

SPECIAL SPACE ISSUE

OMNI

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FIRST WORD

CHEMISTRY IMAGINED: Reflections on science

By Roald Hoffmann and Vivian Torrence

In 1947 I was ten years old. We were in a DP (displaced person) camp in Wasserfallingen, then in the French Occupation Zone of postwar Germany, waiting for a visa to come to the United States. Or maybe we'd go to Israel. Or, in the desperate moments when the visa seemed unobtainable, my stepfather even thought of signing a labor contract (in exchange for a visa) to work in the mines in Chile.

I was becoming proficient in my fourth language, German, and doing well in school, a

school typical of the period, where every class had kids of different ages, for who had gone to school during the war? I read much, and somehow there came my two books, biographies of scientists. One was of George Washington Carver, the black agricultural chemist; the other the biography of Marie Curie by her daughter Eve. I read both in German translation.

In the story of Carver, I was fascinated by the transformations he wrought with the peanut and the sweet potato. Ink and coffee from peanuts, rubber and glue from the sweet potato! Perhaps part of the romance was that I had never seen nor tasted either peanuts or sweet potatoes.

My Polish background certainly provided a ground of empathy for watching Maria Skłodowska transformed into Marie Curie. But Eve Curie's story touched something deeper. I remember to this day the scene when Pierre and Marie completed the painstaking isolation of a tenth of a gram of radium from a ton of crude pitchblende. They put the children

to bed and walked back to their laboratory. I must quote now from Vincent Sheean's translation:

Pierre put the key in the lock. The door squeaked, as it had squeaked thousands of times, and admitted them to their realm, to their dream.

"Don't light the lamp!" Marie said in the darkness. Then she added with a little laugh:

"Do you remember the day

when you said to me, 'I should like radium to have a beautiful color?'"

The reality was more entrancing than the simple wish of long ago. Radium had something better than "a beautiful"; it was spontaneously luminous. And in the somber shed where, in the absence of cupboards, the precious particles in their 8-ny glass receivers were placed on tables or on shelves nailed to the wall, their phosphorescent bluish outlines gleamed, suspended in the night.

"Look... Look!" the young woman murmured.

She went forward cautiously, looked for and found a straw-bottomed chair. She sat down in the darkness and silence. Their two faces turned toward the pale glimmering, the mysterious sources of radiation, toward radium—their radium. Her body leaning forward, her head eager, Marie took up again the attitude which had been hers an hour earlier at the bedside of her sleeping child.

Her companion's hand lightly touched her hair.

She was to remember forever this evening of glowworms, this magic.

Years have passed. The boy whose interest in science was stirred by German translations of a story of a Black American applied scientist and a French-Polish woman chemist is older. He rereads these books, and sees that they are hagiographies. The romance is off the radium, but Marie Curie still makes him cry. **□**

Reprinted from the book, *Chemistry Imagined: Reflections on Science* by Roald Hoffmann and Vivian Torrence, published by the Smithsonian Institution Press. Copyright 1993 by Roald Hoffmann and Vivian Torrence.



Hoffmann won the 1981 Nobel Prize in chemistry (shared with Kenichi Fukui), and Torrence's work is in the collections at the Art Institute of Chicago and the Des Moines Art Center.

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READERS' WRITES

Question for Clinton, asking about the past, and getting real

Into the Great Wide Open

Buzz Aldrin thinks he has the solution to saving the space station (Space, January 1993). Hal White preserving what has been developed, making it happen faster, making it less expensive, and, finally, making it politically viable by using the Russian *energie* all sounds good. I would like to pose a few questions: Is the real problem our lack of a heavy lift? Maybe our real problem is, as author Brenda Freeman suggests, "political battles over its funding, purposes, and design." Maybe our real problem is Congress's "mandated half-dozen redesigns." If cost is the central issue, why has Congress been spending so much money redesigning the space station? Could we have built it and launched it and met former president Reagan's 1982 deadline? I don't want to demean Aldrin. He's a hero! But let's consider new solutions. Will President Clinton see the benefits, honor, and justice in opening up space like his predecessors?

Mark Corliss
Vashon, WA

A Culture Speaks

In your December 1992 issue, author Melane Nwagwu writes about the 500th anniversary of peace maintained between the Turks and the Jews. Ironically, this article suggests that Turkey was the perfect nation in dealing with different ethnic groups—as if all nations, who undoubtedly have problems with ethnic groups, should follow Turkey since it is the perfect role model. As an Armenian American, I know the Turks haven't had a clean record throughout history. They massacred 1.6 million Armenians in 1915. Throughout Armenian history, Turks have persecuted and oppressed Armenians time and time again.

Kristine Choulakan
North Hollywood, CA

The Real McCoy

Your November 1992 issue contained a fascinating article about cyberpunks and the techno-underground. While we cannot disagree with author A. J. S.

Ray's views of the culture, we do disagree with the characterization of these radicals as computer cowboys. We are Computer Cowboys and are proud of the heritage of the cowboy. We, too, rise the rather world of brasseries and databases. However, we seek not to circumvent barriers and wreak havoc. We act in the more traditional role of cowboys who worked as ranch hands to help the ranch owner bring products to market and make a profit. As Computer Cowboys, Inc., our reputation is established as a company that delivers practical and workable technology solutions, and support to those who hire us. This is the antithesis of Ray's description of computer cowboys.

Virginia Hoyt
Computer Cowboys, Inc.
Joplin, MO

Brave New World

While this fantastic magazine has amazed me ever since the first issue, I have never been so inspired to write in thanks and admiration before now. Cutting-edge science always impresses, especially when one tracks its developments and changes over time. Being part of a generation (I'm a 22-year-old college graduate) inheriting a world of technology and discovery, I am also aware of a fundamental change. Feeling that a true renaissance is upon us, it's impossible not to be scared, thrilled, proud, and hopeful. I'm confident that *Omni*, through insight and foresight, will continue to be at the helm of this new exploration. Tom Medcoff summed up a feeling that will very soon pervade "science" at large with "Gravity's Angel" (November 1992), a fantastic and terribly realistic piece of fiction. It is extremely comforting and reassuring to see that there are other people wary of, and disgusted with, the complacency and apathy which is gumming up the gears of real progress. Without a new roster of Galileos and Goddards, we will remain scientifically stagnant. Onward!

