no question that we must wean ourselves away from oil. But given oil's overwhelming importance to our economy, we must move wisely. In order to move away from oil without causing serious economic dislocation, we must introduce market incentives to stimulate development and use of alternative fuels and advanced energy technologies. Equally important, we must remove regulatory barriers that constrain existing alternatives like hydropower and natural gas. Our goal is to maintain a healthy, responsive free market so that all fuels and technologies can contribute to a growing U.S. economy.

Our nation faces serious energy challenges in the years ahead. We do not intend to compromise our future by repeating past mistakes. We will heed the lessons of history and build upon the foundation laid by the National Energy Strategy for a cleaner, more secure energy future. ☐

# FORUM

## OUR TOWN: Americans take an energy lesson from this farm belt community

**T**idy homes bordered by maples line the streets of Osage in the northeast corner of Iowa. The farm belt town of 3,500 seems an unlikely place for a revolutionary in his conservative suit and dark-rimmed glasses. Osage's Wes Birdsall doesn't look much like one either. Instead, the businessman heads the type of insulation revolutionaries generally love to target—the local utility company. But Birdsall has succeeded in making Osage the nation's model for an energy conservation.

Birdsall's vision of a radically different Osage dates back to 1974, a year after OPEC raised its oil prices and townspeople waited in line to buy gas. Osage Municipal Utility had just installed a new generating plant to handle the town's increasing power load. Raising rates was the logical next step.

Most utility managers would consider the prospect of increased rates good news. Birdsall, however, knew they would only compound the beleaguered community's recession woes. In the long run, he reckoned, there was a better way to supply power to

the town without plunging it into deeper debt. "If we could decrease usage, we could make it to the year 2000, instead of spending millions of dollars, say, in 1983, for new energy generation," he says. "We would not only save money for the community, but we could delay the day when we'd have to have more power." Then Birdsall scoured the public library and made phone calls, tracking down information on efficiency.

Finally launching Osage Municipal's energy conservation program, he used infrared scanners to show residents where their homes were leaking heat. In 1975, he set up new insulation specifications. The utility gave away thousands of dollars worth of energy-saving devices, like water-heater jackets and low-flow shower heads, as well as shade trees from its nursery. It even bought the community a tree spade.

At first the town snuffed at the programs and giveaways suspiciously. "It took two years to get them on our side," Birdsall says. "A lot of it was peer pressure." If So-and-so can save twenty-five percent, which it said in the paper last week, I can, too."

Conservation caught on. The Jaycees volunteered to caulk windows in low-income homes and schools began replacing angle-pane windows with efficient thermal windows. And teachers at the local high school began competing to see who could achieve the lowest fuel bill at home.

When Everett Steele rigged the refrigeration system at his Super Value Grocery so that waste heat warmed the store, he found he was able to hold prices down; customers were less tempted to take their business to Mason City, 15 miles away.

Birdsall's doctrine—providing ways to keep customers from buying what you're selling—was hardly what you'd learn at the Harvard Business School. But Birdsall al-

ways managed to keep an eye on the broader bottom line. As a town, Osage saves a staggering \$1 million a year.

Over the last decade, the utility has done better than hold its costs steady, and thus the rates it charges consumers. It even reduced rates by 10 percent.

It's no wonder that industrial firms have discovered Osage. While towns and dreams are dying around the corner of the corn belt, the "City of Maples" thrives, a magnet to new businesses. Birdsall extends energy-saving offers to them as well. "I get criticized on that one. Why would you ever reduce your industrial accounts? That's your bread and butter." "I'd much rather have an industrial account that uses less energy than have none at all."

If Birdsall was a reluctant revolutionary, he doesn't mind being called a pioneer. Utility-sponsored conservation programs have sprouted across the land—especially after the res on sent troops to the Persian Gulf. Suddenly everybody's concerned about the nation's oil fix. "If a program like Wes started was in every community, our energy consumption would definitely drop," says Bill Bollinger, Osage's director of public works.

Indeed, if more towns and cities followed Osage's lead, we might not even need Ouf oil. It's time for all of us to take a hard look at the way we use energy.

But it's going to take some convincing—and conserving. Some people just don't get it. Birdsall says, "Somebody recently told me, 'No wonder you have such a good program going. Look around Osage. It's a beautiful city. You've got community pride. All the homes are painted. New garages, roofs, and so on.' I said, 'You missed the point. Osage looks the way because people now have the money for it.'"

—Beth Howard **DD**

By making energy efficiency the town cry, Osage becomes an example for the whole country.



# OMNIBUS

**OILING THE WHEELS OF PROGRESS.**  
Our efficient writers go to their sources and get the latest dirt on clean energy.

**F**ueling the future is one of the great challenges of the twenty-first century. Coordinating the month's special issue on energy has been one of *Omnis'* environment editor Beth Howard's biggest efforts since joining the *Omnis* staff more than a year and a half ago. Howard (*Forum*, page 12) assembled a team of energetic reporters to pull together data on new technologies designed to drain Earth of every drop of oil, and to find ideas for a sane energy strategy for America and the world in the Nineties and beyond. She dispatched another crew to determine what's happening with the development of Earth-friendly renewable alternatives to fossil fuels.

Solutions that don't destroy our environment and won't break our budgets are realistic and attainable, our writers report. "There are answers that won't require our lighting a war to protect our foreign sources of fuel supplies," says *Omnis'* contributing editor Tom Dworetzky ("Perpetual Power," page 34).

"The technology is already here. All we need now are enlightened leadership and the will of the people to wean ourselves off imported." Energy revolutionary Amory Lovins, for one, struck him as a man with a mission: to apply common sense and the bottom line—economics—to energy.

Ten years ago, oil gave *Omnis'* managing editor Phil Scott a lot of practice working in the dark. He ran an oil rig diagnosing problems that happened 1,000 feet below the surface of his native Kansas. "All I really wanted to do was get home by five," he says, recalling how it felt to be covered in crude oil. "Even after you showered, you'd sweat the stuff through your pores." This year he clicked his heels and returned to Kansas to begin researching "Good to the Last Drop" (page 40).

Fossil fuels, however, may not be the energy of choice in the future. In "Alternative Sources: A Status Report" (page 50) Steve Nadia, Ben Barber, Steven Scott Smith, Mary McDonnell, Dana Points, and Beth Lwermore report on some other means of powering our society.

Nadia is the author of books on solar energy, nuclear power and the arms race. Writing for *The New York Times* and United Press International, Barber has traveled throughout the Third World, where agricultural waste and other biomass materials have been used for centuries. Health-stall writer Beth Lwermore recently completed a fellowship at Woods Hole Oceanographic Institution.

Steven Scott Smith has written the play *Black Ice* and is working on another titled *Andaroca*. Mary McDonnell is managing editor of *Flying*. And Dana Points is an assistant editor at *Family Circle*.

Reflecting on his personal commitment to energy efficiency in this month's Earth column (page 22) Ed Begley, Jr., is a board member of the Environmental Leadership Forum, the Earth Communication Office, Californians Against Waste, and other environmental organizations. The television series *St. Elsewhere* and the recent film *Meet the Applegate* featured Begley's other talents.

Contributing editor Shen Rudavsky is currently a graduate student at the University of Pennsylvania but still found the time to assemble "The *Omnis* Energy Efficiency Guide" (page 44). A thorough researcher, she gathered more information than anyone could ever digest at one sitting.

"Blocks, I mean stacks, were spread all over my bedroom," she says. "I sat across the floor every morning." And what did she learn? "I wish I had a house so that I could make it energy efficient. But I am thinking of buying a car and I'll be sure to fill it with at least 2.7 people."

We can never get enough brain-power, especially from thinkers like neurophysiologist Vernon Mountcastle, the subject of this month's Interview (page 82). From the moment she first heard Mountcastle speak three years ago, *Omnis* staff writer Kathleen Stein wanted to interview Mountcastle for *Omnis*. "He was at the top of my most wanted list," she says. "He represents the epitome of what science is all about, and I will continue to track the ultimate scientific detective."

Science-fiction author Jack Womack ("A Kiss a Wink, a Grassy Knoll" page 66) is making tracks of his own with *Healthcare* (1990) and two other novels. His story "Lifeblood" will appear in *A Whisper of Blood* (Morrow), an anthology of vampirism tales edited by *Omnis* fiction editor Ellen Datlow. **DD**

Contributors, clockwise from bottom: Jack Womack, Tom Dworetzky, Phil Scott, Shen Rudavsky.



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# COMMUNICATIONS

## READERS' WRITES

No more censors, no more books, no more prices of electric cars mistook

### The Art of Censorship

It is ironic that Arthur Miller (First Word February 1991) chides congressional censorship of certain art while he refers to whole areas as "non-governmentally funded mass junk." I assume that Miller feels his tastes provide not only the first word but the final word on artistic value. The only sure way to eliminate political censorship is for the government to assume a hands-off policy and do away with the NEA. Artists could then rely solely on the private sector where they don't seem to have the controversy. That would be a shame since the NEA, by Miller's own count, has had only three or four controversial calls out of 85,000 endowments.

Herold Nickel  
 Flemington, NJ

The problem is not that government is censoring art, the problem is that government cannot help but censor art when it uses our money to support it. If you wish to get rid of censorship, as I do, then you must get rid of government support for the arts. If artists are good enough, the public will support them. Look at movies, television, radio, even comic books. Let art be like the cable companies, and anyone who doesn't like it can do the democratic, individual, American thing—switch it off.

Keith Russell  
 Garland, TX

### Teaching Principles

As Keith Ferrel implies (Forum, February 1991), unless new teaching and testing methods are developed, test scores and interest in science will continue to decline. Administrators should allow teachers to teach. Textbooks should be used more as guides and less like scripts. Implementing new ideas will be difficult, but getting administrators to listen to new ideas will be even more difficult.

Charles Schlaudraff  
 Madison, IL

### Less Dollars, More Sense

A lot of what Bruce Ames (Interview February 1991) says makes sense. I must however, quibble with one remark

outside his field of expertise. Ames says "You can build cars that don't put out any pollution. But it would cost an enormous amount." Our company Electro Automotive has been selling components to convert gas cars to electricity for more than ten years. The cost of a complete conversion is approximately \$5,500, with operating and maintenance costs only 35 percent of those for a gas car. The conversion can reach freeway speeds and travel an average of 80 miles on a charge, making it ideal as a second in-town car. Even accounting for the pollution caused by the electrical generating plant, the electric car is 57 percent cleaner than a gas car. Does this sound like an enormous cost?

Brian Prange  
 Customer Service Administrator  
 Fallon, CA

### Getting More From Nothing

I was starting to wonder if mainstream science was ever going to pick up on the promising area of zero point energy ("Visible Vacuum," February 1991). One needn't travel to Russia to find energy anomalies. If fellow readers are interested in pursuing this subject further, I suggest they pick up a copy of Moray B. King's book, *Tapping the Zero-Point Energy* (Paraclete Publishing, Box 859, Provo, UT 84603). You don't need a multimillion-dollar research lab to achieve results, and the amateur scientist need not be left out of the fun.

Jason P. Wentzell  
 Manchester, CT

### Information, Please

I am a member of an amateur short-wave radio club in the Soviet Union. Through our station, ULBPXX [physically challenged] people can find employment and learn radio technology. We would like to know about similar associations in the United States for handicapped people.

A. Agemuhometov  
 City of Karaganda  
 Association for the Handicapped  
 Box 112, Karaganda 470055  
 Kazakh SSR  
 USSR

# EARTH

## MY GENERATION

One person can make a difference, suggests this energy-saving celebrity

**A** quick stroll through any bookstore offers you a choice of dozens of books on 50 possibly even 100 ways that you can save old-time time. Spend a moment in the nearby video heaven and you'll find a similar choice of electronic fare.

Armed with this vast amount of knowledge, you'd think that we'd already see a huge change in people's life-styles. Certainly the Alaskan oil spill got everyone's attention. And the war in the Middle East always gets me thinking about our varied energy policy. Surely the devastating spill in the Persian Gulf would lead some to consider a reduction in their consumption of oil. After all, it is just another drug war, isn't it? The drug is petroleum, but we've all been strung out on it for years.

After all the talk of blood for oil, the endless speculation about the ozone hole, global warming, and dozens of other doomsday scenarios, people can no longer ignore the problems. Yet according to nearly every study, very few people are making any major changes in their lives. Accepting this fact, what are we to think? That

people don't care what kind of world their children will be left? That there's nothing that can be done? We're mere pawns of government or corporate America (pick your villain) and all we can do is shrug our shoulders, look briefly skyward, and utter our mantra, "Hey, wheriyagonnado?"

The answer is plenty. Here's how I've all but eliminated my dependence on oil.

Let's start with transportation—the big one. You don't have to get rid of your cars as I've done, but you can easily limit your use of the beloved automobile. Consider the bicycle. Obviously not a good choice for picking up the kids from school, but it sure works for the trip to the video heaven or the half-mile jaunt for a loaf of bread and a quart of milk.

Another big fuel saver is public transportation. I'm writing this piece aboard a train somewhere between Los Angeles and New York. Yes, I could have taken a plane, but it uses 50 percent more fuel per person.

The name of the energy-saving game is reduction. Trains and buses still use fuel, they just use a

hell of a lot less. The most daring additions to my transportation package, however, are my electric vehicles (EVs).

Though limited in range, they get me around town with ease and comfort. EVs are not only quiet and low on maintenance, but 85 percent less polluting than cars that run on gasoline. Clearly there's a place for the EV today, but everyone seems comfortable viewing it as the car of the future even though EVs have been around for years.

There's also a lot of ways to reduce energy use in your home, especially with lighting. Insulation works, too. When I remodeled my home and opted for double-paneled windows and two-by-six instead of two-by-four studs, I found it takes only a few minutes to heat or cool the entire structure. It will then maintain that temperature all day if you're a city dweller like me, the sound-attenuation properties of insulation are a bonus. Some well-planned insulation allows you to keep the noisy chilly world at bay.

The boldest of all the measures I've taken around the house sits atop my house and probably represents the future in meeting a large portion of our energy demands. I have roughly 4,500 watts of solar-electric panels on my roof. They provide power for my cars, my computer, and all but two or three of the appliances throughout the house.

I've tried many ways of saving a watt here, a flu there, and believe me, they work. When facing the Mount Everest of environmental ills that stand before us, it's easy to become overwhelmed—not only by the scope of the problems, but by the myriad of solutions. Whether scaling the highest known peak, or tackling ecological dilemmas of equal magnitude, the approach is much the same. Put one foot in front of the other and take it a step at a time. ☐

Actor Ed Begley, Jr., shows how to make energy awareness a part of your life.







# CONTINUUM

## ON AMBER WAVES OF GAIN

Savvy growers ply the trade routes. Also: Pachyderm patties, criminal impulses, and the toxic shock that heals

Lightning struck a Delaware farmer's telephone lines recently, plunging his computer screen into darkness and cutting him off completely from his three-day addiction to watching fluctuations in the corn options and futures market. "The week it took to get that line repaired was fantastic," the farmer said.

A Lexington, Kentucky, corn and tobacco farmer sympathizes. He likes to keep tabs on options, too, but feels he's always 15 minutes behind the market. On a rainy morning several weeks ago, as he chafed down a heater that had gotten into the corn, he had his wife check their home computer so he could call a broker from his pickup truck. "The cellular phone is great," he says, "but we could really use miniscreens so we can take em with us to the fields and follow the markets while we're on the tractor."

These growers, already hooked on using options and futures to hedge crop prices, represent only the finest and most progressive sliver of American agriculture. So the Department of Agriculture and the Chicago Board of Trade are encouraging farmers to make greater use of the speculative markets.

Buried deep within the 1,625 pages of the Senate version of the 1990 farm bill was a \$20 million program that would train farmers to use options as a form of price insurance. Participating farmers would be reimbursed by the USDA for the cost of their options and in return would give up their place in federal farm programs. Theoretically, the government would stop handing out farm loans and taking on surplus grain as collateral. This would eliminate the cost to the government of grain storage—\$674 million in 1989 alone—and it would allow the USDA to stop paying farmers not to grow or to keep their crops off the market to maintain artificially high prices. Options could also replace the hyperexpensive payments now being made to farmers that cover the difference be-



tween market prices and USDA-determined targets. In 1989 taxpayers shelled out \$10.5 billion for the nation's farm programs. In 1990, \$6.5 billion. The USDA hopes that if farmers can be taught to use options to protect their crop prices, they'll eventually be weaned off federal price support systems.

Here's how the program works: An Iowa farmer brings his 20,000 bushels of corn in to a Cargill grain elevator. It's October and the market price for corn is \$2.50, but the farmer wants to get \$2.80 per bushel. He buys four July put options (each contract covers 5,000 bushels) with a \$2.80 strike price, paying Cargill, a commercial grain company in Des Moines, a 30 cents per bushel premium plus a commission for writing the options. The federal government reimburses the farmer for the premium and commission. If the price of corn goes higher

than \$2.80, the farmer lets his option expire and sells his corn on the open market. If it drops below the strike price, he can exercise the option and walk off happily with the \$2.80 he wanted in the first place.

Commercial grain companies that get into the business of writing options stand to gain not only from the increase in premium and brokerage business, but also from greater access to what should be cheaper grain than the federal government is no longer storing or subsidizing. The farmer, ideally, gains price protection as well as the possibility of greater income potential if he decides to speculate or trade in options. The Chicago Board of Trade gets a new market for agricultural options—the farmers—and a concomitant increase in the volume of business. As the prices of American farm products come down, their competitiveness abroad should increase, making everyone involved—from the Department of Agriculture to the 400-acre Delaware farmer—very, very happy.

—JACKY GOLD



## CONTINUUM



Conventional fireproofing may limit damage in case of fire, but it can also lead to roof rot, costing Americans an estimated \$2 billion a year in repairs.

### ALL STEAMED UP

Pressure-treated wood used in conventional fireproofing contains chemicals with acid salts. These salts may limit fire damage, but at 110°F (easily reached in any attic on a summer's day) acidic hydrolysis sets in, breaking down the cellulose structure of the wood. The result: roof rot, which the National Association of Homeowners estimates can cost Americans upwards of \$2 billion a year to fix.

The solution is an inorganic, ceramic-based laminate glued to wood like a veneer and acting as a barrier to flames. Pyrocrete, manufactured by Bamer Technology, Inc., of Vancouver, British Columbia, fits the bill. According to Bamer president William Kotker, the

product is 50 percent water, so when a fire breaks out, Pyrocrete releases steam to retard the flames. And it protects wood from rotting in even the hottest attics.

Kotker, who expects quick approval of his material from Building Officials and Code Administrators International in Chicago, has sold U.S. distribution rights to Weyerhaeuser, the Tacoma wood products giant. Weyerhaeuser plans to rechristen the material BlazeGuard.

—George Nobile

### BOTULISM BOUND

An unlikely miracle is at hand for thousands of Americans suffering from a broad array of involuntary muscle spasms, thanks to the botulinum toxin, one of

the most potent toxins known to mankind.

The substance produced by bacteria is usually associated with botulism, food poisoning that results from improperly processed canned goods. Ingestion can cause paralysis, leading to suffocation and death. However, when diluted to just one five-hundredth of a lethal dose, the botulinum toxin can have beneficial effects by selectively paralyzing muscles that contract involuntarily.

The Food and Drug

Administration recently approved the purified botulinum agent, *Onabotulinum*, for treating strabismus (an eye alignment problem) and spasms of the eyelids and face. A National Institutes of Health (NIH) panel also endorsed the drug for treating dystonia, a host of muscle spasms that cause involuntary movements and abnormal postures.

The technique for delivering the drug requires some artistry, says Roger Duvoisin, chairman of the NIH panel. "You don't want to paralyze people, just reduce the activity of an overactive muscle. That means getting the right amount of toxin to exactly the right place."

—Steve Nads

### MAMMOTH MOVEMENTS

When it comes to solving the mystery of the mammoth's extinction, paleontologist Larry Agenbroad is taking the crap out of what, until now has largely been a crapshoot.

Agenbroad was exploring Utah's Bechan Cave in 1983 when he stepped in the first mammoth manure ever found in the Western Hemisphere. In the years since then, he and his colleagues at Northern

THE FEMALE OCTOPUS HAS HER VAGINA IN HER NOSE. IF THE MALE OCTOPUS APPROACHES THE FEMALE WHEN SHE IS NOT READY FOR MATING, THE FEMALE OCTOPUS WILL BITE OFF HIS PENIS (ONE OF EIGHT) AND SWIM AWAY WITH IT.



Mammoth left behind an archive of data preserved in their excrement that is now giving scientists clues to the ancient climate.

Arizona University have teased apart thousands of mammoth dung patties discovered in dry caves and in alderes found in abundance across the entire Colorado Plateau.

"For the first time, we've been able to approach the mammoth's extinction from

the far side," says Agenbroad, whose radiocarbon test dates the oldest dung yet found in the United States to about 28,290 years ago and the youngest to 11,670 years. (The mammoths disappeared forever sometime around 11,000 years ago.)

By analyzing the dung's remarkably well-preserved contents, Agenbroad's team has gotten the inside poop on the region's Pleistocene environment. About 98 percent of the dung samples collected consist of grasses, sedges, and rushes. Today this floral assemblage can be found only at altitudes 4,000 feet higher than its Ice Age range or at more northern latitudes, a striking indication that the region's climate has become warmer and drier since the Ice Age.

Did the coming of the Ice Age—or the arrival of Ice Age hunters—doom the mammoths to extinction? So far, Agenbroad says, the excremental archives support the "overkill" rather

**SEVENTY PERCENT OF THE 3,000 PLANTS IDENTIFIED TO DATE BY THE NATIONAL CANCER INSTITUTE AS OFFERING POTENTIAL CURES FOR CANCER ARE INDIGENOUS TO TROPICAL RAIN FORESTS.**

than the "overkill" theory. The pachyderm's mammoth-size eating cards give no indication that their diet changed or that vegetation quality measurably deteriorated as their apocalypses neared. But, Agenbroad says, "we're still trying to figure out whether plant nutrients declined."

—Peter Tyson

## WHY DID THE GALAXY CROSS THE ROAD?

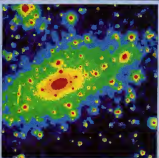
The puzzle "Which came first, the chicken or the egg?" has special significance for astronomers. But they might ask, "Which came first, the galaxy or the cluster?"

Congregations of billions of stars, galaxies often bunch together into large clusters, frequently composed of thousands of galaxies. One theory holds that galaxies form first and following collisions, mergers, and close encounters of the gravitational kind, form clusters. Another theory takes the opposite stance: A giant cloud of gas coalesces into clumps

that in turn become clusters of galaxies. If observations of Abell 2029, a cluster in the Virgo constellation, are any guide, clusters come first.

Researchers from the Kitt Peak Observatory focused their telescopes on the Abell cluster and discovered that light surrounding the huge galaxy at the cluster's center is remarkably smooth. Since they were unable to detect signs of collisions, they deduced that the cluster came first, with the galaxy following shortly after.

But the debate continues. Says Jeffrey Kuhn, a Michigan State University astronomer, "Other clusters may have formed differently from Abell." —Steve Nadis



Using the Abell. A lack of evidence in a Virgo constellation gal-axy cluster may solve a cosmic puzzle.



## CONTINUUM



Skeletons in your closet may be worth more than you think.

### OH, DEM BONES

Got a skeleton in your closet? You may want to consider selling it. With a shortage of skeletons for medical research, a full skeleton that sold for 4,000 six years ago now goes for a hefty \$2,000.

For decades India was the world's main supplier of skeletons. However, in August 1985 the Indian government banned the sales and rumors of grave robbing "I cannot confirm or deny these rumors," says Marshall Cordell, president of the Anatomical Chart Company in Skokie, Illinois.

Cordell says that his company, one of the chief suppliers of skeletons in the United States, has had to purchase private collections to keep up with the demand for bones. Masonic Lodges, which once used real skeletons in their rituals, are one source, but a good role is very hard to find. Many purchasers, balking at the high cost of the real thing, buy anatomically correct plastic replicas instead for a mere \$300.

—Peggy Noonan

### TAKING THE BITE FROM ACID

The perfect sterilant, cleanser, and surface etcher, acid has just one problem: It burns exposed skin and can destroy mucous membranes in the eyes and nose. But an inventor in Denver has now succeeded

in taking the sting out of acids while maintaining their industrial strengths.

"Acid burns because its pH is so low it tends to react with anything and everything," inventor Silvano Garcia says, adding that low pH means a high number of free hydrogen ions. His process, however, blends

strong and weak acids and then mixes them with water to create a hydrogen overload solution. Blending Garcia's concoction with potent acids such as sulfuric, hydrochloric, and nitric acids "occupies" their free hydrogen ions. The resulting mix, he says, releases acids able to handle and doesn't dilute their industrial applications. One chemical company's liability insurance has decreased by 17 percent since the mix began using his product called Chem-Shield.

Studies are now under way to determine how, and if, Garcia's product actually enhances the effectiveness of certain acids.

—Peggy Noonan

### THE STATE OF KANSAS ONCE PASSED LEGISLATION ROUNDING OFF THE VALUE OF PI FROM 3.14159265 ... TO AN EVEN 3

### HOME, SWEET HOME

President Bush has called on the space community to colonize the moon by 2010, but where does he expect those moon settlers to live? Willy Sadeh believes he has the answer.

Sadeh, director of Colorado State University's Center for Engineering Infrastructure and Sciences in Space, received a \$300,000 grant from NASA and a list of requirements for designing moon houses: minimal

labor, total reliability, easy inspection, easy repair, minimum tools, and light weight. His solution: inflatable homes, possibly made of composite fabric less than one-tenth of an inch thick. The permanent installations will provide a shirt-sleeve environment for as many as four people; larger units can be made by linking the structures via an airlock.

Sadeh's homes must be able to withstand 516°F temperature fluctuations between the lunar day and the lunar night. But in some ways, building on the moon is easier than Earth-based construction. "The absence of weather on the moon," he says, "eliminates the need to compensate for wind, ice, snow, lightning, or earthquakes." And with external pressure at nearly zero, the structures don't need traditional walls to help hold them up.

Sadeh says a prototype should be ready in about five years.—Peggy Noonan



Space settler: Shopping for the perfect lunar home.



## CONTINUUM

### SHY PEOPLE SHOULD AVOID HAYRIDES

A survey of 375 undergraduates at George Washington University uncovered a curious fact: Shy people are highly susceptible to hay fever. Among the shyest students tested, one out of three suffered from hay fever; astormented students never displayed the allergy. Scientists are struggling to find an explanation.

If shyness were strictly psychological—that is, people become withdrawn because they have a allergic—researchers would expect to see a link between shyness and asthma, because some forms of asthma are triggered by psychological factors. Since they can't find such a link, it seems that shyness may have a physiological root.

The olfactory system is a good bet, says Ins Bell, the University of Arizona psychiatrist who directed the study.

"The nose is an extension of the brain," she says. Reactions to novel situations are thought to be centered in the limbic system, a part of the brain connected to the olfactory system. The same neural wiring that makes people hyperreactive to novel social stimuli may also make their noses hyperreactive to physical stimuli. Bell admits, however, that the theory is mostly speculation. "We're far from understanding the chemistry of shyness," she says.

—Steve Nadis

EACH OF THE MORE THAN 200 LASHES ON EACH OF YOUR EYES IS SHED EVERY THREE TO FIVE MONTHS.

THE AMNIOTIC FLUID THAT SURROUNDS A BABY IN THE WOMB IS COMPLETELY REPLACED EVERY THREE HOURS.



Light: Bank of astronomers and a state on Jersey reflect

### Y'WINKLE, Y'WINKLE, LITTLE STATE

Financially strapped New Jersey is considering a law to curb "light pollution," a move that will save money and make astronomers happier.

Public lighting costs New Jersey taxpayers an estimated \$50 million a year. Bill S-2026 would reduce the bill by three

quarters. Low-profile sodium lights and shields would direct and focus light, and a better system of public lighting fixtures would shield streets or directed lights. The plan will result in a darker sky for stargazers.

"A light pollution study commission makes enormous economic and environmental sense," New Jersey state senator Dan Dalton says. "We need to cut our reliance on nonrenewable natural resources."

David Crawford, executive director of the International Dark-Sky Association (IDA), is also pleased. "The IDA looks forward to the passage of the New Jersey bill as a major step toward restoring the view of the universe to the people of the state and establishing quality lighting there," he says. "It should serve as an excellent example to other states." —Fred Schaaf



Hay fever: Shy people seem to be more susceptible to allergies, suggesting a possible physiological connection.

### CRIMINAL STIMULATION

If you're a teenager with a low heart rate, dry hands, and a brain that generates little electrical activity, the police may want to reserve a jail cell for you.

Many psychologists, including the University of Southern California's Adrian Raine, postulate that crime rates might be undisciplined people who stimulate themselves by breaking the law. Raine's ten-year study, initiated in 1978, measured

three indicators of nervous system activity—heart rate, blood rate, and brain electrical output—in 101 British teenagers.

In 1985, when Raine toured Great Britain's computerized crime records, 75 percent of the predicted lawbreakers, all with low arousal rates, had established criminal records. Raine says his predictions may be even more accurate because official records list only outlaws who have been caught. —Billy Alzofar



## CONTINUUM



Datsk: Bringing the thermometer into the twentieth century.

### STICK IT IN YOUR EAR

The next time a doctor asks your temperature, he may stick the thermometer in your ear instead of the usual orifice. If San Diego's Datsk, Inc. has its way, the company's mercury-free thermometer can measure human body temperature in less than

two seconds. It uses a tiny heat sensor just eight millimeters in diameter to gauge body heat generated by the tympanic membrane, or eardrum, in the ear canal. A micro-processor inside the hand-held unit converts the sensor measurements into either Fahrenheit or Celsius readings on a liquid crystal display screen.

The ten-ounce thermometer, which can take 20,000 temperature readings on a single battery pack, is an improvement on glass thermometry technology, first devised in the 1700's and little changed since the Civil War. The Datsk Model 7000 aural thermometer, retailing at about \$550, is aimed at the international hospital market.

—George Nobbe

### MEN FROM THE DARK AGES

In a recent study bound to raise the hackles of feminists everywhere, psychologist Linda Carl at the College of the Holy Cross has shown that women who are tentative and uncertain in their use of language are more likely to influence men than women who are confident and assertive.

Carl's experiments with more than 200 college-age students suggest that a woman vastly improves her chances of changing a man's mind or influencing a man's decision by using frequent disclaimers ("I'm not an expert but..."), tag

questions ("It's raining here, don't you think?"), or hedges ("It's kind of raining, maybe..."). Assertive behavior—such as sitting upright in a chair, maintaining eye contact, and talking in a calm, steady voice—impairs a woman's persuasiveness. "Men view tentative women as less competent, but more trustworthy and likable," Carl says. "Men, in general, don't like assertiveness in women because it threatens their position of power."

The phenomenon, says Carl, probably has more to do with status than gender and she's quick to point out the limitations of her own experiments. "I bet if you

studied the interactions between female bosses and their subordinates, you wouldn't see tentativeness in the woman's behavior."

—Steve Nadis

### GOING TO POT

Ever marvel at how quickly potholes and cracks appear in a newly paved road? Engineers may blame structural problems, but Mississippi State University microbiologist Lewis Brown lays the blame on common, ordinary soil bacteria.

Brown explains that paving asphalt is only 5 percent asphalt; the remainder is a combination of sand and rock loaded with macroorganisms. Bacteria grow in the material, producing scablike emulsifiers that strip gravel off asphalt," Brown says.

The result? "The matrix eventually falls apart when cars and trucks roll over the road."

The solution to this microscopic problem and its gigantic implications is the

**MALES ARE MORE SENSITIVE TO BRIGHT LIGHT AND CAN DETECT MORE SUBTLE DIFFERENCES IN LIGHT. WOMEN HAVE A MORE ACUTE SENSE OF SMELL AND ARE MORE SENSITIVE TO LOUD NOISES.**

chemical silane, "which binds with rock, repels water, and bonds asphalt to gravel," Brown says. "It doesn't kill the microbes but it prevents their emulsifiers from washing the asphalt off the gravel."

In lab tests, soil microbes stripped pieces of asphalt coated gravel in just ten days. But when the gravel was treated with silane, the two remained bonded even after 137 days. Adding silane would increase paving asphalt's price by about 25 to 50 cents per ton, but, Brown says, "It's a small price for extending the life of highways ten times or more." —Sherry Baxer



No matter how heavy the backup roller, it can't crush the microbes that speed the destruction of highways.

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Playing pieces shown shown slightly smaller than actual size.

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# PERPETUAL POWER



Can we develop  
a sane energy strategy  
for the future?

ARTICLE BY TOM DWORCZKY

**T**heater adviser (as high as  
the white plastic  
La Mer as I drove toward  
Blown House 02  
from Hawaii, Colorado) I  
a Corvair slaver  
Unwashed regular seas  
back forty five a gallon  
I was on my way to a Shaggy  
is of energy re-  
search, the Hickey-Maurice  
Institute (PMA), headed  
by Henry and Hunter Lewis,  
kept up all forward  
the institute's say otherwise



**Energizing the future: Economical power will come increasingly from the sun. The earth's steaming interior, the wind, and such**

**biomass fuels as agricultural wastes and cattle manure, among other sources. Clean nuclear power may be priced out of the market.**



**T**he majestic palatial stateroom features a lush tropical garden decorated with a two-foot guinea and a ferns banana plant. Thanks to passive solar technologies, the building exudes light and warmth—it yet lacks a furnace or boiler of any kind. Saving energy doesn't mean having to say you're sorry.

Respectable and benevolent looking, Amory Lovins appears more like the physicist he once was than an energy maverick. But his stubborn advocate of renewable resources and the efficient use of energy has proved one of the most persistent foes for the special oil, coal, and nuclear interests that have dominated the nation's approach to energy. "We must learn to make the best energy buys first," he argues, pointing out that RMI's electric bill comes to a mere five dollars per month. "That means starting with efficiency measures to reduce the need for more production, and then moving away from large central power plants to smaller ones that make use of such renewable resources as wind and sunlight and highly efficient gas turbines fueled with biomass like sugarcane and other crops."

Such a shift, of course, would change the world. Peaking man used fire as early as 400,000 B.C. From then on, burning carbon-based materials has been mankind's most basic technology. But today, as the world's burgeoning population coolets its energy use, fire's effects threaten our environment and increasingly raise serious economic and security concerns.

"Energy is not the goal per se," says John H. Gibbons, director of the Office of Technology Assessment. "Rather, energy policy derives from the broader and more fundamental national goals of environmental quality, economic health, and national security. Therefore it only makes sense to develop a national energy strategy that goes the best job of fulfilling these three goals." In other words, policymakers can fashion a national approach to the energy crisis only by examining the options in light of each of the underlying issues.

During the next 40 years, Gibbons, Lovins, and other experts urge, we must undertake a major transition away from carbon-based fuels and wasteful energy consumption practices. If we do not, we run the risk of using up the

earth's capacity to absorb the destructive byproducts of burning.

The other risk of ignoring their pleas is protracted in today's headlines. We went to war at least partially to secure the millions of barrels of oil imported daily from the Persian Gulf. But this didn't have to happen, Lovins says. As he put it in a *New York Times* editorial last December, "Are we putting our kids in tanks because we can't put them in efficient cars? Yes. We couldn't have needed any oil from the Persian Gulf after 1983 if we'd simply kept on saving oil at the rate we did from 1977 through 1983."

It's clear that alternatives to carbon-fuel-based power generation will be filling the energy gap—but not because our traditional fuels are running low. Based on current recoverable reserves and consumption rates, the planet has nearly a century of oil left, maybe 200 years worth of coal, and 50 to 100 years of natural gas. "The security issue is really a red herring," Princeton energy analyst Robert Williams says. "However, these resources will become increasingly scarce due to the security and environmental constraints."

Security constraints mean that the fuel you want belongs to someone else. While 80 percent of the world's coal is in the United States, the Soviet Union, and China, oil and natural gas reserves are predominantly in the Middle East.

Historically, this distribution of resources has had its price—in money and, all too often, in blood. At the time, the United States must make vast military expenditures to ensure oil supplies. The bill for the Gulf War has already topped \$40 billion, in effect doubling the annual cost of this "cheaty" Middle Eastern oil. As Washington's Christopher Elsh points out about the region's resources, "Not only is the world addicted to cheap oil, but the largest drugstore is in a very dangerous neighborhood."

War itself, of course, exacts an environmental toll. Ecological damage from history's largest oil slick offshore from Kuwait dwarfs the effects of such peacetime mishaps as the grounding of the Exxon Valdez. And no one would rush into a hot landing zone to engage in the risky business of mopping up a spill or putting out an oil well fire.

Even in peacetime the ecological impact of burning fossil fuel is bad news

CO<sub>2</sub> emissions account for about half the greenhouse effect and ozone depletion, as well as most acid rain and general urban smog. Air pollution is not only unpleasant but costly. The American Lung Association, for example, estimates that air pollution causes \$40 billion per year in lost productivity and other health costs. Estimates of damage from acid rain on buildings, bridges and forests easily double the price tag.

Global warming, another effect of burning oil, can't be measured in dollars. Burning the remaining stores of oil, coal, and natural gas would result in a tenfold rise in the concentration of atmospheric CO<sub>2</sub>, Flann says. Some of the last 100 years were the hottest on record. Even without catastrophes from rising sea levels or melting polar ice caps, researchers predict climate changes that within the next century could well turn cropland to desert, flood populated coasts, and cause major social and economic dislocations.

Not all holding to current per capita consumption of these energy sources offer a viable solution. EPA scientist, for example, have estimated that global carbon emissions will have to drop by 60 to 80 percent to stabilize the climate. Combine that with the recent World Energy Conference's estimate that by the year 2020, the world's population growth from today's 5 billion people to 12 to 14 billion will require a 75 percent increase in energy use, and the scope of the power problem emerges. Fortunately nonpolluting alternatives to fossil fuels exist. The primary candidates are nuclear energy and renewables, including wind, solar and biomass. Traditionally, the government has favored nuclear energy over renewables.

Through Department of Energy research and development funding, large tax subsidies, and legislative limits on liability from reaction accidents nuclear power has enjoyed a huge advantage over its more modest competitors. In the last 20 years, Lovins says, taxpayers have coughed up almost \$90 billion in 1991 dollars on nuclear technology; the electric utility industry has spent more than \$125 billion. But this may have been an unwise investment. According to Lovins, a few have now written off more than \$60 billion on nuclear power plants. Beyond that, running nuclear plants costs at

**QUITE LIKELY, LONG-TERM SOLUTIONS TO THE ENERGY CRISIS WILL INVOLVE A SWEEPING MOVE AWAY FROM THE CARBON-BASED FUELS THAT ENERGIZED HUMAN DEVELOPMENT FROM PREHISTORIC TIMES TO THE INDUSTRIAL AGE.**

least \$60 billion more than using coal power to generate the same amount of electricity. Altogether, Lovins estimates that the damage totals more than \$200 billion—and that doesn't include the sums needed to decommission aging plants and clean up waste. "One can describe the state of the nuclear industry as the greatest collapse of any enterprise in industrial history," he says.