Gregory Czaples
New Bedford, MA

FUNDS

BARTER EXCHANGES

Gateway to a cashless society?

By Linda Marsa

The 1984 Summer Olympics in Los Angeles was the first modern Olympic to actually turn a tidy profit for the host city—thanks to some shrewd maneuvering by Olympic officials who relied on barter to trade licensing rights for \$196 million worth of goods and services from 30 major corporations.

Today, more than 240,000 businesses, ranging from doctors, lawyers, caterers, dentists, restaurants, accountants, hotels, and building contractors to household names like Xerox, Pan Am, Ramada Inns, McDonnell Douglas, Marai, and Hilton, conducted \$5.9 billion of barter transactions in 1991, according to the International Reciprocal Trade Association, up from 90,000 firms doing \$2.2 billion worth of swaps a decade earlier. The sluggish economy is fueling this phenomenal growth because barter can preserve cash and swell business 10 to 15 percent by using excess services and inventory.

For Fortune 500 corporations, the concept of barter used to be a dirty little secret because it reeked of unloading unsalable inventories at distress sale prices. No longer. The catalytic shifts in the geopolitical landscape have changed that: too. Former Eastern Bloc nations simply don't have hard currency. So companies like Pepsi, eager to capitalize on these untapped markets, have been unabashedly swapping soft syrup for vodka. Plus, the recent development of a trading network that harnesses the speed of supercomputers may be the gateway to a cash-

less society in the twenty-first century. Barter, once relegated to the back door of the economic underground, has gone legit.

"Barter won't save a failing business. But it can give ones that are surviving a real competitive edge, because it allows them to buy retail with their own wholesale costs," says Stephen Friedland, president of Los Angeles-based BXL International, which has more than 12,500 members and 75 branches. Founded in 1960, BXL was the first modern bar-

lans' can add up. For example, a graphic designer used barter credits for a \$20,000 down-payment on a house, and a music teacher went on a photo safari in Kenya—courtesy of her local barter exchange. Last year, New York's Lexington Hotel acquired a \$150,000 computer system in exchange for \$300,000 worth of room credits. Since the Lexington always has vacant rooms, its only real expense was paying housekeepers to tidy the rooms.

If you think your business could benefit from barter, check out the track record of a trade exchange before you join. Find out how long the exchange has been around. Does the network have a directory of its members? Does it offer products and services you can genuinely use? Can you trade leftover inventory or services for items you would otherwise pay for in cash?

A new state-of-the-art software system, UltraTrade, designed for supercomputers, may ultimately even transform the way we do business. About 400 mid-sized companies in Southern California are already online with UltraTrade. If all major U.S. companies used this trading system, experts estimate it would generate additional annual sales of \$1.5 trillion. "We're on the edge of something unbelievable," says Bob Meyer, editor of *BarterNews*. "The day you can get anything you want on this exchange—which would require a critical mass of about 4,000 major companies—this will take off exponentially. And probably make the green stuff obsolete." ☐



less exchange and is still the largest of the nation's estimated 400 trading networks.

Typically, exchanges handle record keeping, expedite the flow of trades, and promote clients through directories and newsletters. In return, they take a 10- to 15-percent slice off the top of each trade. All transactions are now reported to the IRS, so bartering is no longer a convenient tax dodge.

People offer goods and services for "credits" or "dollars" that can be traded on barter exchanges. And those "trade dol-

Barter, of course, is as old as business itself—and Peter Minetti's slick swap of \$24 worth of cloth and trinkets for the deed to Manhattan Island still ranks as the deal of the millennium.

POLITICAL SCIENCE

WARRIORS OF PEACE

Is civilian life the continuation of war by other means?

By Tom Dworetzky

The warrior spirit, long celebrated in verse and story, is not simple business. You've got to be strong, hard, focused, disciplined—and in this country—politically neutral. Recently, Harry G. Summers, Jr., a lecturer and distinguished fellow at the Army War College, wrote an essay in the *Los Angeles Times* in which he argued persuasively that an army engaged in peacekeeping and other politico-diplomatic endeavors would undermine the political neutrality of the corps.

considered themselves apolitical professionals.

I defer to the experts on the military mind. I believe they accurately voice a real, veiled threat. Indeed. Some of the military undoubtedly will resist civilians telling them what their role is. *Fire us, divert us to road building, people feeding, and doing other stuff that we don't want to do, and we might react that you let us protect you from the threats that we think you face.*

At a time when civilians, the bill payers, are considering just how much military power they can afford and just what the threats really are to their security, this is a critical issue. I understand and will accept that empires may have collapsed because they were, civilized armies weren't up to battling hungry, aggressive outsiders (Summers cites the Greeks looting before the rough-hewn Romans). But I find that argument just a bit too selective.

Consider what Carl von Clausewitz said regarding war: "It is clear that war should never be thought of as something autonomous but always as an instrument of policy; otherwise, the entire history of war would contradict us." Or further, he says, "War is not merely an act of policy but a true political instrument, a continuation of political intercourse carried on by other means. What renders peculiar to war is simply the peculiar nature of its means." Clausewitz therefore implies that the military is part of the political continuum.

Today there is much policy upheaval related to the military-industrial complex. We've got troops from many nations working together to feed people in Somalia, chase drug barons to the South, intervene as global police in the Middle East and elsewhere. More-

over, in an attempt to finally get our house in order and develop an industrial policy worthy of the name, our truly impressive national lab systems are at last being pushed away from endless James Bond military research into useful civilian efforts to develop technology we can actually talk about and sell.

The issue Summers raises, however, is worth thinking about. Warriors, just like steel and auto makers, need sensitive liberal thinking and compassionate help in making the transition. They must be urged to discover the way of the civilian warrior. Summers warns that all this peacekeeping in Somalia and other places could well sap the military's fighting spirit. "Such a collapse of fighting spirit could be as fatal to the survival of American civilization as it was to the Greek civilization."

I don't think the implication—that liberals and other civilians are soft, weak, and afraid to die—is true. Each morning they wake to face the terror and dread of challenges as tough as those required to "win" any battle—to fix what's wrong, to help those in need, to make a life. Is the world not everywhere a battlefield, a place of struggle against odds? To borrow from Clausewitz, can't you say, too, that peace is in some ways the continuation of war by other means?

Maybe the sacred history of war is that soldiers, when their peculiar means are no longer in demand, have often been turned out with less consideration, retraining, and severance than other unwanted workers. This is both unkind to them and dangerous to society. What do you think they'll do when they're hungry? Same as anyone else. If you teach a man to fish, he fishes to survive. If you teach him to make war, he fights to survive. **DO**



Will all this peacekeeping in Somalia and elsewhere sap the military warrior's fighting spirit?

He quotes several military experts who point out the conflicts and potential dangers of more peacekeeping with war making. None is more chillingly compelling than the passages from an award-winning essay by Lt. Col. Charles E. Dunlap, Jr., written at the National War College, entitled, "The Origins of the American Military Coup of 2012."

The bottom line: The coup was the result of the all too many "non-traditional duties" people forced the military to play, to the point that "people in the military no longer considered themselves warriors." Moreover, they no longer

ELECTRONIC UNIVERSE

PLAYING THE FIELD

Online gaming matches your wits against real opponents

By Gregg Kellner

Playing the computer hasn't ain't much fun. Sure, you can flop down on the couch or squat in front of the computer screen and play against yourself. At times, the computer-created opponents are remarkably able. But they're nowhere near as crafty and contentious as a living, breathing adversary.

The personal computer and videogame machine may be the best thing since someone figured

play, and waded through the intricacies of telecommunications—no easy task for the best of us. A better way to find willing victims is through some sort of electronic clearinghouse.

Fortunately, they already exist. Several online services—those data networks that sport tens or hundreds of thousands of subscribers—offer entertainment as well as information. Services like CompuServe, Prodigy, and GEnie all include games; some of them outstanding games, that let you play other people, not the PC.

But today's best place to play is The Sierra Network (TSN), an all-game network. Using an approach that's worked for Disney—TSN is laid out like an amusement park, divided into several "lands"—the virtual game board offers a variety of multiplayer games and enough opponents to keep you sufficiently challenged.

Once you connect with TSN, you're staring at a colorful map of the park. To enter a particular Land, you just point to it with the mouse and click. Logging on and navigating TSN is slick—simple, in fact, than even Prodigy, the easiest-to-use general-purpose online service.

TSN's unique make-a-face feature lets you create a portrait that represents you in the games you play. With a composite kit like those used by the police, you mix and match head shapes, hair styles, clothing, and features to build your self-image.

TSN features a general area that everyone can access, and (at the moment) three optional Lands that you pay extra to enter. The everyone-gets-in area, tucked away in the Clubhouse, features eight card and board games—bridge, chess, checkers, and backgammon are four—that you play with others. Enter the waiting room, check out any-

one hanging around, then challenge him or her to a game. While you play, you can talk to each other by typing in short messages. You can also—with the players' permission—watch a game in progress.

But the Lands are what make TSN LarryLand, named after Sierra's goofy Leisure Suit Larry character, gives you a chance to play casino games like slots, roulette, blackjack, and poker. LarryLand differs from the rest of TSN's locations in another way as well—it's an adult-only Land where the conversation tends toward the suggestive and mildly bawdy (though not enough to shock anyone who's sat through an R-rated movie). SierraLand opens up seven more games from Red Baron, a multiplayer WWI aerial background, to Mini-Golf, a cute miniature golf game in MedievalLand, you play The Shadow of Yserbius, a dungeon-crawling role-playing game that includes monsters and magicians, either solo or with a team of elves, dwarves, and trolls peopled with real people. MedievalLand is where the action is in TSN, for Yserbius almost always sports more players than any other game. The fantasy of playing strong heroes and heroines obviously plays a part.

At \$13 for 30 hours of nonprime time per month and with additional time running \$2 to \$7 per hour, TSN can get expensive. Add \$4 per month for each Land you use, and its costs can rival the phone bill for a long-distance romance. Fortunately, you can tell TSN to cut you off after a set amount each month.

The Sierra Network is a far cry from the too-often-abused term virtual reality. But it's a small step in that direction and the best place to play with and against people, not the dull-witted PC. **GG**

With the Sierra Network's Red Baron, a multiplayer World War II game, you wage war against others via modem.



out how to play solitaire with a deck of cards, but they're too much like Pat Buchanan's idea of foreign policy isolationism. Computer and videogames operate with fewer social skills than a serial killer; play like a brain-dead one-trick pony and rarely adjust to your playing style. Winning may be everything, but it gets boring after awhile.

Connected computers is the answer. Rather than play against the artificial life form held captive on the hard disk, you link your PC or Macintosh with other computer owners. Using a modem and the telephone lines, your computer communicates with other, like-minded machines. Data flows back and forth across the telephone lines, giving your moves to your opponent's computer and, in turn, putting his or hers on your screen.

Doing all this yourself can be more trouble than the ensuing game is worth. You must find an opponent, arrange a time to

BOOKS

ELVIS IN WONDERLAND

Jack Wornack shows us our own world through a warped looking glass

By James Salis



Can anyone find redemption in Wornack's grim world—even by bringing back a living Elvis Presley from a parallel world?