The nuclear industry has largely succeeded in bankrupting its only possible customers, the electric utilities.

This condemnation doesn't come from an industry outsider, either. "Thinking about that tragedy makes me feel that there but for the grace of God go I!" Lovins says. "In my student days I received awards for nuclear physics from, among others, General Electric, the Atomic Energy Commission, and the American Nuclear Society."

Proponents of this technology have correctly argued that it could address the environmental problems associated with fossil fuel. Nuclear power after all does not produce greenhouse gases. But it has other significant problems. "Nuclear power reimagined in some smaller, passively safe, and economical form, may indeed come to the rescue, at least for the developed countries," says James MacKenzie, senior associate for the World Resource Institute's Climate, Energy, and Pollution Program.

"But we won't see this for at least twenty years. And nuclear energy is inherently expensive, complicated, and unavailable for most of the developing world. Saddam Hussein also awakened us to the threat of diverting nuclear materials to weapons production."

Renewable fuels and technologies, however, have no such economic or national security drawbacks. Even without huge research dollars and tax subsidies, solar, wind, biomass, and other renewable industries have made great strides in the last decade. Moreover, ever more efficient devices have trickled onto the market. Were there no tax subsidies for fossil and nuclear power, existing solar and wind-generated electricity to name just two sources, would already prove cost competitive.

The move toward renewables began with the 1978 Public Utility Regulatory Policies Act (PURPA), which forced utilities to buy power from anyone who generated it. Since then the percentage of electricity supplied by private producers has jumped—limited more by restrictions on what they could sell than by technical constraints.

At first resistant to the idea, the utilities are recognizing the bottom line. Power from solar and wind-generating facilities is competitive with and in the near future will be cheaper than the same electricity produced by tradition-

al generating plants. The 1990 Clean Air Act should make renewable sources even more economically attractive.

Changing attitudes among state regulators have also enhanced the climate for fuel alternatives. California, Oregon, and five New England states, among others, now encourage utilities to invest in the hidden "sources of energy: greater efficiency. In Oregon's "nega wats" program, for example, a utility company representative can sit down with a building owner and work out a plan to increase energy efficiency by installing less power-consuming lights, heating plants, and the like. The owner pays for the improvements over time through his regular utility bill.

Such programs allow utilities to charge for the wats they sell and for efficiency investments (the wats that they don't sell). The advantage: The utility doesn't have to make large capital investments in additional power plants to handle the increasing load. The risk: Future power consumption might decline, stranding the utility with undesirable surplus capacity. This is no idle fear. Just such a situation has pushed a number of U.S. utility companies over or to the brink of bankruptcy.

In large measure, such economic dilemmas come from an important shift in the relationship between growth and energy. Since the dawn of the Industrial Revolution, GNP and energy consumption have risen hand in hand. However, since the first oil shock in 1973 this trend has changed. GNP has risen as energy consumption has fallen. Advances in energy efficiency are only part of the story. People are also manufacturing and consuming items with costs based less on the raw material and energy required for their fabrication, and more on the labor or ingenuity involved in their production. Although computers, for example, require a lot less raw matter and energy to make and use than refrigerators, they cost more.

The solution to the energy crises, therefore, may well be one that comes from the bottom up. As the price of electricity and gas inevitably rises, individuals will opt for more efficient energy use in the products they buy. With the increasing cost of environmental controls, as well as big-ticket fossil and nuclear power plants, the utilities will seek cheaper, smaller, and cleaner ways to provide energy—or go broke.

Quite likely, long-term solutions to the energy crisis will involve a sweeping move away from the carbon-based fuels that energized human development from prehistoric times to the industrial age. Arny Lovins and other energy revolutionaries envision a paradise of windmills on the Great Plains, solar cells in the desert producing electricity, and fields that turn crops into ethanol for our cars and turbine fuel for power. ☐





Even as tank treads fly the oil-rich sands nine time zones to the east, oilmen lighting on the home front in Lubansil, Kansas, share a thermos of Folgers instant and discuss their own strategy for forcing thousands of barrels of crude oil out of a lease that began to dry up ten years ago. It's a tactic called water injection.

"For oil recovery, it's nothing new," says Mark Ranehart, an engineer for Anadarko Petroleum. "But our method of using purified sewage water is unique to the world."

The earth holds an estimated ultimate resource of 1.744 billion barrels of oil, and at our present consumption rate, 64



## GOOD TO THE LAST DROP

**SQUEEZING OIL FROM A SHRINKING WORLD SUPPLY**

million barrels per day—enough to fill Lake Erie one and a half times—that new Cameroon may sputter its last in about 75 years, according to unofficial U.S. Department of Energy estimates. That's the good news. The bad news: Sixty-six percent of the proven reserves lie in the Persian Gulf.

With the United States importing half its oil and the rest getting more expensive to refine, we've reached the point where—like Mad Max—we're ready to fight for what's left. "If there wasn't oil in Kuwait and Saudi Arabia, we wouldn't be there," says former senator George McGovern.

But while we pay in blood and money to keep our Camerons running on global oil, U.S. producers are squeezing oil in new directions to refine hard-to-produce oil, and toward new production methods that squee more oil from deposits they once thought drained. "A lot of American production today relies on finding small fields and producing them efficiently—high-tech solutions," says Grant Lichten, vice president of Jubco Seismic, an oil exploration firm.

Advances in technology, for example, now allow producers

**ARTICLE  
BY PHIL SCOTT**

to drill into depths horizontally, for more efficient, higher producing wells. The horizontal well begins as a typical vertical well for the first few thousand feet, but directional gyros and computerized sensors in the drill bit allow the drill operator to gradually angle the well's path 90° and toward the subsurface coordinates.

Tom Sullivan, a spokesman for Oryx Energy Company, an oil exploration and production firm, compares it to playing nunchuck-pog with your hand in a pool of oil and your eyes closed. Think of the knife blade as the drill. "Every time you hit your finger you're drilling a dry hole, and then you

But the deeper companies explore, the more chance they take with the environment. "In three thousand feet of water you have that many more feet of water where something could go wrong," says energy specialist Rob Watson of the Natural Resources Defense Council (NRDC), a national environmental group. He points to the July 1980 explosion at the drilling platform Italc, in the Gulf of Mexico. "An explosion of that type," he says, "at the point where the drill meets the ocean floor would be more difficult to avoid in deeper water."

For tapping into landlocked, untouched U.S. oil reserves, a dwindling group of companies

**WITH NEW TECHNOLOGY PETROLEUM COMPANIES CAN TRAVEL FARTHER OUT TO SEA FOR THEIR OIL.**



still may not tap into all the vertical deposits of oil between your fingers," he says. But if you slide the blade underneath your fingers, you can get at all the oil. "It costs more," but it doesn't cost as much as drilling dry wells in each finger," Sullivan says.

Imagine, however, the bad blood arising if you punched into the oil on the lease of another. "You have to carefully outline [to regulatory agencies] where you're drilling and follow it to make sure you're not draining the guy next door," Sullivan says.

Petroleum companies are also going farther out to sea for oil. Shell Oil continues setting deep water drilling records in the Gulf of Mexico. The company simultaneously built the world's deepest offshore platform and its tallest structure (82 feet more than Chicago's Sears Tower) with its 1,615-foot Butterfield fixed platform. By 1993 Shell hopes to pump oil from its Auger platform, a floating platform held in water 2,880 feet deep by vertical "tendons." And for a preview of deeper things to come, the company has recently drilled an exploration well in 7,520 feet of water.

think they've a better way mining. Geologists estimate that portions of Utah, Colorado and Wyoming hold up to 1.8 billion barrels of oil trapped in oil shale. One company, Unocal Corporation, struck a rich vein near Grand Junction, Colorado. By heating the shale to 900°F to release the oil, the company now produces up to 7,000 barrels of the so-called synthetic crude oil per day. Workers scatter the spent shale—it takes 2,520 pounds of shale to produce one barrel of oil—near the mine, spread topsoil over it, and revegetate the area. "The deer love it," says Unocal spokesman Jeff Callender.

Keeping a home for the deer and antelope to play is Unocal's brightest note, however. Unscheduled shutdowns, to clear spent shale, plague the production plant, which has yet to reach its design capacity of 10,000 barrels a day. And not least, one barrel of synthetic oil costs between \$45 and \$50 to produce, compared with \$4.82 for a barrel of U.S. oil, and \$2 per barrel for everybody's favorite, Saudi oil. The company receives price support from the government—up to \$400 mil-

**BUT WHEN THEY DRILL IN DEEPER WATER, THEY TAKE MORE CHANCES WITH OUR VERY FRAGILE OCEAN ENVIRONMENT.**

lion by 1996—to make up the difference between the price it sells the oil and what it costs to produce. After price supports run out, Callender is not sure whether the company will keep the operation going. "When oil rises to fifty dollars a barrel, shale isn't the only economically feasible energy option," he says.

But the NRDC's Watson says, "How much energy does it cost to produce one barrel, when you heat the shale up to nine hundred degrees?"

To remove the oil from the shale, many synthetic oil companies have employed a slurry process, which uses up large volumes of water from the already parched area. Watson says, "The environmental cost is not rolled into the alternative fuel cost."

The same goes for the Bush administration's proposed energy plan, which would open up 1.5 million acres of Alaska's Arctic National Wildlife Refuge (ANWR) to exploratory drilling. "It may be only one percent of the land," Watson says, "but it lies along the shore—it's teeming with wildlife, and any of us take from there won't make a dent in the U.S. oil deficit."

The administration wants to find more of this "easy oil," also known as primary oil, the gushers that make Texas wildcatters dance around in crude blackhats, the bubble'enza that propelled the likes of Jed Clampet to Beverly Hills. It accounts for just 12 to 15 percent of a deposit's oil. Secondary recovery—like the water-injection field in Kansas—can flood another 15 to 20 percent from a field.

For years secondary recovery meant injecting salt water—a by-product in many deposits—down the deposit's center wells, and forcing oil to wells on the perimeter. When prices rise, producers find increasingly ingenious and expensive means of injection that depend upon the quality of oil.

At one Southern California lease, Oryx and Mission Energy use steam, heated by natural gas (another by-product of oil production), to get at one especially gooey deposit. And in a new procedure, workers inject microbes and molasses into a deposit, seal it, and let it

CONTINUED ON PAGE 100



1955



1962



1968



1971



1979



1985



1991

You always come back to the basics.



40% ALC/VOL (80 PROOF) WHISKEY. 100% GRAIN NEUTRAL SPIRITS. DISTILLED BY JIM BEAM DISTILLERS CO., CINCINNATI, OHIO. © 1991 JIM BEAM DISTILLERS CO.

# THE OMNI ENERGY EFFICIENCY GUIDE

SAVING FOR THE FUTURE

BY SHARI RUDAVSKY

**A** movement is sweeping the country. Its genesis lies in the exploding financial, political, and environmental costs of energy. Folks have discovered what they call a hidden "source" of energy, one that is clean, safe, and cheap. It's called efficiency, and it's the best strategy we have to combat our addiction to fossil fuels. Indeed, energy efficiency experts contend we can reduce the nation's need for oil and other fuels as much as 44 percent by the year 2000.

Americans have taken on the task of sustaining the environment—recycling waste, cleaning up the coastlines, and eschewing disposable goods. Now it's time to focus on energy. The bonus: Energy efficiency saves not only the planet but also money.

In the Seventies, car service meant donning flannel shirts, lowering thermostats, and waiting in lines for gas. The imperative then was of embargoes. Now conservation car repairs to the new-found commitment to preserving the environment. And due to technology, discomfort need no longer govern our acts.

The guide offers only a starting point for reducing energy consumption. For those who want to do more, we also provide a resource list.

## HOME REMEDIES

**\$** The coins situation was how it did not resemble "the jetsons" home. In fact, it will probably look more like the Cleaver household. The most important changes in mid-riff energy efficiency, reports say, will be social rather than technological, although technological advances increasingly pay heed to energy usage.

While energy-efficient appliances sometimes carry higher price tags, in the long run they prove significantly less expensive than many models that may initially cost less. Before you buy, calculate what the energy savings will be in a year and then multiply it by the lifetime of that appliance. Compare that cost with the lifetime price of the less efficient model and you'll see the long term savings.

“**FOKLS HAVE DISCOVERED**

**A HIDDEN SOURCE OF ENERGY THAT IS CLEAN, SAFE—AND CHEAP. EFFICIENCY IS THE BEST STRATEGY FOR REDUCING FUEL NEEDS.”**

**COOKING LIGHT**  
Methods for saving energy while cooking require little more than common sense. The microwave, which uses about 50 percent less energy than conventional ovens, substitutes for an oven if you need to heat or cook only a small amount. When you do use your oven, streamline its heating capacity. • Defrost frozen food in the refrigerator before cooking it. • Preheat your oven no longer than ten minutes. After that,

ally energy you use will just be wasted. Similarly, you can turn your oven off ten minutes before your dish is done; the food will continue cooking as the oven slowly cools off. • Avoid opening the door while cooking. Each time you do, you can lose more than 50% of heat. • Use the right size pan for cooking; larger than necessary pans require excess energy. And when cooking on the stove, place lids on pots to keep the heat inside

Cooking pasta in a large pot, for example, requires three times as much energy as cooking it in a covered pot. • Materials can also make a difference. Substitute glass or ceramic baking dishes for other materials, since they bake your food at a temperature about 25° lower than the one stipulated in the recipe. Copper-bottom pans are best. They heat faster, food cooks faster, using less energy.

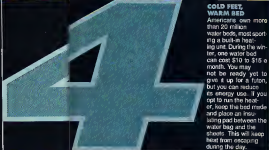


## LITE LIGHT

**!** Of all the products that help you save energy effortlessly, light bulbs are the cheapest and easiest to install. Compact fluorescents cost light, that's indistinguishable from that of incandescent bulbs, but can save you more than \$30 on your electricity bill. They cost more than ordinary incandescent bulbs—between \$10 and \$25—but save over the long run. An 8-watt compact fluorescent bulb emits as much light as a 75-watt incandescent bulb and lasts ten times as long. • Maximize the energy of incandescent bulbs by cleaning the fixture at least four times a year. • Calculate energy costs when you consider wattage. Using one 100-watt bulb will cost 70 percent less than using two 60-watt bulbs. • Paint or paper walls in light shades. White walls can mirror 80 percent of the light that hits them, while black walls reflect only 10 percent. • Install occupancy sensors. If you forget to turn off the lights, the sensor does it.

## RESOURCES

• The Consumer's Guide to Home Energy Savings contains practical suggestions for energy savings, as well as lists of "green" products. Contact the American Council for an Energy Efficient Economy, 1001 Connecticut Avenue, NW Suite 515, Washington, DC 20006 (202) 295-5000.  
• Home Energy Magazine, 2124 Kell Road, Suite 50, Berkeley, CA 94709-2625, (415) 957-5709, 9/87 • For information on OFCs, contact the Alliance for Responsible Oil Policy at 1001 North Ford Meyer Drive, Suite 1300, Arlington, VA 22209.  
• The Smart Kitchen, by David Goldbeck, Green Press, Box 97, Dept. EE, Woodstock, NY 12498; \$15.95.  
• Fuel Goods, 968 Mazzoni Street, Ukiah, CA 95422; (709) 762-7025. Energy wise products.



## COLD FEET, WARM BED

Americans own more than 20 million water beds, most sport a built-in heating unit. During the winter, one water bed can cost \$10 to \$15 a month. You may not be ready yet to give it up for a futon, but you can reduce its energy use. If you get to run the heater, keep the bed made and place an insulating pad between the water bag and the sheets. This will keep heat from escaping during the day.



## CHEAP FREEZE

**!** Monitor the refrigerator's temperature settings. The fridge should hover between 38° and 42° F, the freezer between 0° and 5° F. Periodically do a savings check on the fridge by placing a dollar bill in the door as you close it. If it drops out easily, it's time to tighten the door gaskets. Condenser coils also require periodic checking for cleanliness: To operate efficiently, the coils need air circulating around them. • Focus on freezer loads. When fully loaded with food, you can "load" the freezer and use less energy. Fill milk cartons with water to at least halfway and place them in the freezer. • When it's time to dump your old fridge, recycle the chlorofluorocarbon (CFC) refrigerants. (CFCs, contained in almost all fridges, contribute to ozone depletion.)

## SOME LIKE IT HOT

The water heater consumes more electricity than any other appliance in the typical household, nearly twice as much as the refrigerator. Its second greatest electricity user. • Maximize the performance of your water heater by buying an insulating blanket for the top of it. Monitor the heater's temperature

and be careful not to raise it to more than about 120° F. • If you use gas heat, consider a gas water heater. Over its lifetime, a gas hot water heater will cost about \$3,240, while an electric one will cost \$6,050. • Monitor your hot water usage. Stop leaks, particularly hot water dips, as soon as you notice them. • Use low-flow faucets

and aerators, available at most hardware stores, on shower and sink faucets to reduce hot water consumption by as much as 50 percent. Low-flow aerators can save between \$50 and \$80 a year. (To test whether you should install low-flow aerators, completely open the tap of a sink or shower and place it under

the shower running full blast. If the carton fills in less than ten seconds, you should consider purchasing an aerator.) • Washing machines and dishwashers can also waste water. Run only full loads, never one or two garments or dishes at a time. • Use cold water in the rinse cycle. As much as 90 percent of the energy

consumed in the average washing cycle goes toward heating the water. • In summer, it's practical to use a clothesline instead of a dryer. • Washing dishes by hand saves about half the water a dishwasher requires. • If you use a dishwasher, save energy by setting the appliance on a cool dry.



### THIS COLD HOUSE

Programmable thermostats best ensure proper heat levels, allowing maximum heat when you want it (early morning and late evening) and minimal heat (during the day and while you're sleeping). But before you take this ambitious step, try these measures:

- Weatherproof and caulk your home to prevent heat leaks.
- Weather-strip windows and doors can save as much as 20 percent on your heating bills. A major un-

expected heat leak: the fireplace. To fix it, insert an inexpensive plastic strip around the damper. • You can never over-insulate an attic. According to the Department of Energy, the heat retention value of your attic (known as the R value) should be at least 30. To meet the standard, lay down about 9 inches of fiber batting or 10 to 14 inches of blown insulation, both available at the hardware store. • Another 20 percent of heat leakage occurs through basement walls and 1 percent through the basement floor. Insulate well under floors. • Place foam insulating pads (about \$2 for ten pads) behind electrical outlets to minimize heat loss. • Leave some rock storage space underneath the slabs if you're building. Basement walls can absorb solar heat during the day and release it into rooms after the sun goes down.

### NO PANE, NO GAIN

The main culprit of heat loss in the winter and heat gain in the summer, windows are essential weapons in the war against energy abuse. • During the winter, faulty windows can produce nearly 25 percent of a house's heat loss. Heavy drapes help. In the summer, keep the drapes drawn to keep heat out. • Cover windows with clear plastic or install storm windows and doors. • Better yet, buy windows made of low-emissivity, or low-E, glass. Low-E glass is coated to reduce the amount of heat lost to the outside world by at least 50 percent. It also reflects outside heat, reducing heat gain in the summer. • An effective as the low-E window is, superwindows are twice as beneficial. These windows basically comprise two low-E panes with either a vacuum or a transparent, nonconducting material such as argon between them. Although they can cost about 50 percent more than normal windows, they pay for themselves in energy savings in about three years. They also provide greater thermal insulation, resist condensation, and block ultraviolet rays.



### THE BIG CHILL

Cooling can consume as much energy as heating. Air conditioning is the most costly way to cool a home, especially when you factor in the environmental costs of HFCs.

- If you use an air conditioner, place it in the shade on the north side of the house. In the sun, a unit can consume 5 percent more energy than those in the shade.
- Shade trees block the influx of sun, reducing air conditioning by as much as 50 percent. • Use ceiling fans to cool and heat. Placed in an attic or on the upper floor, ceiling fans sweep hot air off the lower floors. In winter, running in reverse, they push the warm air down.



### RESOURCES

• Greenpeace Catalog, Box 77048, San Francisco, CA 94107; (800) 456-4029. Light bulbs and faucet aerators. • The Conservation and Renewable Energy Inquiry and Referral Service (CAREERS), Box 2900, Silver Spring, MD 20907; (800) 523-2929. • The Energy Store, P.O. Box 3507, Santa Cruz, CA 95063; (800) 288-1938. Energy-saving products for the home.



### NINE TO FIVE

You may not have control over your company's policies or equipment, but you can still save watts in the workplace. For starters, turn off lights and computers in your office when you step out for more than a few moments. You can also urge your employer to adopt these measures:

- Buy copiers with energy-saver controls that keep the machines from running at full power when they're not in use. • Turn off the copiers during standard off-peak hours, such as early in the morning, at lunch, and overnight, to save even more energy. • Laser printers require about ten times as much energy as less expensive dot-matrix printers. Use lasers for presentations, standard

printers for drafts. A similar energy gobble: fax machines with thermal printers. Although they tend to be the least expensive models, they require the most energy. • Laptops are more energy efficient than desktop computers and they also allow workers to take work home with them. If desktop computers are the norm, however, opt for small screens. • Switch to recycled paper, which requires up to 64 percent less energy to produce than virgin paper. • Institute recycling. Recycling paper reduces air pollution by 75 percent and water pollution by 35 percent. • Promote telecommuting. • Establish car pools for employees. • Turn boardrooms into locker rooms for employees who bike or hike to work.







## **ALTERNATIVE SOURCES: A STATUS REPORT**



ARTICLE

Where do we go from here?  
Today's fossil fuels won't become fuel fossils  
overnight, but now is the time  
to look seriously for other energy sources  
PHOTOGRAPHS BY PETER MENZEL

Will coal, even so-called clean coal, be stoking the world's stove in 2025? Will petroleum products propel our cars—and continue to wreak havoc on fragile ecosystems? Never has the cost of energy—the environmental cost, that is—been more profound.

The urgency with which the earth's citizens investigate these questions, in fact, has never been greater. Policymakers and politicians have gotten wind of this buildup of harmful greenhouse gases around the globe, primarily due to the burning of fossil fuels. They must answer to an increasingly concerned public no longer willing to tolerate the polluting energy sources and policies of the past.

Researchers and engineers are also hunkering down, fine-tuning the technologies for clean, renewable energy alternatives. Forward-thinking entrepreneurs are pitching in, too, by finding the means to make them economical.

These efforts are already bearing fruit. Today there is an array of renewable energy sources that hold promise for the future. The status reports that follow highlight some of the energy options facing world leaders and utility companies. As we race toward the twenty-first century, however, we will need to face an even greater issue: Our entire energy infrastructure must be reevaluated. On to the post-fossil era.

#### HAS SOLAR ECLIPSED?

Once upon a time, solar power was the golden child of energy. In the Seventies politicians embraced it, environmentalists hailed it as the answer to the energy crisis, and enterprising businessmen took advantage of generous federal incentives to develop solar ventures. President Jimmy Carter even had solar panels installed on the White House.

Within months of President Ronald Reagan's inauguration, however, he ditched the solar collectors, signaling the slaying of solar research budgets for eight consecutive years. From 1981 to 1988, U.S. funding for solar energy and other renewables was cut from \$750 million to \$100 million, according to Christopher Flavin of the WorldWatch Institute. Hundreds of solar collector manufacturers went out of business or left for other shores.

Despite federal funding barriers, however, the solar industry has flourished. More than 1.2 million U.S. buildings now sport solar water heating systems, and the political climate for developing other uses for solar energy appears, well, sunny. And in 1990 federal research and development budgets increased by 30 percent. "In the Seventies there was virtually no solar industry," says Scott Sklar, executive director of the Solar Energy Industries Association. "To-

day it's a mature, billion-dollar industry" nowhere is this more apparent than in California's Mojave Desert, where an array of collectors now produces roughly 350 megawatts of power, almost half the capacity of a nuclear power plant and 92 percent of the world's solar supply. Built by the Luz Corporation, the system uses mirrors mounted on parabolic troughs to focus sunlight onto pipes carrying synthetic oil. Heat from the oil creates steam that drives a turbine generator. Luz's electricity costs about eight cents per kilowatt hour, close to the residential average.

The drawback: Prime sites for such solar thermal-electric plants are confined to the sunny Southwest. Other solar technologies, however, such as seasonal solar energy storage systems could potentially fill in where sunlight is less abundant. Demonstrated primarily in Europe, these systems gather heat during summer months and store it underground for use in the winter.

Solar photovoltaic cells, however, hold the greatest potential. Semiconductor devices, photovoltaics convert sunlight directly into electricity, producing no pollution or noise, and don't require any moving parts. Today's best cells convert 36 percent of their area's sunlight into electricity, up from about 18 percent in the mid-Seventies. Promising thin-film devices, one fifth the thickness of human hair, should let the sun shine even brighter.

Photovoltaic electricity now costs five times more than conventionally produced energy. But photovoltaics should eventually yield electricity cheaper than what we have today because thin-film cells can be easily mass-produced, says Princeton University energy analyst Robert Williams.

The climate for solar development may be improving, but some industry watchers fear that it may be too late for the United States to reclaim its early edge in the world market. "It's a question of whether we're going to do it ourselves or sit back and let the Japanese run our solar energy factories, just like they're doing in the auto industry," Sklar says.—Steve Nicks

#### BIOMASS FOR THE MASSES

In a remote village in central India, a banished farmer beams with pride as he shows off the community's power source: an underground tank where cow manure, straw and other plant residues are converted into methane gas for cooking and lighting.

Bioenergy—burning plants, wood, and agricultural waste for fuel—is nearly as old as man. Today millions of Indians and Chinese use such materials for energy. Biomass, mainly in the form of firewood, already provides 14 percent of the world's energy, equal to the 21 million barrels of oil produced by





Barbara Nessim's studio is the very image of the Manhattan artist's flat. The area is filled with all the tools of the trade: brushes, sponges, jars of paint and ink, scattered workbooks. But what sets her studio apart are the computers, which, with a corner all their own, form the true center of her work space. "I still work with other materials, of course," says Nessim, "but I've actually been working actual for more than two decades, but I spend most of my time with the computers."

Programmers have been toying with computer graphics for decades, but it is only relatively recently that nonspecialists have been attracted to computer art. Nessim herself was one of the pioneers, getting involved in the early Eighties, when computer graphics were just gaining limited academic acceptance in some circles. Many people in the art world, as in society at large, remain skeptical of computers, but Nessim hopes to introduce them to the possibilities with her "Random Access Memories" exhibition, which opened at New York's Flatiron First Art and Gallery on April 11.

"Random Access Memories" consists of four displays: a series of three-dimensional "stereo pair" framed images, four poster-size single-image pastels, seven of Nessim's 6" x 8" composite flags (each composed of 12 individual computer drawings), and a Macintosh-based interactive experience that yields each visitor a personalized miniature sketchbook. Although at first glance Nessim's work does not suggest the

aid of computers, these displays would have been nearly impossible without them. The 3-D display, for instance, relies on two similar but slightly offset side photographs—one for the left eye, one for the right—placed in a viewing device. The distinct images are combined in the viewer's brain to create the illusion of depth.

The minute differences between the two sides would have been extremely difficult to manage by hand, but with the computer's help, Nessim could make the changes easily. Likewise, the interactive exhibit, which Nessim calls "the jewel of the show," couldn't exist apart from the computer. Nessim filled a database with more than 200 drawings, and the gallery visitor uses the computer to select sketches to include in a miniature booklet, which the machine prints on the spot. "Everyone who comes will get a little gift," Nessim explains, "which not only serves as a souvenir from the show but is also a unique work of art. And they choose it themselves; they participate in it." Just as some writers are searching for ways to involve the reader, more directly in the reading experi-

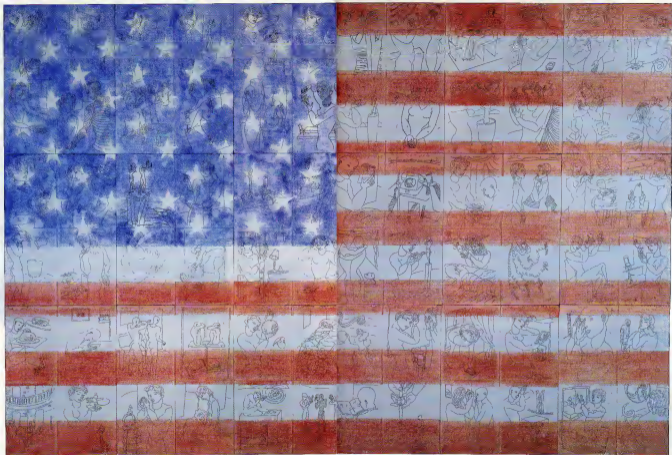


PICTORIAL

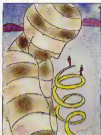
## ART FOR A BRAVE NEW WORLD

TEXT BY  
ROBERT K.J. KILLHEFFER





FROM A DISTANCE, THE COLORS DOMINATE, AND YOU SEE A FLAG. BUT AS YOU NEAR, THE DRAWINGS APPEAR, REVEALING THE PEOPLE WHO MAKE UP THE NATION.



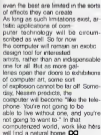
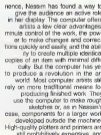
LOOKING CAREFULLY, YOU CAN SEE THE MINUTE DIFFERENCES IN EACH PAIR OF

DRAWINGS. WHEN YOUR LEFT EYE SEES ONLY THE LEFT IMAGE, YOUR BRAIN MUST



COMBINE THE TWO TO RECONCILE THE INPUTS, CREATING THE ILLUSION OF DEPTH.

THE COMPUTER MAKES THESE SLIGHT ALTERATIONS SIMPLE FOR THE ARTIST.



rence, Nassim has found a way to give the audience an active role in her display. The computer offers artists a few clear advantages: minute control of the work, the power to make changes and corrections quickly and easily, and the ability to create multiple identical copies of an item with minimal difficulty. But the computer has yet to produce a revolution in the art world. Most computer artists still rely on more traditional means for producing finished work. They use the computer to make rough sketches or, as in Nassim's case, components for a larger work developed outside the machine. High-quality plotters and printers are still prohibitively expensive, and

even the best are limited in the sorts of effects they can create. As long as such limitations exist, artistic applications of computer technology will be circumscribed as well. So for now the computer will remain an exotic design tool for interested artists, rather than an indispensable one for all. But as more galleries open their doors to exhibitions of computer art, some sort of explosion cannot be far off. Someday, Nassim predicts, the computer will become "like the telephone. You're not going to be able to live without one, and you're not going to want to" in that computerized world, work like hers will find a natural home. **CG**



The doors of perception:  
Exploring the structures of the sensory  
brain, the dean of American  
neuroscience is beginning to see  
the very mechanics of  
mind and how we construct reality

## INTERVIEW

# VERNON MOUNTCASTLE

**T**he monkey in the chair screeches and bares his teeth at intruders. He doesn't like interruptions at work. Deconstructing work. Brain work. From the next room, you watch the trail of his decision making on a computer screen. Microelectrodes in his cerebral cortex signal the precise neurons receiving information about the vibrations he feels in his fingertips. You see the neurons "evaluating" that information, comparing one frequency to a slightly different one milliseconds later. In the course of a working day, the monkey mixes hundreds of discrim-

inations between frequencies. He's seldom wrong. "We've based in the neural discriminandum," says Johns Hopkins neurophysiologist Vernon Mountcastle. "We've discovered where the animal tells the difference between these things."

The scientific life of Vernon Mountcastle can be seen as a 45-year sequence of finders. As he punkeys deeper into the nervous system, each discovery about how the brain constructs reality leads to another cliffhanger. It's 1991, and Mountcastle has located the spot in the primary cortex where the primate discriminates. But will

PHOTOGRAPHS BY MICHAEL SOMOROFF



**NAME:**  
Vernon Mountcastle

**AGE:**  
Seventy-two

**MILITARY AFFILIATIONS:**  
A surgeon in the Navy's amphibious forces in World War II. Grandfather (and his four brothers) rode with Jeb Stuart's Confederate cavalry.

**SPORTS:**  
Horseback riding, tennis, rose gardening

**MOST NOTED ACHIEVEMENT:**  
Discovering the columnar structure of the cerebral cortex

**BEST HIGH:**  
Scientific discovery. To suddenly see something new. "There is no greater joy. It must have been what Baboia felt when he saw the Pacific."

**HANDIEST TRAIT:**  
Ability to turn in five seconds from one endeavor to another and operate at maximum capacity. "Physicians get that drilled into them by experience."

**RECENTLY READ:**  
*The Cultural History of the Classical World*, by Boardman, Griffin, and Murray; *The Hollow Man*, by Siles; *Island Channels of Exquisite Mermaids*, by Hill

to discover how the animal tells the difference between 20 and 31 hertz buzzing on his fingertips? Catch the next paper.

Coming from Virginia, and like many old-line Virginians, Mountcastle can trace his lineage—to Scotland, and to Pocahontas. "I once started to put Native American on an application," he says, allowing as how he'd calculated 500,000 Southerners are descended from Pocahontas. "But in Virginia it confers *kaazi* rights. Pocahontas's son married in to one of the families and had about fifteen children. It spread that way." Mountcastle's grandfather raised horses. "My father's job was to break the three-year-olds," he says. "He was a superb rider and at ninety his belly was hard as a rock." His father built railroads, and as a boy Vernon rode the regular gauge rails and operated the steam shovel. The depression destroyed railroad building, but the father bought a broken-down concrete plant "and drove it to great success." Mountcastle worked there as a teenager and through Roanoke College. He went to medical school at Johns Hopkins, graduating in 1942. "I intended to be a neurosurgeon," he recalls. "I didn't become a scientist until I was thirty." He did research for a year in the Johns Hopkins University School of Medicine and eventually never left, serving for 16 years as the director of the Bard Laboratories of Neurophysiology and now University Professor of neuroscience. Addressing colleagues in 1973, Mountcastle spoke about brain and reality. "Each of us lives within successively cascaded enclosing worlds. One [world]

lies deep within, hidden still from objective probes. From it, Cyclopsian-like, we view all others, like that distant one in which, via teleoperation, you see me now and hear my voice." Brain research increasingly emphasizes molecular biology and chemistry. Yet many maintain that the man embodies the essence of neuroscience. As his friend Maxwell Cowan said recently: "When the last gene is synthesized, we'll still want to know what the brain does. Then we'll come once more to Vernon Mountcastle."

**Omer:** You are a pioneer in research on the waking brain.  
**Mountcastle:** I'm just a worker in the ranks. Until the late Sixties we all worked in "preparations"—anesthetized animals or animals in which the brain had been reduced, say, by removal of a part or intersection of the spinal cord. We studied brain pathways and what we thought were physiological aspects of sensation and perception in a preparation that wasn't sensing or perceiving. The advent of waking brain methods broke open a whole new world of central nervous system physiology in which we approach these problems. One nice thing in these experiments is the animal is in control. If he won't work at the task you've trained him to do, the experiment ends.

Mountcastle sought to discover how "an event in reality" is registered—first, as a relatively close match to what the skin might "feel" (a representation he named the *isomorph*). As the somorphic signal enters the sensory cortex, it is transformed into a more abstracted

code. Distributed by neuronal systems throughout the brain, these codes are ultimately reconstructed as a perception—with its memories, emotions, and intentions to act. These constructions he abstracted "central representations of external reality," he says. "Are essential components of the mechanism of mind."

**Omer:** Until recently you were investigating complex visual perceptions. Why did you return to the system of touch, an area you set aside for almost twenty years?  
**Mountcastle:** Because of its relative simplicity. The somatic system is a window—because the skin is so close to the cortex. One or two synapses and bang you're in! In the visual and auditory systems the processing is much more complex before you get to the cortex. I want to study a couple of things absolutely fundamental to understanding the brain. The truth is, nobody can answer the big questions of how we think, perceive, or put things in memory. A secret of a successful scientist is choosing a problem with at least a fractional probability of being solved.

**Omer:** At your career's beginning you studied one neuron at a time. What did you think you'd find with single-unit analysis?

**Mountcastle:** It was really an atrocious idea. Sticking an electrode in the brain to study the cell kills half the cells on the way down. Still, most of what we now know about the basic mechanisms of sensation and perception has been learned by single-neuron analysis. Previously, my teacher Philip Bard and colleagues devel-

continued on page 30

# CHOOSE YOUR FUTURE



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FICTION

## A KISS, A WINK, A GRASSY KNOLL

BY JACK WOMACK

The assassination of John F. Kennedy touched a generation—and spawned a wealth of conspiracy theories

VIDEO PHOTOGRAPHS  
BY TED CORNETT



Edgar met Natalie when they worked together repositioning the Zapruder film for use in a music video. He enhanced the images and she added them into an unending loop. They were haunted within their own conspiracy before the job was done.

Not long after, he invited me to his Twelfth Street apartment for dinner, to meet Natalie as well. With traps set from I agreed. Since high school I'd watched him perform his rituals with the blind regularity of a

tribe which offered up its virgins without remembering why. A woman showed interest in him, he'd thrust his head into the mix of love, yet, if his feelings were reciprocated, the couple soon found themselves unable to develop their tryst into more than a brief corresponding of mutual obsessions, for as the woman's lessened, his grew, and after so long she would pass again ghostlike into the night.

"It's different this time," he avowed. "As over I chose to believe, the romantic in my soul leading me astray."

After dinner we led in his living room, talking. Each minute spent in Edgar's cigarette cloud surely stole a more distant minute from my life, but he was always memorable company. Our conversation flowed as freely as the wine.



## I WAS IN SECOND GRADE WHEN THE PRINCIPAL ANNOUNCED THAT SCHOOL WAS CLOSING EARLY, THE PRESIDENT HAD BEEN AMBUSHED.

Natalie poured for herself; she was attractive, intelligent, and cheerfully argumentative. Edgar clasped her hands in his and constantly stroked her wrists, as if forever needing to be taking her pulse. "Look at what we've done," he said, getting up and inserting his tape into one of his machines (that I might judge the fruit of their work). His television was well-sized; in its beam I could guess at every shadow. "The group hasn't had any luck getting a play," he said. "Not even in clubs."

"For reasons of taste, perhaps?" I asked.

Natalie nodded and drew in his smoke as he exhaled. "Exactly. At the band's re-

quest the director blue-screened space babes on top of our loop. You can see everything in those garb belts they're wearing."

"And the images bleed at the edges," he added. "The lines overlap. Ours is the purer, if less artistic, version."

Natalie kissed him. When she did they seemed to forget that their surrounding world contained anyone, or anything, other than themselves. Coeval in age, at that point they ceased in mind as well. Natalie was genuinely different; something about her forewarned me that she was as careless as Edgar in allowing her lines to bleed into another's. Perhaps that was what each had sought, after all, someone with whom they could sacrifice their soul, that for others, if not themselves, a splendid harvest

unward. The President clutched his neck, and then the governor was hit, his cheeks inflated with air forced from the lungs, as if he'd been punched in the stomach by someone unseen.