If 200 years from now our world were to be reconstructed from artifacts of pop culture—comic, martial-arts and science-fiction films, pop music, media imagery—the result might be something close to what we find in Jack Wornack's work: a representation at once horribly wrong and strangely right.

Published early this year by Tor Books, *Elvissey* (as in adverb) follows *Ambwer* (1987).



Templaine (1989), and *Heathen* (1990) in Wornack's projected sex-volume series. The world of these books, presented as a universe parallel to our own, mirrors much while it exaggerates or utterly transforms much else.

The ground beneath us at first appears somewhat familiar. Mammoth corporation Dryco owns virtually everything, various armies and security forces vie for table scraps of power within cities where casual slaughter is the order of the day. There's an omniscient computer and an elite cadre of bodyguard-assassins, people cross over into their parallel worlds.

But in this world, Germans re-

main Nazis, flying saucers are flight-tested in Mississippi, all blacks have been Randolphed, female sculptors produce fetal art, and the G of E (Church of Elvis) is going strong.

The mission at the heart of *Elvissey*'s plot gives the word despair new meaning. The savage, brutal society we know from Wornack's earlier books is now being "regooded," and to accomplish this reformation (and consolidate Dryco's sovereignty), Isabel and husband John are sent into a parallel world to bring back that world's Elvis so their society might worship him in the flesh. Isabel is a black woman with hair straightened and skin lightened by chemicals, John a bodyguard-assassin whose violent impulses have been neutered with regooding drugs, and E, when they find him, is standing over the mother he just shot in adolescent rage.

While *Elvissey* in its relentless sense of futility and anemia, may well be the darkest of Wornack's novels, it is also, with its emphasis on inchoate, doomed relationships, perhaps the most human.

Not surprisingly, *Elvissey* begins with Iz and John studying 1950s slang, for language is an important part of what these books are about. They're written in a dense, supercharged idiom, almost telegraphic, yet also oddly poetic. Verbs become nouns and nouns verbs; prepositions graft to their objects. "My husband and I are mutilated," says Iz early on. "Change cosmetics but I don't wish to scander, and he'll not last if we do."

Extrapolating from such current trends as the now-common use of impact as verb and adjective, Wornack's prose shows where our language may be headed; much as the books themselves demonstrate what our culture as a whole could become

This telegraphic compression, along with the furious spin of events—killings, mutilations, tripecrosses, takeovers—finally throws into sharp relief the fact that nothing much changes in this world, there is little real action, only activity. Wornack's characters are suspended in an endless, unrelenting present. History here exists, like all the world's ravaged resources (people included), for one purpose only: consumption. Even if dimly, his characters perceive that without history, there's no chance of a future.

Early in the novel, at a pretop psychic session, Iz's computer analyzer repeats, "What is your fantasy about your trip?" Again and again, until she realizes that this is no profound psychoblastic play, that the machine is simply dumb, the loop sticks. Suddenly her whole culture is suspended, stuttering, trying forever to loop back to things that once worked, if only briefly. The obvious question arises: Like our own culture? *Unlike our own?*

We understand our world, inasmuch as we understand it at all, through metaphor, whether the metaphors are of science, religion, history or art. In his four novels to date, Jack Wornack has invented a machine, a metaphoric engine, that in principle can compress and examine everything—sensus sociological extrapolation, high and low comedy, pulp adventure, pop iconography. Lionel Tilling pointed out the adversarial intent of modern writing: its dedication to fixing the reader of habits of thought and feeling imposed upon him by the surrounding culture—literature as challenge, as danger—and that edge is obviously where Jack Wornack chooses to work.

I'm glad to have a dangerous man like him around. We're all just a little sicker for it. **DD**



STYLE

GREEN HOUSES

Maverick architects show how style can save energy

By Michelle Kearns

Tim Devil's work: Concern for the environment led Jersey Devil to build ingeniously efficient homes decades ago. But even during the energy-wasting years of the Reagan era, they bucked prevailing trends by creating such sensible and tasty structures as "Football House" (top), which has survived every earthquake since 1976, even while straddling the volatile San Andreas Fault. Buildings such as "Airplane House" (bottom) on a cold Colorado plain, keep residents comfortable in winter with heat-retaining, water-filled walls that absorb the warmth of sunlight and keep winter heating bills low. In the summer, the shade makes out of "cool tubes."



A football-shaped house near the San Andreas Fault has survived every earthquake since 1976. A grass-covered frame peaks out from beneath the crest of a hill in Northern California, keeping warm all winter with no fuel. A Virginia structure resembling a giant submarine sandwich suspended over a cliff boasts a 112-foot-long skylight that automatically blinks shut at night when the sun goes down.

Funky style, energy efficiency and weather-smart technology characterize Jersey Devil, a firm of three renegade architects. Named after a mythical beast that roams the pine barrens of Southern New Jersey, the team bucks their profession's conventions by inventing the country, handbuilding everything it puts on paper. "We're the architects, the general contractors, and the carpenters," says ringleader Steve Badanes.

When the three joined forces in the late Eighties, Jersey Devil began its unique approach to design, getting strolls with a structure's site by camping out in tents and vintage Airstream trailers. They stay put until the last nail is in place—sometimes two or three years later.

Their unusual methods have led to far-out innovations. While goats lunch on the grass-covered roof of "Hill House," wedged in a California mountaintop overlooking the ocean, nature wreaks its havoc. Temperatures drop 30 degrees in an hour and winds whip at 125 mph. Devil managed to keep the temperature stable inside by surrounding the floors and walls with massive amounts of concrete. The thermal "blanket" resets outside

temperature fluctuations for several weeks.

Windmills harness the wild gusts, pumping water into solar-heated drought-protecting storage tanks. And the sun heats up a hollow sailboat concrete face beneath an arc of windows—an old French idea called a Trombe wall. The device warms air and sends it indoors through vents. No fuel is ever needed.

According to Badanes, energy-conscious design can help change wasteful human habits, like our nation's air conditioning addiction. "Americans think the only way to survive in hot climates is to shut themselves off from their environment and live in artificially cooled houses, cars, and offices," laments Badanes.

Indeed, energy efficiency has always been a Devil trademark. Even after Ronald Reagan removed Jimmy Carter's solar panels from the White House, sending energy consciousness the way of bell-bottoms and peace signs, the design firm has stayed true to its environmental roots (Things reached such a sorry state that an insulation company discontinued a series of energy awards for architects when a survey found they no longer consider it a priority.) With the Clinton presidency, Badanes believes change is on the way.

"Those solar panels are in the presidential basement, but I think they'll go back up," he says. Now the goal is to use renewable energy sources and phase out the bad technologies that are screwing up the planet.

During the Reagan era, Devil was building homes like "Airplane House," an aerodynamic abode on the snowy Colorado plain, for retirees on a fixed income. The structure fans southward from a narrow carport toward a two-story bank of windows. Sunbeams



STYLE

●Americans think the only way to survive in hot climates is to live in artificially cooled houses, cars, and offices ●

Jersey Devil stays close to its projects, camping out in vintage Airstream trailers until every nail is in place—sometimes years on end. Nestled into the brow of a ridge top in the Santa Cruz Mountains, "Hill House" (bottom), fares well against fierce Pacific storm winds. The passive solar structure uses massive green-



food in, warming the space by soaking into the concrete floor and a heat-retaining wall filled with water. The exterior is covered in sun-absorbing dark-brown corrugated asphalt. For hot summer days, Devil added an all-natural air conditioner, "cool tubes"—pipes that run eight feet underground, pulling in drafts of cold subterranean air. The home keeps heating bills well below the local average.

Similarly efficient, the firm's "Space Age Cracker House" endures Miami's steamy 90-percent humidity and 90-degree temperatures without air conditioning—and without overheating its residents. In fact, during the six-month summer they sleep with blankets. The trick: Window overhangs provide shade from the sun, while the house, built to face prevailing southeasterly breezes, is wrapped in a heat-reflecting metal skin. Layers of NASA-designed radiant barrier foil beneath the roof, however, do most of the work, alternately blocking and releasing the sun's heat.

Energy expertise was less an issue for a Virginia couple who wanted a large, informal residence. Chosened "Horse House," it represented Jersey Devil Jim Adamson's chance to install an industrial-strength skylight he'd invented and patented. Designed to naturally illuminate large spaces such as malls and warehouses, his domed "Roto-lid" is wired with light sensors and thermometers. Readings are communicated to a computer, which rotates an insulated panel within the window according to sun position without leaking heat. Thanks to counterweights, motion is effortless. Left to its own devices, the lid will run indefinitely. And gadgets don't stop there. The deluxe home requires a 150-page owner's manual for operating the mo-

torized window shades and built-in vacuuming and indoor plant watering systems.

High-tech gizmos aside, Jersey Devil typically emphasizes more basic innovations. The firm's latest project in Key West, Florida, recycles an old building with simple, yet ingenious design themes. Starting with two seaside cement structures, built by the Red Cross to shelter local residents after a 1926 hurricane, Devil added a studio, lookout tower and carport with a rooftop Airstream. Trailer-turned guest room. To unify this eclectic mixture, the firm surrounded the buildings with a mesh metal trellis called a "living screen"—where bougainvillea and passion fruit will grow. "It's a barrier for noise from the road in the back and pollution," Badanes says. "And plants add good stuff to the air. They give off oxygen to combat the carbon dioxide from cars."

On a larger scale, Badanes believes more plants could generate enough "oxygen exhaust" to help repair holes in the ozone caused by the construction industry. "It's not enough to build houses that save energy when they're in use," he says. "Cement and aluminum production contribute to global warming."

To that end, Jersey Devil hopes to shift to more basic materials—and to more worldly shelter challenges. "I'm interested in techniques that will have implications in developing countries—indigenous materials like earth and clay to replace things like concrete and lumber," Badanes says. Later this year, the firm plans to build medical clinics in Mexico with the help of architecture students. After twenty years of houses," says Badanes, "I'd like to build places where people can go without having to own them." □

titles of insulating concrete. In addition, the sun heats up an innovative Trombe wall, warming air before circulating it indoors through vents. Bored with building private residences, the firm is now turning its attention to public spaces. This year, Jersey Devil plans to build needed medical clinics in Mexico with the help of university architecture students.





CONTINUUM

"And all things, whatsoever ye shall ask in prayer, believing, ye shall receive." —Matthew 21:22

Don't believe the hype. Neither God nor prayer is dead in these troubled high-tech times, according to a study by the National Opinion Research Center based in Chicago. Headed by Andrew Greeley, Catholic priest and best-selling novelist, researchers measured the meaning of prayer among the skeptics and the faithful in America—6,000 people from all segments of the population participated.

How often do you pray? It seems most of us, the study says, tend time to pay homage to some form of Divine Intelligence, with 57 percent of Americans praying daily. Seventy-eight percent pray at least once a week, and only a meager 1 percent never pray. However, if you were charting the frequency of daily prayer on a graph, it would seem that America as a country became more religious as the world grappled with the terrifying Atomic Age and the possibility of global annihilation. According to the study, people born between 1930 and 1954 prayed less on a daily basis than those born between 1955 and 1970 by a ratio of 37 percent to 44 percent. Disaffection in prayer time started its decline with youngsters born in the early Forties and ended with the "Leave It to Beaver" generation of the Fifties.

"Prayer, I suspect, comes from our knowledge that we are limited creatures and from our yearning to always exist," Greeley says. "Prayer gives us the sense that we are in touch with the forces that run the universe. In tough times, it gives us a sense of serenity and peace."