"The second shot," said Edgar. "You saw the film jump, before the car came out from behind the sign?"

"That wasn't deliberate?"

"Not on our part," said Natalie, her bracelets clinking together as she brushed Edgar's hair from his face. Kennedy slumped toward his wife. "The third bullet took his a curb," Edgar said. "The fourth strikes at frame 313." Mrs. Kennedy climbed onto the trunk as the Lincoln raced out of the red mist, as if trying to bring the car to a stop and push it back to where it had been seconds before. The camera panned

right, and all disappeared into a fog of trees rising from the grassy knoll. The film reloaded; the Lincoln swung slowly onto Elm Street. The crowd cheered as it always had, the President waved as he always would; the over-lightened night believed that God, touched by the First Lady's efforts, reconsidered and pressed forward, that the scene should replay as intended, that no one be hurt.

"When the film jumps, that proves it."

"Proves what?" I asked.

"That the film was edited," he said. "At the time, certainly, Pres, six frames gone, by my estimate. There've always been suspicions."

"But the notion of missing

footage: that's a new one," Natalie said. "The key to the complexities."

I was in second grade when the principal announced that school was closing early that the President had been ambushed. I imagined rustlers, guns drawn, leaping up from behind asphalt. Edgar never before demonstrated any greater awareness of complexity than my own, but then, this was one of his traditions: that the fascinations of his other became his own within seconds of his hearing of them. Romance enabled Edgar to allow others to plot his life in advance as carefully as the route of a motorcade through an unsecured city. "You started reading up on this for the project?" I asked. The film sumped; Kennedy lifted his arms. Edgar raised his own and pointed to a stack of books atop a black console.

"Natalie lent me part of her collection."

"What would be on this missing footage?" I asked.

"The first shot," he said, "if the film originally showed that initial impact, the official timing would be demonstrated false. The single-bullet theory would be demolished, and with it, the single-assassin theory." Edgar smiled. "Takes two to tango." She kissed him, again.

"But it happened so long ago." I said. "What's to be gained from seeing

missing footage, were it to exist, and if it were still in the film?"

"Understanding," they said as one, beamed their ruzzled. "Has America—or been the same, since? And can any one say exactly why that should be so? The choir comes home from school and finds Father lying in a pool of blood in the living room. Will the child's life afterward ever be the same? If you don't understand what actually happened in the past, how can you ever relate to the present? Perhaps, I hoped, this bespoke an awareness of how that specific injury might be applied to his emotional state as well as his political. "But knowing there were two assassins won't mean we'll ever know who they were," Natalie said.

"It could still make a difference." Edgar said. "Misperception, that's where all the trouble starts. Thinking you understand when you really don't. But if you do truly understand the past, you can start making sense of the present, and then, finally, you can move on to the future—"

"The future's something else," she said. "Let it happen and worry about it as it comes."

"The point is," he said, ignoring hers, "the waves from this particular storm break even today on the unlikeliest shores. What were you saying the other evening, Natalie? When we met

the musicians at the studio?"

"The assassin's why drums became so important in popular music after 1963," she said. "I meant to tell that to Lawrence—"

"Excuse me?" I asked.

"Why the big beat's essential? Do you remember hearing anything else that weekend? When you think of Kennedy now, what do you hear?"

"A psychic necessity you could say," said Edgar.

"You could," said Natalie, rolling her eyes. "A heartbeat you had to hear ever after, to know you were still alive. That's what I'd call it."

"Some opinions concerning history are best left alone. I let it go," Natalie said she had to leave, not long after. That she wasn't even spending the night shocked me more than that she wasn't yet living there. Edgar moved his ex-wife into the apartment halfway through their first date.

"What do you think?" he asked, growled gone. I told him "It's so wonderful," he said, agreeing. I know he would. "We have so much in common."

"Just keep your head on straight about this and all work," I said. "You know how you tend to behave, though—"

"It's not like that with Natalie. It's not—"

"Why'd she leave?" I asked. "Does she do editing at the weaving?"

"Her husband's expecting her." He looked away from me, that he wouldn't see the expression he knew he'd find on my face. "That is, Lawrence—"

"Her husband?" I repeated. "Does he know about this?"

"Not yet," Edgar said. "No one knows she's seeing me. It would hurt her too much if anyone knew, so don't let on." I took my coat from the closet. "We work around it. It's no more uncertain than any relationship. More complicated."

"Be careful," I said.

"She's worth it," he said. "It's different this time. It is. It really is." Concluding his history, he smiled and shook my hand goodnight, for the moment seeming to believe what he'd told me.

They kissed; they were happy; how easy a state is that to even attain, much less possess? But circumstances demanded that their shared world remain circumscribed; it must have been impressed upon them each day how their life together could be appreciated to no greater degree than night frames snipped from a film, or undeniable facts lacking a theory, however ultimately provable. They slipped sounds of love over the lines of pay phones, passed cryptic messages to one another that no one else could decode—met by serendipitous arrangement, if not at Edgar's, in bistros in the afternoon, where no eyes saw their word-



last kisses, no ears heard their silent secrets. No recriminations, no confessions, no footprints left visible in the grass. Those rules their pilot required.

After that first evening it seemed to me that I only saw them from afar, however near they may have been, glimpsed them but peripherally, as through an upper-floor window washed too infrequently to be anything other than opaque. When the three of us were able to meet, our conversations took on a disconcerting predictability. Natalie always had to go home by ten, before eighty-third Street monologues concerned the trials of forever working around Lawrence, and after, the words dealt solely with assassination arcana, geometric equations regarding wound rates, or the norms de guerre of tramps arrested near the triple underpass after the shooting, or the misperception of a fence shadow as the silhouette of six Cuban gunmen.

Sometimes I wondered if they would ever again recall that existence proceeded nevertheless after 1963. After another month I desisted their monologue, becoming solely Edgar's, when Natalie interrupted, it was only to remind him of those areas of their concept with which Lawrence disagreed: her husband had his own theories.

One night I ran into the three of them

at a party in Soho; that evening it was evident who accompanied whom. Afterward I went with them to a coffee shop, as one hurried to see the results of a friend's automobile accident. Lawrence was a teacher, and twenty years older than Natalie.

"My course is called 'Kennedy Postmodern,'" he told me.

"A postmodern approach?" I asked.

"Neopost," he said. As dog owners, over time, take on the less ignorable characteristics of their pets, so he had looked inferred an abstract genetic relationship to his subject, as if he might have been a previously overlooked Kennedy brother, perhaps struck into this world from one parallel, where the men of that family refrained from entering police and became instead shoe salesman, bouncers in Irish bars, or teachers at the New School.

"I've been tackling the question of direction—" Edgar began, bringing up the usual topic of conversation.

"We agree that a cross fire was involved," said Lawrence.

"Evident," said Edgar. Neither he nor Lawrence, I noticed, looked directly at one another as they spoke. "And the missing footage could demonstrate that, at the expense of some of your ideas—"

"Missing footage is a red herring, not unlike Oswald," I said. Lawrence. "The

construct works without the introduction of superfluous facts that so-called missing footage might show."

"When construct do you mean?" I asked. Lawrence stared at me, as if forgetting exactly who I was, and how I had come to be sitting so near Natalie sat between him and Edgar, looking from one to the other as she listened.

"What is the context?"

"What are you talking about?" I asked.

"Edgar's fallen prey to the usual misconceptions, I think, that after the assassination some enormous cabal sprang forth full-blown to fudge the evidence as it was discovered. When would there have been time to add the film? Who would have delayed the changes? My orbital points—that is, my essential theses—work better, I believe, so we'll go with those."

I could tell he knew about Edgar and Natalie, even if he didn't know, call it perception, call it inspiration, call it what you like. When Lawrence looked at his wife it was clear to me how much he hated to love her.

"What are your essential theses, by the way?" I asked, cognizant of how dirty he had thus far avoided mentioning them.

"There were at least two assassins in each location," he said. "Two on the knoll, two in the Dal-Tax building, two at the Texas School Book Depository. Possibly three in the Depository, though on different floors."

"How could that many people keep a secret?" Edgar asked. "Besides, they'd have been shooting each other—"

"Deliberately, perhaps," said Lawrence. Glancing up from the table, I was taken aback to see Natalie wink at me and smile. I looked away.

"Your theories could not concurrently!" I heard her say, she was as attuned to her husband's conceals as she was to Edgar's. "There's no reason for them to be mutually exclusive."

"Nor reason for them not to be," said Lawrence.

"Can't you see how impossible this is?" Edgar asked, taking a pen and sketching lines upon the paper tablecloth. "Leaving acoustics aside for the moment, how many others would have been caught in such a cross fire?"

"By my estimation," Lawrence said, "twenty-seven shots were fired. Most miss."

"You're not hearing me," Edgar said; he scrawled a sharp-edged triangle atop his map of Dealey Plaza's streets. Waters passed by, glared, and didn't offer rights. "That's the essential form, right there. Anything else would be impossible. The angles would never align, following your plan."

"The lines of fire are superimposed," Lawrence said. "One over the next, over the next, and all aiming in similar



directions. Undoubtedly some shots were fired into the air to confuse Sparrows fell from the sky into the plaza, minutes after the abducting."

I suspected at first that he was only stringing Edgar along, taking some indefensible pleasure in academic sadism, then I realized that he believed in what he said, and that made it all the more troubling. The plaza's three streets, I saw, curved into a loop just before they thrust themselves through the underpass's opening. Natalie smiled at me again. "No," said Edgar. "Nothing more than an acute triangle with three simple vertices. You're making this so much more complicated than it has to be."

"Lawrence's points are as valid as yours, Edgar. Natalie said. "Don't push it."

"Certain evidence, too, is believed to exist," Lawrence continued, his smile showing how aware he was that his manipulations were so subtle that there was no need any longer to acknowledge the existence of another's argument, suggesting that Kennedy wasn't killed, that he was impersonated in the presidential imbricose by Officer Tippot." Edgar sighed, looked at the angles into which he'd allowed himself to be drawn.

"He may still live in peaceful seclusion," said Lawrence, "on a farm in

Montana, or on a Pacific island. Who can say?"

What Natalie winked at me when she smiled. I understood the compulsive attention that in private her presence demanded from them, however distant appeared her public relationships. As Lawrence unfolded the blueprints of his illusory structure, so as well I felt the inner peace that an impossible sunny might lend to souls that toss and turn in the night. Closing my eyes I almost believed I saw a hidden sea, way west of Sumatra. There, in a palm-shaded grove, the Kennedy brothers creep in to Marilyn Monroe's grass hut to cover her skin in coconut milk, John Lennon strums a ukulele as Jim Morrison serves fresh tropical fruit to Hitler afterward emptying the Führer's bedpan. James Dean, horribly disfigured, lies on the beach, listens to the surf, dreams of the open road as evening falls, all gather for their torchlit ritual, dropping to their knees in prayer, searching astartiscamed black velvet skies for Elvis, who in his glory will one day descend from heaven in a shiny silver mother ship, accompanied by a retinue of Venetians, Jovians, and the Lindbergh baby.

I stared at the triangle, to my eyes it appeared not acute, but obtuse.

"It's like arguing with someone who's sure the earth is flat," Edgar said to me,

several weeks later. "I'll never win."

He'd called after midnight, asking—begging, truly—if we could talk. Natalie and Lawrence were away for the weekend attending a conference in Philadelphia. "If you were working on something, you wouldn't be so preoccupied with this," I said, "and I'm not talking about these theories. Don't you have any new assignments coming up?"

"I've been putting them on hold," he said. "They might not have even gone to the conference. There may not even be a conference, for all I know—"

"Why would she tell you there was if there wasn't? You trust her, don't you?"

"I don't trust him. I do trust my perceptions. Something's scaring him and he's taking it out on her. You've seen them together. He pulls the strings and she goes along. He's been able to make her do anything he wants—"

"I wouldn't think he'd be making her go out with you," I said, "and if he's scared I'd imagine it's because he knows you and he wife are up to something, even if he's not sure what. And he may be crazy but he's not stupid."

"He's keeping her from me. We get along so perfectly. It's not fair—"

"Edgar, they're married, that's reality."

"Reality's what you make it," he said. "They have nothing in common. Why can't she see? It was so late, and I was so tired, and unable or unwilling to think of anything else I might say to him which he might heed, whatever I said in his mood of his would harm as much as help. I suspected. Why won't he let her see? What's he got to hide? Do you really think he's so crazy as he seems? He can't be, she wouldn't put up with it. It must be some sort of act."

"Some sort of game, perhaps." It's a bad situation, I wanted to say, get out of it. "Be careful, Edgar."

"I don't see how she stands him."

"Talk to her about it." I said. "When's she get back, Monday?"

"I think so," he said. "She wouldn't tell me."

Having so much undesired expertise now concerning these matters, I am aware of the essence of a photograph of President Johnson, taken aboard Air Force One, moments after the swearing in on the afternoon of November 22, 1963. Old Lyndon looks away from the camera and turns to face a fellow Texan politician. The image forever preserved captures the man giving his new President a wink and a smile. Much could be made of that, were one of suspicious mind, yet, if in any given instant less, as well as more, beats un- seen beneath the unperceivable shell, then a wink may be no more than a reflex, a theory nothing but a dream, a hope only delusion: that in every instance the most evident is least certain. It unnerved me, recalling how I was so



wasted by her wink, her smile, and they loved her.

Two weeks after Edgar called me following a prolonged silence, during which time I began to wonder if they had somehow managed to slip back through the years, to take what they imagined as their solar place in a by-gone era, or perhaps attempt to change what had gone before and so at last bring a possibility into the present that they could in no other way have. "People were trying to find you, Edgar," I said. "You missed out on at least one job that I know of. Where've you been?"

"We went out of town for the week and he said in the background I heard Natalie cough. "Seized the moment Lawrence had to go out of town for another conference. Natalie decided not to go. We had three days to ourselves. It was so wonderful."

"Where did you go?"

"Dallas." When he told me, I couldn't imagine why I should have been surprised. "It was like a honeymoon. We went to the Depository on Saturday afternoon and took the tour. It is a museum now, they even have the boxes in the right place on the sixth floor. You didn't get my postcard?"

"No— Natalie seemed to be saying something, but I couldn't hear her well enough to understand."

"It might have been intercepted," he said. "You understand?" Deciding that I did long before I could reply he continued. "We had dinner at a wonderful restaurant."

"Friends've told me of good restaurants in Dallas—" I started to say.

"And then we went back to the plaza," he said. "There was a full moon and you can see the stars down there at night. It was so warm even at this time of year. The homeless are able to sleep on the grass. No one else was around. We were walking along the pergola, it's like a little concrete porch. It's where Zapruder was standing. At that moment I realized how apparent it was that it'd never work."

"You did—?"

"The plaza's too small," he said. "There couldn't have been so many people shooting, everyone would have been killed. Talk about red herrings, you'd think he was using it as a cover story. She could see how close his theory was than I know she could. I kept saying 'You see,' and she kept nodding. She saw. Then we both saw."

"He'd lowered his own voice enough that I could more distinctly hear Natalie's. I couldn't tell as to whom she might be speaking. There wasn't any way around it—" she was saying, I supposed she referred to whatever it was that they'd seen.

"I don't follow Edgar."



If you wonder who you see also please post to Bob Sperry's page on the left of our site.

FOLKS OFTEN ASK US if there really was a Jack Daniel. Well, there he is up on the left.

Keeping his old photo around (as well as the one of his nephew, Lem Motlow) helps us keep true to their whiskey making methods. You see, we still smooth out our whiskey in exactly the same way our founder prescribed—mellowing each drop through hard maple charcoal burned right here on distillery grounds. We think Jack and Lem would still approve the results. And after a sip, we think you'll approve them too.

SMOOTH SIPPIN'  
TENNESSEE WHISKEY

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# ANTIMATTER

## UFO UPDATE:

Was a Japanese secret weapon responsible for the most publicized UFO report of all time?

UFO researcher John Keel believes that the most famous UFO incident of all time is just a lot of hot air. According to Keel, the infamous wreckage reported near Roswell, New Mexico, in 1947 was not a flying saucer, as UFO buffs claim. Nor was it a weather balloon, as the U.S. Air Force says. Rather, says Keel, the debris found in the New Mexico desert came from a Fu-Go balloon, a type of Japanese bomber used during World War II.

Though it's not well-known, the Japanese did launch an aerial attack on the continental United States during World War II. For a period of months, beginning on November 3, 1944, the Japanese sent aloft 9,300 unmanned balloons, each armed with a payload of 50 pounds or so, from several sites in Japan. Hundreds of these balloons were carried by the upper atmospheric air currents of the jet stream over the 8,500-mile wide Pacific Ocean and into North America.

The Fu-Go balloon bombs caused 285 incidents on the side of the Pacific between November 4, 1944, and August 8, 1945, according to a report prepared by the Smithsonian Institution in 1973. The balloons peppered 18 states, from Hawaii and California in the West to Michigan in the East. Remarkably, however, they caused very little damage. Only one incident resulted in casualties: five children and a woman picking near Lakeview, Oregon, were killed when a balloon bomb they were dragging out of the woods exploded.

As for the Japanese, they listened eagerly for news of widespread destruction in the United States. But the U.S. Office of Censorship had asked the media to withhold all reports of balloon incidents. Because newspaper editors and radio broadcasters largely complied, the Japanese assumed their Fu-Gos had failed.



"But one of the places a Fu-Go landed was in Roswell, New Mexico," Keel declares. "The witnesses to it—and there were only a couple—described in detail what Fu-Go debris looked like: a lot of paper, twisted little pieces of metal, and pieces of plastic. Like a lot of people who found these things, they thought it might be from outer space."

Keel believes that upper atmospheric air currents had kept this one balloon airborne longer than most. Then, when the rubber cement holding the balloon panels together fell apart, the whole thing came crashing down in the New Mexico desert. Debris from the balloon and its instrumentation would later be discovered by a rancher thinking he had come across the crushed remains of one of the flying discs, which, at the time, were just beginning to make the news.

Howard Dory, a meteorologist who established the Air Force's Balloon Branch at nearby Holloman Air Force Base in New Mexico beginning in 1948, calls the Japanese Fu-Go balloons "a very fine technical job with limited resources." But "no way could one of these balloons explain the Roswell episode," says Dory, "because they could not possibly have stayed aloft for two years."

Kevin Randle, who is coauthor with Donald Schmidt of the new book *UFO Crash at Roswell: The Military Cover-up* (Aeon, June 1991), also dismisses Keel's Fu-Go explanation. "His entire hypothesis hinges on the fact that the balloon bombs were secret in 1947," he says, "and that's simply not true."

New York attorney Peter Gessen is also investigating the Roswell incident and, like Keel, is convinced of a terrestrial explanation. "It seems to me that Keel's explanation has to be closer to the truth," he says, "than those who believe in alien spacecrafts." —PATRICK HUYGHE



## ANTIMATTER



### OPENING NEW WOUNDS

How can you tell if so-called psychic healing has any real effect? Alternative healing researcher Daniel Werth chose an innovative approach. Werth had a medical doctor deliberately inflict skin wounds of identical depth and diameter on the shoulders of 44 volunteer subjects. He then randomly selected half of them for exposure to what he calls a "noncontact therapeutic touch" treatment intended to heal their wounds. To guard against a possible placebo effect, none of the subjects were told they were being exposed to the intended treatment until

after the experiment was completed.

After the surgical wounds were inflicted, Werth's subjects each spent five minutes a day, for a period of 16 days, sitting in his laboratory with their arms and wounded shoulders placed through an opening in a wall. Although they were told that a monitoring instrument in the opposite room was recording the "energy" flowing from their wounds, no such instrument actually existed.