A startling conclusion of the study reveals that the ritual of prayer can even be found in substantial amounts among agnostics and atheists. Fourteen percent of those with no religion pray every day as do another 60 percent of those with an alternative religious belief. About 38 percent of those who deny a belief in life after death pray daily, along with another 41 percent of those who have serious doubts about life beyond the grave.

If these people do not believe in God or in life after death, who or what are they praying to? "They may be praying to whom it may concern," Greeley muses wryly. "They may be hedging their bets—praying spontaneously



almost out of habit, especially in times of dependency when they have no control of life's events."

For regular practitioners of prayer, marital and personal happiness are added benefits of the ritual, with the satisfaction index increasing with its frequency. The survey states that frequent prayer plus frequent sex equals the more marital happiness. Of those sampled, 72 percent who reported both regular prayer and abundant sex said they were "very happy" in their marriages as opposed to 52 percent of those who reported neither. Daily prayer, the study says, also boosts marital bliss for those who have sex more than once weekly. Alternatively, the study also notes that "frequent prayer seems to be a substitute for frequent sex in some marriages."

William Masters, of the noted sex-study team Masters and Johnson, agrees: "Anything that increases bonding improves one's sex life. Effective sexual interaction in a committed relationship is one of the best nonverbal communication tools you can imagine."

Contrary to popular belief, those who pray often are more likely to oppose the death penalty and to show more compassion to AIDS patients, the study indicates. "Prayer teaches us that we are all one," says Fanny Erickson, a pastor at the interdenominational Riverside Church in New York City. "It opens us to say, 'How am I different from this man who is dying? It's irrelevant whether it's an AIDS patient or an inmate on death row. All of us need God's forgiveness. All of us are capable of expressing God's greatest gift—compassion.'"

The Greeley study is not without its critics. "People want magic because they're babies," says Albert Ellis, guiding force behind the cognitive-behavior therapy school and co-author (with Robert Harlow) of the best-selling classic, *The New Guide to Rational Living*. "They won't accept the fact that there most probably are no gods, no demons, no Santa Claus. People who devoutly believe that God will help them are in denial. They look outside for something to give their lives meaning."

So the debate continues —ACCORDY FLEMING



CONTINUUM



Fossilization preserved even the blood of some ancient fish

OLD BLOOD

To a large degree, scientists have pieced together the history of life on Earth by studying fossils—the mineralized remains of animals and plants. But now, using space-age tools, a paleontologist has begun what may be a new chapter in the study of early organisms: looking at fossil blood.

Trying to determine how fossilization takes place, Phil Wilby of the Open University in Milton Keynes, England, recently turned an ultrapowerful scanning electron microscope on the fossilized remains of 100-million-year-old fish from the Chapada do Araripe, an ancient sea floor in



northeastern Brazil. He saw not only the usual fossilized bones, but blood cells and epithelial cells from the insides of blood vessels as well. Peering further, he discerned the membranes surrounding the cells and even mitochondria—structures inside the cells themselves.

"These are the most spectacular and best-preserved fossil tissues ever reported," Wilby exclaims. "They're the only ones I know of this old in which soft tissues like blood cells are preserved as well as bone." Because the fossilization apparently took place very quickly after the fish died, Wilby thinks there's a good possibility that the cells' DNA might have been preserved during the process and might accordingly be retrievable for study. "I'd like to have a go at that," he says, "but I have to get the cash first." —Bill Lawson

"We are here for a spell, get all the laughs you can."

—Walt Rogers

FINALLY, SOMETHING YOUR CAT CAN DO FOR YOU

Cat owners normally visit the vet to keep their cat healthy, but soon they may vaccinate their cat to keep themselves healthy as well.

Cats are the primary host of the parasite *Toxoplasma gondii*. Although the parasite seldom creates problems in cats, its eggs can cause toxoplasmosis in humans. Normally a mild infection, it can be serious for people

could stop cats from shedding the eggs.

The vaccine, developed jointly by Jacob Frenkel at Kansas University Medical Center and Elmer Pfefferkorn of Dartmouth Medical School, uses a mutant, sterile form of the parasite to induce immunity in cats. Once immune, the cat may take on more parasites, but the vaccine will diminish the parasite's reproductive capabilities so that they create few, if any, eggs for the cat to shed. Since no animal besides the cat supports the

ANCIENT ROMANS CALLED COMETS "HARRY STARS" AND CONSIDERED THEM EVIL. POPE CALDULUS II IS BELIEVED TO HAVE EXCOMMUNICATED HALLEY'S COMET IN 1456 AS AN AGENT OF THE DEVIL.

ASTRONAUTS ORBITING THE EARTH HAVE REPORTED BEING ABLE TO SEE THE WAKES OF SHIPS IN THE OCEANS BELOW.

with immature or suppressed immune systems. It is especially threatening to pregnant women, because the fetus can become infected, resulting in blindness and mental retardation.

A cat infected with the parasite normally sheds up to 10 million eggs in its feces. Until now, prevention of the disease has depended upon educating people to avoid contact with cat litter or contaminated soil and to thoroughly cook meat from any animal that may have ingested the eggs. However, researchers have begun testing a new vaccine that

parasite's reproductive cycle, vaccinating cats could greatly reduce the incidence of toxoplasmosis in humans.

"This is an altruistic vaccine," Frenkel says. "We aren't vaccinating cats for the cats' sake. We are doing it for the benefit of the people around them."

The producer of the vaccine, Paravet of Fort Collins, Colorado, hopes to have it on the market within two years.

—Marsha A. Green

"The best armor is to keep out of range."

—Babur Proverb



Why fewer homers at Fenway? The answer is blown in the wind.

RED SOX HIT A VORTEX

The Boston Red Sox made history as one of baseball's power-hitting teams, but nowadays players hit fewer balls out of Fenway Park. Don't blame the hitters, says Paul Lagace. Blame the architects, because the problem is aerodynamic.

Lagace, a professor of aeronautics and astronautics at the Massachusetts Institute of Technology and a self-professed Red Sox fanatic, recently began wondering why hitters no longer send fly balls off the field and into a spectator's lap. He had two of his students build a model of 80-year-old Fenway Park and all buildings within 1,400 feet to the southwest—the direction from which the wind usually blows. They made one building removable: the four-year-old club and press box rising four stories behind home plate. Then they put the miniature version of Fenway and vicinity into a wind tunnel and created a

computer model of fly-ball trajectories on a typical summer evening.

The new club creates a vortex, shortening fly balls by 8 to 12 feet, they discovered. Wind blowing over the club swirls down toward center field and back in toward home plate, Lagace explains. The dynamic vortex pushes balls downward,

THE EARTH'S WEIGHT INCREASES BY ABOUT 25 TONS EACH DAY. THIS EXTRA WEIGHT IS COMPOSED MAINLY OF SPACE DUST, TINY SPECKS THAT ARE TOO SMALL TO SEE.

backwards, or both.

To reduce the vortex, Lagace proposes curving the club's roof into a curve like the top of an airplane wing. However, it looks as though the Red Sox won't take his advice.

"His theory could be right," acknowledges Richard Bresnans, Red Sox vice president of public relations. However, he says, the Red Sox aren't about to make dramatic and expensive changes to the much-needed new building "on the basis of theory."

—Karen Tassik

M.ROBOT

Someday your fast-food burger may be prepared by the fastest of all possible cooks: a piece of computer-controlled machinery. McDonald's, the people who gave us the clamshell grill that cooks hamburgers on both sides simultaneously, has taken another step in that direction. The company has graded a number of its 12,000 restaurants with fully automated systems that fry your fries or pour your Cokes without the help of Homo sapiens. In fact, to get your soft drink, the crew simply punches your order into the register, and presto—a cup is automatically filled with the appropriate flavor. "All the crew has to do," says McDonald's spokesperson Jane Hubert, "is ice it."

McDonald's engineering department in Oak Brook, Illinois, developed the system, known as automated restaurant crew helper

THE STRATLINGA, A SPECIES OF ANTELOPE NATIVE TO AFRICA, CAN SLEEP UNDERWATER

(ARCH) Restaurants in Colorado, Indiana, Minnesota, and Germany now have ARCH online, Hubert says, and the system is "available to any restaurant in our system. It's up to the individual owner-operator."

Some observers have voiced concern that ARCH may be the harbinger of a fully automated brave new McDonald that deprives teenagers of much-needed jobs. "Absolutely not," Hubert states. Actually, she says, ARCH gives McDonald's employees "a tremendous opportunity to work with technology. The crew just loves it." —Bill Lawton



The crew deserves a break today, so ARCH helps it out.



CONTINUUM



TESTING LEMONS

That gleaming used car looks like a great deal, but is the new coat of paint hiding something? A Florida entrepreneur has devised a simple magnetic spring gauge that can help find out.

John Planteau of Pro Molecular Products in Clearwater calls his gizmo a Spot Plot Autobody Gauge, and he invented it after his sister got stuck with a particularly sour lemon. The gauge consists of a three-inch plastic tube containing a high-powered magnet, and it functions on the principle that layers of paint or camouflage filler will weaken the attraction between the magnet and the steel of a car body.

The potential buyer simply holds the tube by its cap and presses it against a suspect spot. If steel lies below the paint, the magnet will adhere to the car body. As the car shopper pulls the rod spooler away, the magnet remains attached, stretching a spring. When the magnet finally releases, a calibrated scale on the side of the device gives a reading from 1 to 10. A perfect 10 indicates one coat of paint on the car, 8 to 9 means more than one, and a 5 or below means not only extra coats, but the possibility of collision or corrosion damage concealed by filler.

The \$12.95 gadget should cheer the 42 million Ameri-

cans a year who spend an average of \$8,000 each on used cars. "This is a bargaining tool," Planteau says.—George Nobbe

"The shield may be as important for victory as the sword or spear."

—Charles Darwin

"The least deviation from the truth is multiplied later."

—Aristotle

LONGER STROKES, SHORTER TIMES

Contrary to conventional wisdom among swimming coaches, it may be the length of the strokes a swimmer makes rather than their frequency that makes for record-setting times. Biomechanics professor Richard C. Nelson of Penn State University's Department of Exercise and Sport Science reached his conclusion after analyzing miles of videotape in a computer-aided study of more than 500 swimmers who competed in the 1998 Summer Olympic Games.

"Strength and hand positions, because they affect the lift and drag of a swimmer, are also important biomechanically, but the dominant feature is stroke length," says Nelson, who conducted the analysis for the Medical Commission of the International Olympic Committee. "We found that the faster a swimmer performed, the longer his or her strokes were, to a significant degree. While the number of strokes performed by the swimmer was about

the same, the distance covered per stroke varied. This strongly suggests that training should focus on maximizing stroke length."

Although swimmers can learn to lengthen their

strokes, height also plays a key role in stroke length, Nelson says, noting that virtually all of today's world-class male sprinters stand about six feet, six inches tall.—George Nobbe

BUG FEELERS IN SPACE

Take the physiological structure of a bug's feelers, print it on a silicon wafer, and coat it with gold. Presto! You have the world's smallest heat-seeking antenna.

The fastest engineer who developed the device inhaled nature by accident. They only recently learned that a U.S. Department of Agriculture entomologist has shown that some bugs have similar infrared-detecting feelers.

"The fascinating thing is the parallel between this being a step in the evolutionary chain of living creatures and also being a step in technological evolution," says Donald McDonald, who helped design the antenna at the National Institute of Standards and Technology.