Indeed, members of the randomly selected treatment group were unknowingly exposed to a "healer" on the other side of the wall. The healers concentrated on mentally "healing" the

THEY WERE TOLD THAT A MONITORING INSTRUMENT WAS RECORDING THE ENERGY FLOWING FROM THEIR WOUNDS, BUT NO SUCH INSTRUMENT EXISTED. INSTEAD, THE TREATMENT GROUP WAS UNKNOWINGLY EXPOSED TO A HEALER, WHO FOCUSED ON HEALING THE WOUNDS.

subjects' wounds without touching them. The control group unknowingly exposed their wounds to an empty room.

The result? The treatment group's wounds healed significantly more quickly than did those of the control group. While 13 of the treated subjects were completely healed by the end of the experiment, none of the control subjects showed this result.

Commenting on Werth's experiment, psychologist and skeptic Ray Hyman of the University of Oregon says, "Unfortunately, Werth's experiment was flawed because of the possibility of contact between the healer and the experimental subjects. The subjects might not have known they were participating in a healing study, but they might have somehow felt some pleasant sensation such as radiant heat or responded to some other subliminal stimulation coming from the person in the other room that might have influenced the rate of healing."

As for Werth, he says he plans to repeat the study, modifying the design to "rule out the possibility of any such contact again."

—Keith Hasty

### HURRICANE JESUS

Hurricane Hugo slammed into the Carolinas in September 1989. Charleston, South Carolina, was devastated and high winds disrupted power and toppled trees in Charlotte, North Carolina. Residents of Gastonia, just south of Charlotte, felt lucky the powerful storm didn't destroy their small town.

But a few months later, word began circulating that luck had nothing to do with it. When the temble storm swept inland toward Gastonia, according to reports, a robed Jesus-like figure had appeared in the sky to protect the area.

A local woman, the story goes, had a roll of film developed at a one-hour photo lab and discovered she had photographed the figure of a robed man floating among the clouds with his arms outstretched. The image proved so popular that the Gastonia Wal-Mart photo lab processed more than 1,000 copies of the picture for customers.

"It's a figure on a piece of paper and you can take it to be whatever you want," says a Wal-Mart employee who asked not to be named. "But I think it's real. It's Jesus."



But Eastman Kodak senior technology specialist Kevin Moran of nearby Belmont doesn't agree. Using a computer to enhance and study the photo's image, he found that it contained no true information at all. "The photograph was clearly put together by someone working in a darkroom," Moran says. "The figure was applied to it."

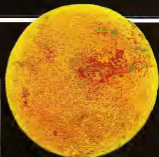
Moran says that he has seen the identical image repeatedly over the last two years. "The last time someone brought it to me, they said it was taken at Aunt So-and-so's funeral. The figure was floating on a more clearly tree background. In the huge picture the trees are blurred. But the figures are virtually the same and obviously came from the same negative."

Who is behind the doctored photo and who is the mysterious woman who claimed to have snapped Jesus in the sky as the hurricane approached? No one knows. Moran says, "I met several people who took the image very seriously. But I think whoever started all this was just having fun."

—Sherry Baker

## SPACE FLU

Where does astrology, its end and science begin? Some scientists are wondering if Fred Hoyle, the unorthodox British astrophysicist and noted science-fiction writer, noted where to draw the line. Hoyle, who previously theorized that life on Earth was seeded by spores from outer space, now suggests that increases



in solar activity may be related to widespread outbreaks of the influenza virus among Earthlings.

Hoyle and his colleague Chandra Wickramasinghe, both of the University of Wales School of Mathematics, recently presented this connection in a letter to the eminent British science journal *Nature*. Since 1751, they note, periods of maximum sunspot activity

and flu pandemics, both of which have irregular periods that average about eleven years, have more or less stayed in step.

Hoyle and Wickramasinghe explain their theory by suggesting that electrically charged molecules of flu virus float freely through space. These free-floating virus particles, they add, are then drawn down through Earth's atmosphere by intense solar winds. The solar winds themselves are created during peaks of solar activity.

Word of Hoyle's latest suggestion has spread rapidly among scientists.

"We know about it," says Walter Gunn, an epidemiologist at the Centers for Disease Control in Atlanta. "But flu is extremely complicated, and because we are not experts in sunspots, I would not want to evaluate his hypotheses." Andrea Dupree, an astrophysicist at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, has no such qualms. "It's pure speculation," she says. "As far as I am concerned, this is really not serious science at all."

—Patrick Nuyttge



## BIGFOOT WANTED DEAD OR ALIVE

If Bigfoot actually does exist, he may be in grave danger. The peril? A number of Bigfoot researchers, who now say that they must

supply their critics with positive proof of the animal's existence, are to be belittled.

"It is impressive that we called a wilderness," says Danny Perdue, an activist Bigfoot buff and member of the International Society of Cryptozoology, and chairman of the IBC, IBC member Mark Parnis agrees. Speaking to a group of the society's recent conference attendees, in fact, Parnis asked an fellow members to give out and cheer a slogan for the cause.

Perhaps the most outspoken advocate for the acquisition of physical proof is Washington State University anthropologist Grover Krantz. According to

Krantz, "If you scientists at places like the Smithsonian Institution want to oust the wilderness Bigfoot, then killing a creature is an absolute must."

Even some critics, says Krantz, have said, "Oh, well and shoot it, then, and then I will believe that you would animal or not."

Of course, not all supporters of Bigfoot think that proof of the animal's existence should be killed. Bigfoot activist Paul Newman, for instance, advocates the use of a camera instead of a gun.

These pressures don't bother anybody," Freeman says, "so why harm one of them?"

—Michael Deemert



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## ALTERNATIVES

CONTINUED FROM PAGE 12

OPEC every day, according to the Biomass Users Network, a consortium of 48 Third World nations. And with concern over harmful greenhouse gases associated with fossil fuels, researchers are now taking a closer look at the potential of biomass energy. By converting biomass to electricity in numerous small-scale power plants, Third World countries could radically reduce their consumption of oil and coal, says Princeton's Robert Williams.

Indeed, produced at a sustainable rate, biomass has a lot going for it. Carbon dioxide, released when biomass is processed, burned, or fermented, balances the carbon dioxide consumed during photosynthesis. The bottom line: Unlike fossil fuels, biomass does not contribute to global warming.

Williams believes biomass, especially in the form of wood chips and sugarcane waste, could power electric plants that use new technologies borrowed from jet engines, as well as the coal-fired power plants that biomass could ultimately phase out. The plants would rely on gasification, a process of converting the solid fuel into gas by burning it with low oxygen, similar to banking a fire in a wood stove by shutting down the air intake. A byproduct of gasification, carbon monoxide would burn in a super-efficient turbine generator like those in jets; waste heat would be recycled to power an additional steam-driven electric generator.

Such technologies could easily furnish electricity in the 80 developing nations that grow sugar. Over the next 40 years, the gasification of waste bagasse, the part of sugarcane with the juice extracted, could produce 70 percent more electric power than all the countries produced by burning coal and oil in 1987. Biomass power plants could also greatly low-quality wood harvested from forests or grown as an energy crop on hundreds of millions of acres of nonproductive grasslands, pastures, range, and deforested lands.

To succeed, producing energy from biomass will require responsible agricultural and industrial practices, warns Sam Baldwin, a physicist with the Office of Technology Assessment in Brazil, for example. 44 million cars are currently powered by ethanol, a biomass fuel made from fermented sugar, and the discharge of untreated ethanol by-products has fouled many of the rivers in the country's northwest.

Moreover, if countries fail to use only surplus, waste, or specially grown fuels, biomass power plants could end up consuming trees needed to control erosion, dung needed for fertilizer, straw necessary to replenish soils, and even



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such food ingredients as cornstarch and sugar. "I'd hate to see a choice being made between food for the poor and fuel for the rich," Baldwin says.

—Bon Barber

#### NUCLEAR WINNER?

The two words nuclear energy pack as much emotional punch as A-bomb, cancer or AIDS. Chernobyl and Three Mile Island have become emblems of great hopes dashed such as the Challenger disaster forced NASA to overhaul the U.S. space program. Unlike the space program, however, the nation's nuclear industry—which has contracted no new plants since 1970—appears indefinitely stalled.

But not doomed. Growing concern about global warming may offer theiling industry a chance for a comeback, says Carl Goldstein, vice president of the U.S. Council for Energy Awareness. According to a 1989 council report, nuclear-generated electricity reduced utility emissions of carbon dioxide by 20 percent. Nuclear plants produce almost no particulate emissions, carbon monoxide, volatile organic compounds, or methane. Nor do they generate noise or visible pollution or require large numbers of vehicles to haul fuel.

That is the good news. The downside of nuclear power—the safety of reactors and the disposal of radioactive waste—continues to challenge researchers. Nuclear's "second coming" will require solutions to both problems.

Most American nuclear power plants, including the one that neared meltdown at Three Mile Island, have light water reactors. For many of them, when problems crop up, plant personnel must activate systems designed to avert potential disasters. The U.S. Nuclear Regulatory Commission (NRC) is currently reviewing plans for an advanced light water reactor (ALWR) that takes human fallibility into account. It sports passive safety features dependent on natural physical processes—gravity, natural circulation, and convection. The ALWR is simpler to build and operate and has lower generating costs than current nuclear plants.

The United States is far from alone in the search for a safe reactor. One promising though untried reactor is the process inherent in ultimately safe reactor, a radically passive design from Sweden. The reactor would be completely submerged in a pool of water laced with heat absorbing boron and would cool by natural convection. The reactor would be virtually invulnerable to a catastrophe caused by operator error, terrorist attack, or conventional war.

Even as scientists come up with safer reactors they still must solve the problems of storing long-lived radioactive waste and decommissioning worn-out reactors. To date public outcry has hal-

ted the establishment of any long-term dump site for nuclear by-products.

Indeed, widespread fear of nuclear power may be the industry's foremost roadblock. In two recent polls, more than 75 percent of Americans reported that they believed nuclear power to be important. The same percentage of respondents, however, rejected or reserved judgment on a nuclear plant in their own neighborhoods.

Thomas Murley, director of the NRC's Office of Nuclear Reactor Regulation, believes time is on nuclear's side. "In the beginning, people were afraid of electricity or of riding in a vehicle that ran on gasoline," he says. "If we don't scare people every five or ten years with an accident, then they might begin to feel that nuclear power really is a viable alternative."

—Steven Scott Smith

#### LAST GAS

Picture this: The earth's deserts are sown with solar collectors, sprouting vast fields of photovoltaic cells that convert sunlight directly into electricity. An electric current is then passed through pools of water, splitting the H<sub>2</sub>O into its component gases (one part oxygen, two parts hydrogen). Hydrogen gas is captured, stored, and piped to urban areas. Buses burn it to heat homes. Power plants use it to fire the generators that produce electricity. Filling stations pump it into cars, trucks, and buses. Hydrogen, the most abundant element in the universe is harnessed in the service of humankind. And because it returns to the atmosphere and recombines with oxygen, all you get when you burn it is more water.

Although solar technologies are not the only way to electrolyze water and produce hydrogen gas, solar-based hydrogen systems offer one of the best long-range prospects for hydrogen. Joan Ogden of Princeton University's Center for Energy and Environmental Studies estimates that it would take only 24,000 square miles of solar collectors (about half of one percent of U.S. land area) for hydrogen to replace all of the oil used in the United States.

Hydrogen enjoys widespread use in industry today, most notably to manufacture ammonia and process petroleum products, and photovoltaic technology is familiar to anyone with a solar-powered pocket calculator. But an overhaul like the one Ogden envisions, requiring the erection of a whole new energy infrastructure, is decades away.

Steady advances in solar-cell technology may advance the hydrogen age in more peaceful fashion. By the mid-Nineties, Solarex, the largest U.S.-owned manufacturer of photovoltaic cells, will be inexpensively mass-producing photovoltaics made of ordinary window glass coated with a thin film of se-

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soon. By the end of this decade, Solarix vice president David Carlson believes solar-hydrogen systems will begin to appear on a small, independent scale in communities isolated from traditional energy sources. A village in Africa, for example, could set up a small photovoltaic array, hook it up to a modest-size electrolyzer, electrolyze the hydrogen on-site and then store or use it for heat and car fuel, or run it through fuel cells to generate electricity at night.

Hydrogen-powered cars, of course, require an infrastructure before they become commonplace. (Hydrogen gas stations, for example, must be readily accessible.) In the meantime, engineers face a big challenge: how to store enough hydrogen in a car to give the vehicle a reasonable traveling range. BMW has developed a car that runs on liquid hydrogen and has a range of 190 to 200 miles. But the system still requires two to three times the volume of a normal gasoline tank. Liquid hydrogen must also be kept at -425°F, making self-service hydrogen gas pumps impossible, says Christoph Huss, BMW's product information manager in North America. And because some hydrogen may be released when the engine is not running, garages would have to sport sophisticated ventilation systems.

Beyond the technical obstacles to these solar-hydrogen applications,

there are the inevitable political ones. "Solar energy in the Sahara alone can supply the world's energy needs," Huss says. "But if you use the Sahara or the desert in the Arabian states, many people will still be afraid of depending on these countries for energy."

Considering the Persian Gulf conflict, Huss's point is well taken. But with local fuel supplies dwindling, political discussions of the future of clean, limitless hydrogen may well be academic.

—Mary McDonnell

#### HOT PROSPECTS

Deep within the earth, where tectonic plates collide, magma boils and splutters, creating a steamy brew that represents a gold mine of untapped power: geothermal energy.

Mexico, New Zealand, and Iceland already produce much of their energy from geothermal, and scientists say the Philippines, Indonesia, and other oil-poor developing nations of the Pacific Rim, rich in volcanic heat, could easily reap this earthly treasure. But geothermal energy also promises to help meet America's power needs.

Current systems, like those lighting up much of Southern California, tap into steam deposits 5,000 feet to 10,000 feet below the ground to turn turbines and generate electricity. Science, however, is fine-tuning the process. Acting

as high-tech diving rods, computers pinpoint geothermal hot spots, and a new crop of sturdy pipes and materials defy the corroding heat of the underground. Scientists at Southeastern Massachusetts University, moreover, are perfecting systems that test the resilience of well gear in the lab, a step up from costly well-and-see drilling.

Researchers are also finding ways to trick nature into providing an endless supply of steam by making use of hot dry rock. To test the technology, U.S. Department of Energy (DOE) scientists have targeted a site in the mountains near New Mexico's Los Alamos National Laboratory where volcanoes hummed hundreds of thousands of years ago.

To produce steam, scientists drill two wells 10,000 to 15,000 feet deep into rock and then force water down one well to create fractures in the billions of both wells. The goal: to pump water through the lacework of fractures so that it emerges from the second well as superheated steam.

Molten rock, however, represents an even hotter geothermal prospect. In a pilot project in Long Valley, California, DOE researchers will drill down 20,000 feet to just above the chamber of molten rock in a dormant volcano, where temperatures could reach 1200°C—potentially producing enough steam energy to power a city of 1 million.

But you don't have to have a volcano in your backyard to take advantage of the earth's changing temperature, says Paul Lenay, director of the Oregon Institute of Technology's Geothermal Center. Some 110,000 homes and businesses nationwide use low-temperature heat pumps that rely on a network of pipes buried from ten feet underground. The pipes are warmed in winter and cooled in summer. Water running through the pipes heats or cools the facilities. The cost, about \$8,000 per unit.

Within 20 years, says Ted Mock, the DOE's director of geothermal research, geothermal energy should provide the United States with about 5,000 megawatts of electricity (equal to five large nuclear plants) with minimal risk to the environment and public safety. Call it no contest against geothermal's chief competitor, natural gas. "If we are really serious about our future," says Dave Anderson of the National Geothermal Association, "geothermal is ready." —Dane Pointe

#### WINDS OF CHANGE

Hikers along California's Cameron Ridge have a choice of spectacular views. To the east the Mojave stretches under a cloud-cluttered sky. To the west, on every hilltop, rows of giant pinwheels spin like hummingbirds in overdrive. This is wind power in action.

Born out of 1980 tax incentives, wind farms got off to a stormy start. In



"Oh, here He left his body to science."

order to harvest time-limited credits thousands of faulty machines were rushed into action and millions of dollars were sunk into ill-conceived projects. By 1985 the government had withdrawn incentives and cut research grants by 90 percent. Observers confidently penned obituaries for the industry.

Today wind power, among the cleanest and most competitive of renewable energy sources, is making a brisk comeback. "Since 1981 costs have dropped from twenty-five cents per kilowatt-hour to less than ten cents, and reliability has increased from sixty to ninety-five percent," says Randall Swisher, executive director of the Washington-based American Wind Energy Association. In California, Pacific Gas and Electric, the state's largest utility, will purchase most of the 2.6 billion kilowatt-hours that state wind farms are expected to produce this year.

For the handful of wind entrepreneurs who prevailed, the Eighties proved to be a time of trial and error. For example, once planners learned that the on-site output of two machines just 100 feet apart could vary by as much as 20 percent, they began "staging" the placement of every windmill they installed, rather than grouping them. Moreover, farm operators now wash their equipment once or twice a month to clean away grime, which can reduce a turbine's efficiency by 30 percent.

The industry plans greater technological leaps in the future. In one promising cooperative effort, the Electric Power Research Institute, Pacific Gas and Electric, and wind turbine manufacturer U.S. Windpower are testing prototypes of a 300-kilowatt wind turbine that will spin at the speed of the wind rather than at the fixed speed of standard turbines, increasing wind capture by as much as 10 percent. Other groups aim to improve windmill efficiency through better blade design.

Other things to look for: advanced materials that yield lighter, stronger components, extra tall towers, and rotors that can bob up and down, in addition to moving east and west in pursuit of the wind. These improvements should reduce the costs of wind electricity to about five cents per kilowatt-hour by the mid-Nineties. According to DOE estimates, costs should drop even more in the next 20 years.

Even so, while the technical problems are solvable, wind power could use a little help from Uncle Sam, says Robert Jans, an energy consultant in Byron, California. Government funding for the development of wind turbine technology in Europe is currently estimated to exceed U.S. federal support ten times. "Unlike us," Jans says, "they have decided that the environmental and social costs of not doing this are much too high." —Beth Lwermore DC

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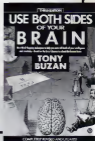
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oped the evoked potential method. This resembles the EEG and lets you record the surface of the brain. From '35 to '60 we learned a great deal about the mapping of the external world in the brain—the representations of the hand, fingers, toes, and mouth in the sensory cortex, representations of loci in the visual field in the visual cortex, and different frequencies in the auditory system.

Single-neuron analysis is a bad name; that's not what the name means. A single neuron has no value; you lose them every day. You analyze neurons one by one to understand the population. Important information is embedded in the population signal. My colleague down the hall Kenneth Johnson has been studying the way in which letters are represented in first-order [touch] fibers in the hand, and then in the postcentral gyrus [primary sensory area of the cortex]. If you looked at any single fiber, or neuron, you'd see no sign of a letter. But if in the postcentral gyrus you reconstruct the instantaneous activity of the neuron population, there's the letter K standing like a rock!

Critical information is embedded in temporal relations. So we've now adopted a multielectrode method that allows us to put seven electrodes in. The complexity of the experiment goes up as the power of the number of electrodes.

**Ozmi:** Is this analogous to recording one instrument in an ensemble versus all the instruments playing together as music?

**Mountcastle:** You can't derive the orchestral sound by listening to each instrument separately. Now, we're dealing with nothing so complicated as an orchestra. But we know say that if you train an animal to move his hand in one direction and look at the neuronal activity in his motor cortex, you may not find a single neuron that provides a very precise signal of which direction he should move. But if you compute the vector for the population of neurons, bam! That's it precisely.



**Ozmi:** How does that work?

**Mountcastle:** We have to assume the brain has mechanisms for looking at the population signal. Until recently, the dominant idea was that all those signals converge on a single point—the famous "grandmother cell." But there is no such thing as a grandmother cell. I like to call what's happening "interface transformations." Now that phrase covers a lot of ignorance. For example, our animal discriminates between two frequencies. If the frequency is higher than a base he compares it to, he moves his arm in one direction; if it's lower, he po-

jects it in the other. Well, look at the interface problem: Input from the two frequencies arrives here in the sensory side, and way off there [in a motor area] he has a decision made: Go A, go B. And there's a lifetime of work between the two. But that's where the interest is: the big in-between.

**Ozmi:** So these populations are not necessarily in a single area?

**Mountcastle:** No. They may be distributed hierarchically, but that's an oversimplification, because these areas are all interconnected. The big interfaces are probably composed of distributed systems with many nodes, all having access to each other. Many nodes lie outside the cortex and so are influenced by other systems like those controlling motivation, drive, emotional sat. A neuron doesn't get labeled as sensory, motor, or association by virtue of any intrinsic property but by virtue of its extrinsic connection. It's like society: It's


  
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**have a terrific brain to**  
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a matter of whom you know.

Gian Poggio, down the hall, is studying depth perception and has discovered sets of neurons in the visual cortex that selectively tune to different depths around objects you fixate on. There are many cues for stereopsis [judging depth by comparing images from both retinas], but in this cue some neurons tune one place when you focus here, and if you stare elsewhere, others tune in another place. So no single neuron tells you anything about three-D, but the population has within it the information for depth discrimination. They are tuned in space.

**Ozmi:** In a physics sense, is this analysis difficult?

**Mountcastle:** Real difficult. But you can analyze the frequency components of neuronal signals. And these signals are in the same neuron set, not different ones. So now we're ready to find out how he does it. We haven't the slightest idea. One proposition: He remembers that the second stimulus is coming up the same set of neurons. There must be a "hold operation." If I deliver

to you two stimuli in sequence and ask you whether one is red or blue, you've got to hold the first one to compare with the second. The monkey's got to hold the signal of the frequency of the first stimulus and compare it with that of the second, reach a decision, and push his arm one way or another. To discover how he does it covers the next 50 years of neurophysiology.

Cognitive psychologists distinguish between many hold operations: whether you hold something briefly in sensory memory, or whether you form a template in deep memory and pull it up. We've never yet seen any sign of a hold operation in the primary sensory cortex. Now we're going to move deeper into the parietal lobe in our search.

**Ozmi:** Do all interactions in "the mind," then, have this mathematical, computational basis?

**Mountcastle:** My dear lady, that's how we all live our lives! I don't believe there is any such thing as "the mind." What you call the mind is a very complex aspect of brain function. I frequently use the word *mind* as a verb, rather than "the mind" as a separate entity. You are *mind*ing all the time in a very complex way so that when you say the mechanism of discrimination is embedded in physical reality, I'd say, "For heaven's sake, what else is new? How could you imagine it being anything else?" And most neuroscientists would agree with that.

One of my dear friends thinks this is a put-down for man. I think exactly the opposite. If there is no other force, consider what humans have accomplished—to pull themselves up in a few hundred thousand years from an animal hunting on the African desert to modern culture! It is so fantastic people can hardly believe there isn't another force in the universe. I think the greatest compliment to humans is to say we've gotten here on our own. Now, where we've gotten may not be ideal. But look at what has been accomplished, and in terms of evolutionary time, it's occurred over a brief moment.

Mountcastle showed how the body's form is represented in maplike configurations in sensory areas of the thalamus, a vital "networking" center and great portal to the cortex. Then exploring the cortex's somatosensory area, the postcentral gyrus he saw the body's cartography there. The sensory areas, he demonstrated, are made up of maps within maps of the body and its parts. These successively refined, specialized maps register simultaneous and successive signals and so transform the essentially two-dimensional texture of the cortex into the four-dimensional sensitivity we call conscious perception.

**Ozmi:** In the Fibres you mapped the thalamus. Explain that work.

**Mountcastle:** Basically, [Harvard physiologist] Elwood Henneman and I used electroanatomy to work out the relation between the body form and its representation in the thalamus. That was a precursor to studies aimed at a more dynamic problem of understanding how the brain works. Before, there appeared to be just one big map. So the question came up: both for the thalamus and the somatosensory cortex. How are the different modalities represented? You have five fingers. There are maps for each in the thalamus and cortex. Within each finger you have two or three types of modalities—touch, temperature, and vibration. You have maps for these, too. It's mapping within maps that accounts for the multimodal, simultaneous representations. Touch, temperature, and vibration are being intermittently mapped over and over again throughout the topography of the postcentral gyrus. This principle holds for the visual, auditory cortices, and so on. Within the visual cortex alone, certain maps deal with color; certain don't. **Owens:** If one is playing the piano, say, all these modalities are in operation simultaneously. **Mountcastle:** At a mad rate, and with great complication. Mapping of variables within larger variables, within larger variables.

Modern neurophysiology may well have begun with his discovery in 1957 of the columnar structure of the neocortex. Using electrode stimulation, he showed that the cortex of the cat is organized not only in horizontal layers but also in vertical columns—chains of interconnected neurons extending the thickness of the cortex. Today columnar organization is presumed a universal phenomenon of the mammalian cortex, a cornerstone in our understanding of the links between brain architecture and behavior.

**Owens:** Was your discovery in 1957 of the columnar structure of the cortex an expected finding?

**Mountcastle:** I'd no real expectation, but it was still a complete surprise. The experience of the scientist and artist are much more alike than people realize. There is no greater joy—particularly when you're working up experiments, looking at data—than to suddenly see something new. For just a few moments nobody knows but you. Whether it's important, or your colleagues criticize it, that's for later. For the moment it's a wonderful experience, and I've never known anything that quite matched it. There's something in science beyond making a career, getting a grant, being a professor. All those are secondary impediments. They're not important com-

pared to the central theme. You have an opportunity to discover something and you can make a living playing wonderful games. If you find a scientist who doesn't have that joy, he is rarely top-flight. Look at the people who've accomplished great things in neuroscience. Every one of them has it.

**Owens:** How does proprioception work in terms of higher cortical control?

**Mountcastle:** That you perceive rather accurately the position of your limbs, their relation to each other, their movements through and around your immediate extrapersonal space, is obvious. The question is how. It probably depends on multiple systems. Clearly, nerve fibers in the joints project into the cortex. And one certainly can evoke motor sensory illusions and unwillful movements by activating the stretch receptors of muscles. The arm seems to be moving when it's not, or you see it moving when you don't think it is. I suspect cutaneous skin input is extremely important, especially for the hand, where the innervation of the joints is also rich. Still, your capacity for the detection of joint angles is not so good.

Just where all these sensations are put together in the cortex bears on a higher aspect of somatic sensibility called stereognosis. This relates to how you know and recognize a square of a

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certain size in your hand without looking at it. You discriminate shapes beautifully, with great accuracy you can tell a pure sphere from a slightly oblong sphere. This probably depends on the input both from the skin and deep afferents [nerves], which may include the joints, and stretch-activated muscles. Now where in the cortex are all these inputs brought together to yield an integrated percept of round versus non-round? Ben Hoken Sakata of Nippon University in Tokyo and I have surmised that the integration of your perception, the proprioception of bodily position depends on two posterior parietal loops, one largely somesthetic, the other visual. Studies are fashioned so that the animal can show you he's executing the task. Sakata sees a fancy robot that presents the animal with changing shapes. The question is, What is the critical signal to tell the difference between round and egg-shaped?

**Owen:** This perceptual activity is all processed precariously?  
**Mountcastle:** If the system is damaged, you may have to relearn it consciously and then push it down into the precariously. Just like after you learn to play tennis you no longer hit the ball by thinking precariously about the stroke. You emit the stroke as a whole. My friend Jacques Paillard, a great psychologist who became a consultant to the French basketball team, trained them to emit a shot in imagery before taking it. You practice the neurocircuits that will execute the task.

Mountcastle has contributed overwhelmingly to understanding how the brain processes information the senses gather—in particular the somatosensory system, qualities of touch and pressure, pain, warmth and cold, vibration, and inesthesia: the sense of position and movement of the body in space. He's studied the precise transmission from nerve fibers originating on the body's surface to their inputs in the higher brain. The pathway projecting from skin, muscles, and joints up through the spine, brain stem, and thalamus to the cortex he calls the "great autobahn" to conscious somatic sensation.

**Owen:** You stress the security of the "great autobahn," the primary sensory system. What is the basis for it?

**Mountcastle:** It's so secure that if you're recording from a single neuron in the ventrobasal complex of the thalamus and give a lethal dose of anesthetic at the end of the experiment, synaptic transfer persists beyond heartbeat. In other systems like the reticular formation, a neuron might receive a few inputs from one source, a few from another, so that neither source can dominate the cell. That great security in the primary sensory system has significant biological impact or adaptation: simple things like survival.

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Suppose you received stimuli in the visual system, but the transmission through the brain's processing centers was less secure. You might get it or might not. A monkey sitting in a tree with a weak relation between the retina and visual cortex won't live long when the eagle flies in. You have to get that information quickly and react instantaneously to escape. The fact that the external world is introduced and signaled strongly right into the primary sensory cortex allows information to be there ready for you to act on it.

**Orin:** From what you've found in the Braille studies, how is the signal transferred between the fibers innervating your fingertip up to the cortex?

**Mountcastle:** Kenneth Johnson studied one neuron and moved the Braille letter K across it and was able to construct it at first order level—that is, at the primary sensory cortex. He found a virtually isomorphic representation of K. He hasn't gone far beyond this, but in the next step in the cortex, the representation of K appears to get fuzzy. But the fuzziness is really the most interesting thing, Johnson thinks, and I agree: it's the first sign of code transformation. Moreover, if you ask the subject to discriminate between K and L, and look at the output in the motor cortex, you don't see any sign of K or L. Now, if you think about it, you see there isn't

enough brain available to continue to have isomorphic transformations all the way through. So there must be some code transformation leading to greater efficiency. These are nice words covering up ignorance.

**Orin:** How, then, do you experience K so sharply? Where is the illusion built? **Mountcastle:** There's no illusion. Somehow you have stored in memory a template of the letter K. And I lost the template, it's not isomorphic. I lost you match whatever the letter K is with some thing in the cortex. Imagine having to store in memory as you would in a filing cabinet, there's not enough brain to go around. There must be something else, but that's a deep mystery now.

**Orin:** Why do pain pathways project so widely within the brain? **Mountcastle:** Like all of our sensations—especially vision, smell, and taste—pain includes something more, but pain, for most people, always has this added aspect of affective (emotional) response. The fast pain system is of tremendous advantage as a survival mechanism. Having a specific pathway, probably right into the cortex, it allows you to localize, quickly identify the pinpoint and do something about it.

A second or so after you prick your finger, it really begins to hurt. The slow pain, with its powerfully affective component, projects into the central core smack into the limbic system. This is where the great variability among people comes in, whether it's due to difference in brain connections or life experience that's affected those connections. Some people withstand pain stoically or claim it isn't so bad, whereas others are absolutely distraught.

You might react with revulsion to an ugly scene, and others might not, or with pleasure to a beautiful scene. The affective component is attached to all our sensations; it's just brought to your attention in a more forcible way with pain. The evocation of disgust by unpleasant smells, or pleasure by nice ones, probably is at least as great on the affective scale as pain.

**Orin:** What are the relationships between lower and higher, or more complex, sensory processing operations?

**Mountcastle:** Most of us believe that when you get away from primary sensory and motor areas you are dealing with nodes and connections. Each of the higher areas is widely interconnected with other areas of the cortex and with subcortical structures—reciprocal connections. But there's no reason to think a subcortical structure, like the putamen (in the thalamus), which is so much larger in primates, is any "lower" in any hierarchical sense than another area.

When you make a lesion, the higher you go the less certain you are to completely eliminate a function. My col-

leagues in neurology once showed me a middle-aged man who just twenty-four hours earlier had had a vascular lesion of the left parietal lobe. He had the classical symptoms: "Which arm is this in bed with me?" Although he had no motor incapacity or defect in primary sensation, he had a major defect in the internal construct of his body form. Yet a year later it was almost impossible to demonstrate that. But if you removed the primary visual cortex, he'd be as blind one year as on day later. So there is this striking difference.

**Orin:** Are brains plastic?

**Mountcastle:** At the microlevel—a single cell and the axons that reach it—structure can be modified by experience. You might improve the function of your brain by changing its microstructure in terms of how you train yourself. I always go back to athletics. Look at the difference between McEnroe (even now) at tennis and me. He'd been trained since he was two years old to do that. Of course he's got pretty good equipment in terms of very short reaction time, superb vision. Have you ever looked at his eyes when he plays? Like he's staring the ball down. I'd guess the microstructure in his motor system is different from what it would have been if he'd not played tennis. Other great athletes or dancers—all the same way.



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**ARE PEOPLE  
TREATING YOU  
LIKE AN ALIEN?**

Omm: So if you were to section the brain of a great tennis player?

Mountcastle: When Lenin died the Russians thought there might be something very exceptional about his brain. They brought in Oscar and Cecile Vogt from Berlin, the greatest cytoarchitectonists of their time, to examine Lenin's brain. Oscar Vogt looked at it and said, "Oh, we've got to have some colleagues to help with this!" So the Soviets said "Fine, how many?" The Vogts got the colleagues in Moscow to build an institute. Finally the Soviets asked, "All right now, what have you learned about Lenin's brain?" And he said, "I think the cells in the part are a little bit bigger than elsewhere... The truth is, Lenin had a couple of strokes, his brain was small and in bad shape."

Omm: Why are flow fields, the way the visual parietal neurons signal the sense of the body in the surrounding space, so essential for life?

Mountcastle: I was once riding through the forest on a wonderful horse going like hell down a trail. Suddenly I was swept off by a limb that struck me on my riding helmet. I know that I ducked just enough to avoid decapitation—a wholly preconscious action—because when I went back and looked at the limb, it should have hit me in the neck. When you let the horse have his head through the forest, he never hits a tree. There is a preconscious processing of these objects coming through. When monkeys leap through the forest, they don't hit anything. People who train pilots are very interested in flow fields.

I worked on the visual flow system to show an example of a nonomorphic representation: a central construction. There's no sign of it in the discharge from any axons leaving the retina. You operate on these flow fields in an extraordinarily efficient preconscious way when you drive a car. You locate dead ahead and if something happens off to the side in that flow field, you turn the wheel before any conscious processing. Your response can be based on consciousness immediately by something unusual, such as another car coming across the road. Most of our thinking is central constructions. You'd have to have a terrific brain to have isomorphic replicas of all the way and store memory in isomorphic form.

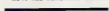
Driving an automobile involves a lucid inner adaptation—a balance in the activity of visual neurons in the parietal lobe that are involved in flow fields. Disturbance of that balance causes you to turn the wheel or make a sudden lane change. Running velocity fits very well with parietal visual neural sensing. I once calculated that the neuronal peak velocity is exactly that of an Olympic-class sprinter running a ten second hundred-meter.

Omm: Humans must have been sprinting for eons.

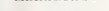
Mountcastle: Yes, to get away from the lions.

Omm: What happens during dreaming? Mountcastle: There hasn't been much recent work on the activity of cortical neurons in dreaming sleep. There's a profound inhibition of the peripheral musculature, with breakthroughs in epileptic-like discharges, eye movements, and dreaming. During dreaming, the cells in the sensory cortex are disconnected from their input. And you have no output. Early in sleep, you can drive the deeper, but not upper, layers of the cortex [which has six layers]. But you may function on layers two and three during dreaming, which are reciprocally connected with other cortical areas. Now, consider a situation in which operations between these cortical areas go on alone, functioning without output.

We've had tremendous success



Down the road, animals in perfectly natural environments will be telemetered. Imagine observing the phases of sleep with implanted electrodes in a cortex. ●



with chronic implantation of electrodes. Down the road in brain physiology, animals in perfectly natural environments will be telemetered all the time. Before or will be brought under control or not. Imagine observing the phases of sleep, with large numbers of implanted electrodes in a cortex. It'll come. It's an intriguing problem. I'd love to try it.

Omm: What else are you working on? Mountcastle: Laminar operations. A good bit has been learned about different projections out of the visual cortex, but not about the dynamic operations between the laminae, the layers of a single cortical column. Within this little area—a single column—there is a superimposed multichannel processing operation. And we haven't the slightest idea what goes on. In fact, nobody knows what the cortex does intrinsically. Things come in and things go out. You know where they come from and where they go to. It's possible that at least at the basic level, operations in one column would not be strikingly different in columns in different areas of the cortex. It would be exciting to

see how they differ, and disappointing to find they don't. I although I believe they do.

An aim of the present experiments is to study the activity of all the cells in a single column simultaneously while the animal uses his cortex to do something. The postcentral gyrus is ideally suited for this. You can approach this region without excessive damage and creep into it. Even if we can get only three or four electrodes in it, say three hundred microns apart into a region driven by the stimulus—the animal making frequency discriminations—we'll begin to find whether there are differences in activities of the various neurons.

Omm: The brain, you've said, is a Cy-clopean eye, and we are precisely within it. Is it our only window to reality...

Mountcastle: Yes, and that window is very narrow compared to the total number of cells in your brain. We're not simply photographic plates, reflecting or recording events in the external world. Particularly as we begin to get to more complex things, each of us sees things differently; each of us constructs a world of our own. And you do that in both space and quality. Are you a cubist?

Omm: I admit the abstract expressionists. Rothko.

Mountcastle: See, each of us sees differently. As you construct an image that's pleasing, I construct another. Those constructs are very powerful in guiding behavior.

After our first interview, Mountcastle urged me to visit the George Peabody Library. There is a very special room there, he said. Later, opening a side door in the 1878 building, I was virtually propelled into a five-tiered atrium of cast iron balustrades rising to a skylight 67 feet above. More amazing than even the ornate workwork were the rows of columns rising from floor to ceiling. A nineteenth-century spatial provision, perhaps, of what Mountcastle was to call the dynamic architecture of the cerebral cortex.—Kathleen Stein OGD

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## A KISS

CONTINUED FROM PAGE 75

"We saw the car," he said. Kennedy's car. It turned the corner and came down Elm Street, soft edged and white like a brand new. "We couldn't see who was in it."

"Maybe somebody," I began, started again. "Maybe somebody else borrowed it for the evening—"

"I said, 'You see?' and she saw." Again, in the background, I heard Natalie speak. "He asked where I'd been. I couldn't lie anymore—"

"Edgar," I said, as she began to cough, "who's Natalie talking to?"

"Natalie?" he said. "Oh. She's talking to me."

"But you're not talking to her—"

"She's not here," he said, his words sounding suddenly as if they issued from an unexpectedly abstracted mind. "Not as a physical presence. This is when she came over the other night. I have her on tape."

"How could I hurt her like that," he said—Natalie's voice returned.

"For nothing," Edgar said. "He threw a glass at the wall. I heard her say, 'It almost hit me in the head.'"

"It helps," he concluded, and then returned to his professed reality. "We ran across the knoll hand in hand as it passed us, and then we watched it go into the underpass and fade away. I wanted to make love to her there on the knoll." He began to whisper, as if into her ear. "What she saw upset her too much, she told me. I understood. But wouldn't it have been romantic?"

Natalie called me a week after that, asking that I come at once to Edgar's apartment. Their film was playing when I arrived. Edgar was watching, hitting pause repeatedly, studying the frames in normal ratio and then punching enhancement, enlarging areas of each image until nothing but phosphorescent glinted the screen. Natalie stood behind him, stroking his shoulders.

"Look who's here, Edgar," she said. "I see him."

As the climax approached, Edgar zapped through the sequence more rapidly, stopping at frame 313. Kennedy's head flared as brilliantly as a tropical sunset, bits of skull flew through the air like seagulls, and he sank into the seat as if beneath the waves.

"Now watch," Edgar said. "I'll show you. You'll see." Thumbing the button again, he allowed the tape to progress, until the knoll's trees appeared, casting roundly shadows as sharp edged as knives. The foliage's blur could have had a leafless number of embers or rustlers, or Cuban gunman, deep within the leaves. "He'll wish this footage

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# LAST DROP

CONTINUED FROM PAGE 42

was missing. Sure as death in Texas."

Natale walked away and sat on the couch, covering her face with her hands, hearing Edgar laugh.

"One frame more," he said. The Lincoln disappeared beyond the Lincolnpass. Edgar brought up the picture until the trees appeared only as a brownish-gray smear and whatever lay beyond them might as well have been seen through an uncleaned window, or from the vantage of sparrows. "There he is. A cover story that's what it was. No wonder it was so ridiculous. This is so simple once you know what you're looking for."

"Who do you see, Edgar? I asked wonderingly why I asked.

"Lawrence," he said, the screen's cathode glow lighting his smile, brightening his eyes, lighting rays through his face. "The second gunman. He knows I know I know he knows. We've always known."

Second gunman, third, fourth, or fifth, who can say? Natale began to cry. Edgar drew on his cigarette, smoke blurred his edges, fogged his words. "No wonder he never liked me," he said. "No wonder."

Some wonder for too long why history happens as it does, why the past unspooled as it did, and thereby assure that in remembering too well what has been, the condemnation unto perpetual repetition is carried out, others gaze too deeply into the face of other enigmas, ones ultimately greater and no less likely to elude conclusions by which one can live, or even sleep, why love lingers where it shouldn't, or why it runs when it should stay. In gathering a harvest of scorched faces, the reaper must remember that, once planted, seeds still grow as they will, and one must make do with the crop resulting.

Their project won some award, neither attended the ceremony. Edgar went away for a while and then returned to his work. His art improved if not his life. I didn't know what happened to Natale, a year later I ran into her at the Whiskey in the video galleries. She was alone and we went to the museum's restaurant and talked over a doubtful lunch. "I didn't know how to help him anymore," she said. "That's why I called you that night, so you could come over. You were always so nice to me."

"Why shouldn't I have been?" She prodded the food on her plate with the tip of her knife. "Everyone has their reasons," she said. "How's he doing?"

"No worse than ever," I said. "He's working."

"That's good," she said. "I never wanted to hurt him."

"How's your husband?"

"We separated. My friends say it's as well. Relationships with academics are

rarely healthy. I was thinking about them only this morning. Lawrence and I had a past, certainly, but Edgar and I could have had a future, if we'd have only let it happen. I never wanted to hurt anybody."

For whatever reason, I found myself asking one more question. "What was your theory?"

"About what?"

"Kennedy?"

"It matters?" she asked. "Once I believed a husband's obsessions should be the wife's as well for a marriage to work. After I saw I was wrong, I stopped thinking about it, and when he started teaching he never talked about the assassination at home anymore. I was so glad he didn't."

Then Edgar and I started working on the project. He seemed so interested, and I knew I was it, should have worked, perhaps. Still, we thought we had something in common, and it wasn't something of ours. She finished her drink. "Edgar had the better theory, but in practice"—Natale gave me a wink without a smile, knowing as I knew how, through a complicity so deliberate as hers, I'd allowed myself to become as tangled up in secrecy, avoiding truth perceived, however rightly, as being too hurtful to tell to those most harmed by its absence—"well, you know."

To conclude my story of Edgar and Natale by saying that one wound up kissing the other's cheek would be romantic, perhaps, but there were no sites of state or unending lines of mourners, no accompanied procession into glory. Natale went her way, Lawrence went his, Edgar continued to toss himself onto his eternal pyre. Sometimes he called and told me of his newest girlfriend. "It's different this time," he said, and said, and said again.

Some autumn nights in Dallas, a ghost Lincoln swings slowly onto Elm Street. Those at rest in Dealey Plaza atop the grassy knoll or on the pergola where Abraham Zapruder stood to shoot, awake from their nightmares, glimpsing the vision passing through the mist. Three figures are in the car, two men and a woman inexcusably involved. Their heartbeats sound as drums. One man has no idea what is happening, but is sure he's all right. The woman, seeing what is happening, stares at the other man, the one sitting beside her, and wishes she could reverse time and save what had been. The man beside her understands what is happening. He's read the books on ritual and romance, he's foreseen the conclusion. This still seems different from what he always imagined. He slumps, as if hoping that the woman will comfort him. When she reaches over to touch his head, it isn't there anymore. **OO**

they pump water into the brow and pump thinner oil out. Oil deposits tend to be deeper than ground water, so there's seldom worry about injectants becoming pollutants. I mean, is anyone worried about polluting the crude oil?"

Then there's the \$2 million Anadarko project in Liberal, Kansas, the center of the dust bowl in the Oaty Thirties. With not enough salt water or natural gas in the deposit for normal injection and water scarce enough that Kansas law prohibits oilmen from drilling into the aquifer for injection water, Anadarko engineers looked at Liberal's huge waste water evaporation lakes, paused, and took a deep breath.

After negotiating with the city's sanitation department to buy that which most cities would pay to get rid of, Anadarko engineers built a purification plant next to the sewage treatment plant. Filtering the water to remove minute particles, which could corrode pipes and plug the oil deposit, the plant pumps the water 12 miles north into injection wells, flushing fresh crude oil to the surface.

After showing off the plant's filtration tanks, which brim with beads made from plastic milk cartons, plant operator Bill Glick says, over the din of high-speed pumps, "One state official said our water was cleaner than Liberal's drinking water" (With a hint in the air of the sewage treatment plant, next door, no one, however, looks willing to try a glass.) Rinsart adds, "And who's to say that, to get our drinking water, one day it won't come to this?"

After all, to get oil, it already has.

Yet secondary oil recovery—bringing oil to the wells instead of wells to oil—remains preferable to more exploratory drilling in new wilderness campaigns. Okay, we're not at the point where, like the Road Warrior, we stop up gas with a handkerchief after a car crash. Oil, however, is a nonrenewable resource. "We'll be sopping it sooner or later." The more time we waste going into places like the Arctic National Wildlife Refuge, the more time we waste developing alternatives, says the NRDC's Watson. "We should drill for oil in Detroit" by forcing automakers to raise fuel consumption standards to 60 miles per gallon by 2010. But the thought of society running out of gas in 2095 may be a worry too far down the road.

"Oil will not disappear overnight," says Earl Ross, a spokesman for the American Petroleum Institute. "It will continue to be our primary energy source for some time to come, and more oil is going to be discovered in the future. That's not saying it's going to be cheap oil, but we'll find it." **OO**

# VIDEO GAMES

FROM KICK STARTS TO KICKING ALIENS  
Helmet crushers and monster  
bashers need brains as well as brawn



The gridiron has cooled and the popcorn is packed away for another year. Yet just before the clock ran out on last season, a hard-driving video football game appeared to keep the mud-and-grass spirit alive until next fall. There were some full-back competitors in our recent look at electronic football, but none as big or as fast as Electronic Arts' new *John Madden Football*, which may be the best reason yet to own a Sega Genesis.

Football is a tough game on the field, even tougher on the small screen. It's nearly impossible to cram 22-man action, variable weather and field conditions, a complete playbook, and an entire professional league into a game cartridge. And forget authority: Even carts that score big on action tend to have strategy simulation that's about as believable as Howard Cosell's hair.

But from the moment the official changes onto the field to spot the ball, it's clear that *Madden Football* is different. An incredible 3-D Skycam view sweeps across the video screen. You'll reset the game just to double-check your eyesight on this one.

Once the game begins, you'll find the most full-bodied, yet accessible football simulation ever created. 17 teams with individual player stats, regular season and play-off competition, one- or two-player head-to-head action, a wide choice of sets and formations, and a full book of offensive and defensive plays.

On the scrimmage line of arcade action, *Madden Football* facilitates the competition with fast animation and blazing controller response. And while pausing is the downfall of many football games, *Madden Football* ingeniously solves the problem of competing pass plays with a multiple screen display.

Fingers not as athletic as they once were? Don't let that keep you in the locker room. You can also play *Madden Football* as a game of pure strategy and tactics. You pick sets, formations, and plays. Genesis runs them

**KICKING ALIENS** When you're ready to throw long bombs of another kind, rev up the ignition on Electronic Arts' *Battle Squadron*, a graphically scorching fly-and-shoot classic. The best computer arcade game of 1989, *Battle Squadron* now lights up the Sega Genesis in a terrific new version with the same slimy monsters, weird land scapes, and a hot musical score that backbeats you into a frenzy. A two-player cooperative option offers a rare chance for video addicts to develop their social skills. Look for cheap and overwhelming thrills, not strategic subtlety in this top-to-bottom scrolling shooter. Just leave your brain in the airlock and start firing.

**RENDISH TOYS** A kidnapped heroine terrorized by evil dolls isn't a very convincing setup, but HudsonSoft's *Mendel Palace* (for the Nintendo Entertainment System) is an ingenious oriented board game and puzzle that could be realized only on a video game system. Your character strolls across a grid of cartoon panels, alternately chasing and evading teams of killer toys. By flipping the panels you can crush the playmate nasties against the walls. Flipping panels can also reveal a variety of toy-busting secret weapons. Fleeting from persistent pursuers can demand a bit of power pad technique, but *Mendel Palace* is primarily a challenge of logic and strategy with eight levels of dozens of different grid designs.

**LINKING UP WITH LYNX** A bundle of great new products continue to appear for Atari's color portable Lynx game system. *Rampage* uses a scrolling landscape and maniac sound effects to recapture the destructive excitement of the arcade hit in which you are a giant creature running amok on a city-leveling spree. In *Zelix Mercenary*, a graphic tour de force in a four-way scrolling shoot-'em-up, the action soars with true arcade-quality audiovisuals. Also, multiple tile layouts and other enhancements in the Lynx version of *Shanghai* improve the computer-based original's playability.—Bob Lindstrom **CC**

# GAMES

## NEW WORD ORDER

The dictionary won't provide much help with these bits and pieces of language

**MN FL WV MA SC SD  
IA LA HI OR PA CA CO UT GA MS VA AL  
NV AZ IL CT AK AR OH RI IN OK ID WA  
DE KY ME KS NE MT NM NC ND WY MD NY**

Published four times a year, *Word Ways: The Journal of Recreational Linguistics* of fans readers an array of word plays. Take, for example these anagrams. The letters in President Ronald Reagan can be rearranged to read planned language orders. George Herbert Walker Bush becomes huge, beserk rebel warfrog. The journal also recently published a timely palindrome: "Dad! Sad did a mad bastard." The best wordplays, however, come from its readers. The dictionary defines *cabaret* as "a restaurant serving liquor and providing entertainment." Shift the letter *c* to the end, Eric Albert found, and the word becomes its own definition: "a bar too."

Philip Cohen submitted a collection of rumors that circulated around an IBM conference. Take, for example the one about a rumored merger between the *Fordist* and *Honeywell* companies. The deal fell through because company executives feared somebody would nickname the new company *Farewell Honeychild*. The merger of *Stop & Shop* with *A & P* failed for a similar reason.

Readers have also focused on the 50 state postal abbreviations. The word *America*, for example, contains three of them: NE, RI

CA, and each of those states—Maine, Rhode Island, and California—contains three other abbreviations. Can you find them? And reader Dave Morice arranged state abbreviations to form vertical word pairs (above). But he was able to include only 42 states. Can anyone use the other eight?

### WORD RECORDS

Chris Cole continued a list of record holding English words, using Webster's *Third New International Dictionary* as his source. The quiz here presents 25 of the longest and shortest models, each with a parenthetical hint. For example, *non-supports* (letter choice) would tell you that the letters used in the word make it a record holder. (It happens to be the longest word composed of letters from the second half of the alphabet.) What is the record held by each of the following words or word pairs?

1. ABSTEMIOUSLY (letter order)
2. AMOUNTS/CONTOUR (telephone)
3. APERS (transformation)
4. BROUGHAM (pronunciation)
5. CARRIAGE (music)
6. CACODONALACTIA (letter choice)
7. CHAROTE (typewriter)

8. CHECKBOOK (word type)
9. CONSCIENTIOUSNESS (chemistry)
10. DERMATOGLYPHICS (letter count)
11. EPIDEMIOLOGY (pronunciation)
12. HOMOTAXY (letter type)
13. KINKINKINK (letter pattern)
14. LATCHSTRINGS (two records)
15. LILLYPILLY (letter appearance)
16. NUMEROUSNESSES (letter appearance)
17. OXYOPIA (pronunciation)
18. POLYPHONY (typewriter)
19. PROPRIETORY (typewriter)
20. SCINTILLESCE (letter count)
21. SQUOGIA (letter choice)
22. SUBCONTINENTAL (letter choice)
23. SPOON FEED (letter order)
24. SQUARRLED (pronunciation)
25. UNDERSTUDY (letter order)

### ANSWERS

1. Longest word with all vowels in order
2. Longest words using the same numbers on a telephone keypad
3. More words (12 in all) can be made from these letters than from any other five-

- letter set apart, après après pares, parse parse, press press, rapet, rapet, spars, spars
4. Longest string of silent letters (Lgflts)
5. Longest word composed of musical notes
6. Longest word using state abbreviations (CA CO, GA IA, CT, IA)
7. Longest word typed in reverse order on a typewriter, from the bottom row to the top row
8. Longest word with horizontally symmetrical letters
9. Longest word formed from chemical symbols
10. Longest word with no repeated letters
11. Shortest seven-syllable word
12. Longest word with vertically symmetrical letters
13. Longest palindrome
14. Longest word with only two vowels and longest string of consecutive consonants in one word
15. Longest word from "all lowercase letters"
16. Longest word from "short" lowercase letters
17. Shortest five-syllable word
18. Longest word typed with the right hand only
19. Longest word from a typewriter's top row of letters
20. Longest word in which each letter appears twice
21. Shortest word using all five vowels
22. Longest word using all five vowels, reverse order
23. Longest word with letters in reverse alphabetical order
24. Longest one-syllable word
25. Longest string of letters in alphabetical order (rstu)

—Scott Morris

# STAR TECH

## ACCESSING THE FUTURE



### SPACE TRADERS

Trading cards depicting the space program's history. Bubble gum not included. Cost: \$19.50 for 150 cards. Contact: Space Ventures, Dallas, TX; (800) 748-8853.

### PETITE POOL

Lots to swim but don't have room for a pool? The 12- by 6-foot SwimEx lap pool can be installed indoors and lets you do laps at your own pace—all year long. Cost: \$23,475. Contact: SwimEx Systems, Warren, RI; (401) 245-1200.



### EASY RIDER

The R.S.T. mountain bike, complete with air-filled shock absorber, takes the bumps and bothers out of riding rugged, rutted trails. Cost: \$1,700. Contact: Commenda, Georgetown, CT; (800) 245-3872.





## HERE, FISHY

The Scout Sideliner tracks furtive fish and tells you where they are. Unlike other fish finders, this one's sideways sensor can even detect fish over the surface. Cost: \$300. Contact: Bottom Line-Competrol, Meriden, ID; (800) 456-5433.



## A SOUND WAY TO STORE MUSIC

The Muffin safely stores compact discs and uses 80 percent less plastic than conventional CD jewel boxes. Cost: two for \$4.95. Contact: DiscMuffin, Boise, ID; (208) 853-7333.

## I, ROBOT

The Meats robot kit demonstrates the basic principles of robotics. The easy-to-assemble robot changes direction when it hits a surface or hears a sound. Cost: \$41.95. Contact: OWI, Compton, CA; (310) 638-6732.



# LAST WORD

## A THOUSAND POINTS OF BLIGHT The Committee to Pave the Earth stands ready to tackle the energy crisis

In my role as third vice president for the Committee to Pave the Earth, not a day goes by without a million phone calls from concerned citizens yearning to decimate their communities in asphalt and cement. I assure them that no matter how small their town, giant paving machines will eventually transform their home into a miniature Times Square.

The idea of so many twinkling lights often raises the question of energy use. To help the public understand their responsibilities on this score, I've prepared the following energy primer.

### LIGHTING UP

Every 3 million years Americans buy enough light bulbs to cover the land surface of the earth (How to attach them to sheer cliffs and steep mountain slopes remains a problem.) Indeed ever since Thomas Edison and Joseph Swan invented the incandescent bulb in 1879, Americans have had an ongoing love affair with light. It was in Edison's laboratory that popular phrases such as "a thousand points of light" were born.

Even though fluorescent lamps produce several times more light than incandescent bulbs, they only create one-fourth as much heat. With "a thousand points of light" (incandescent, of course) in your house you will be able to throw away your furnace. In order to cool your home, all you'll have to do is turn out the lights.

Incandescent lights utilize energy at a faster rate, helping to drain the world's supply of oil. When all the oil is gone, we can switch to clean nuclear energy and cheap coal power. Then we can kiss OPEC good-bye, raise the price of uranium, and recover all our money from the foreign countries that have caused us so much grief.

Little-known fact: Fluorescent lamps were developed by the hat industry as electronic baking devices. Hatmakers, befuddled by exposure to mercury, were convinced that bald men would buy more hats. Of course, they had no way to anticipate Yul Brynner.

- To beat the high cost of light
- Go to bed when it gets dark
- If you have to stay up after dark, take your paperback novel or portable TV to an all-night market
- Work nights and let your employer pay for lighting
- Lure snow the Arctic Circle and enjoy 24 hours of daylight every summer. Then drive down to Antarctica for the winter.

### BODY HEAT YOUR HOUSE

One of the cheapest and most efficient sources of heat is good old body heat. If your house is cold then it's obvious that there are not enough people in it. To heat a house with body heat, the President's Council of Home Body Heat

cons suggests ten adults for every 200 square feet.

Falling this approach, you can "Turn down your heat 1° a week. In a year, the temperature in your home will be a comfortable 20° and you will no longer need a refrigerator.

- Join a local chapter of the Polar Bear Club.

### JUST SAY YES TO OIL

Every 32 years the United States dumps enough oil into the sea to cover every ocean on the face of the earth. Obviously, we need to discover more oceans to maintain our way of life.

Oil is proof that not all addictive substances are necessarily bad. It enabled us to create such wonders as the minivan, the drive-in church, and that great American sport, cruising.

Oil is the most addictive substance the world has ever known. Let's face it, lots of people quit smoking but only the dead stop using oil. Gasoline is the main source of speed for most Americans. It makes America what it is today.

What should you do?  
•Use oil and oil-related products as fast as you can. The faster you use oil, the less chance there is to spill it.

•Get immunized against the oil-eating bacteria that are being developed to devour oil spills—once those bacteria finish eating all the oil, they're going to be awfully hungry.

•Make a bumper sticker that reads, WHEN OIL IS OUTLAWED OIL WILL STILL BE ON THE HANDS OF OUTLAWS.

•And remember, oil is an essential ingredient in asphalt, without which man cannot hope to pave the earth. ☐

Actor/comic  
Darryl Henriques  
uses stand-up  
comedy to  
promote  
environmental  
awareness.



Excerpted from 99 Simple Things You Can Do to Pave the Earth by Darryl Henriques, published by Mosaic Press, Berkeley, California. Copyright 1990.