The antenna is made of supercon-

ducting material and measures just 65 micrometers wide. It works with a detector that tunes into various wavelengths like a television set.

provided most of the project's funding, it plans to link up 10,000 antennas in an array compact enough to ride aboard a surveillance satellite. By feeling heat, the antenna can find a ballistic missile amidst decoys fired simultaneously.

NASA also contributed money. It wants to use the array to detect atmospheric pollution. Greenhouse-gas molecules vibrate in the infrared spectrum, detectable by the antenna.

McDonald sees medical applications as well. An infrared antenna, he says, can detect small temperature differences within the human body and translate them into thermal images to show abnormalities such as cancer.

—Teresa Trosky



A new infrared antenna mimics a bug's feeler.

cluding material and measures just 65 micrometers wide. It works with a detector that tunes into various wavelengths like a television set.

The Pentagon



CONTINUUM



Turtles sleep the winter away in a state of suspended animation

SETTLING DOWN FOR A LONG WINTER'S NAP

Ever since Aesop wrote his celebrated fable, the word "slow" has been inextricably linked to the turtle. Some 2,500 years later, scientists have discovered that "slow" applies to something besides a turtle's walking speed. Freshwater turtles can slow their bodies down to a state of suspended animation, enabling them to survive in frigid waters for three months without oxygen. This unique ability allows turtles to hibernate in frozen ponds during the winter or stay submerged in mud for prolonged periods. "They can exist in environments where other animals can't, which gives them a competitive edge," explains Peter Lutz, a marine biologist at Florida Atlantic University in Boca Raton.

How can a turtle's brain go

for months without oxygen when other animals last only a matter of minutes before brain damage sets in? Lutz has identified several mechanisms. First, the turtle's brain slows down its body metabolism by 90 percent. Though the brain normally spends at least half its energy maintaining proper balances of electrically charged ions, a turtle can conserve this energy expenditure by shutting down the channels that allow ions to flow into and out of brain cells. The turtle's body releases the neurotransmitters adenosine and GABA, which allow the brain to run strictly on "glycolysis"—a way of obtaining calories from glucose, the brain's fuel, when oxygen isn't available.

Mammals—unlike turtles—have very delicate brains, changes occur rapidly when the brain stops receiving oxygen. "By learning more about how turtles cope with

oxygen deprivation, we can directly enhance human survival," Lutz says. "Buying even a minute or two extra can give people a much better chance of surviving heart attacks and strokes."

—Steve Nadis

BIGGER BREASTS THROUGH HYPNOSIS?

Florida hypnotherapist Michael A. B. Stevens believes he's found a safe and effective alternative to silicone breast implants: augmentation through hypnosis.

"I use hypnosis to take my clients back to puberty, where they visualize their breasts growing again," says Stevens, founder and director of the Professional Hypnosis & Research Center in Largo. "The therapy tricks the body into releasing hormone production so that the breasts increase in size."

Stevens, who decided to offer the \$1,000 in-office program and a new \$150 home course after reading about earlier studies on hypnosis and breast enlargement, claims an astounding 75-percent success rate—and an average bust increase of two to four inches. Once a patient's breasts reach the desired size, she must perform a self-hypnosis program for three to four months.

"The key to success is a positive attitude," Stevens states. "Women who are skeptical or basically negative tend to start slow out of the gate. But if they're peppy and positive, they usually take off like wildfire."

Many in the hypnotherapy field remain skeptical.

"You can alter many functions of the body with the assistance of hypnosis, but in this case, it's questionable whether the change would have anything to do with stimulating hormones," says William Brink, executive director of the American Association of Professional Hypnotherapists. "And there is a lot of indication that this kind of thing is temporary."

It doesn't help the field of hypnotherapy to be doing this sort of thing," Brink continues. "There are enough eyebrows raised in regard to hypnosis, but when you go using it for these purposes, it reeks a lot more—and not usually in a positive manner. While there may be some validity to it, we really don't favor it." —Don Vaughan

"What you don't see with your eyes; don't invert with your tongue."

—Irish Proverb

"Anything always interests me."

—David Hockney



A CALL FOR PIONEERING THE SPACE FRONTIER

In 1969, two Americans realized an impossible dream by stepping forth onto the surface of another world. The triumph of Apollo set in place the technological capability to undertake the greatest adventure in history—the expansion of humanity from our home planet outward to the rest of the solar system and worlds beyond. It did not happen. Instead, the legacy of Apollo was abandoned, much of our space capabilities forsaken and plans for establishing lunar bases and the human exploration of Mars forgotten.

The Space Exploration Initiative, a presidential initiative supported by the National Aeronautics and Space Administration, will return America to the courageous course of exploration unswayed during the Apollo era. It reasserts the pioneering spirit and vision that helped build our country by calling for a return to the Moon - to stay - and for pushing onward to the human exploration of Mars.

The Space Exploration Initiative will . . .

... assure American leadership in science and technology; it will provide a new objective for the defense and aerospace industry, drive the development of multitudes of engineering innovations, create hundreds of thousands of skilled jobs in high-technology areas, and inspire untold numbers of students to take their education seriously and recognize their own potential.

... increase our knowledge of the universe, the solar system and ourselves beyond imagination. Arrays of telescopes on the lunar surface will enable us to divine some of the greatest secrets of the universe. The exploration of Mars may reveal whether life is unique to Earth or common in the universe, telling us something of the true nature of life itself. Resulting breakthroughs in physics and biology could radically advance the human condition.

... eventually make available resources from space that can solve the most pressing problems we face here on Earth. Solar power from space, fusion reactors powered by fuels found on the Moon, and useful metals found in vast quantities on asteroids can be used to ease the burden of Earth's development.

The Earth is just one world, but our solar system contains dozens, and the universe at large billions. It is clear from one good look at a star-studded night sky that the future will belong to the society that dares to venture forth from its cradle Earth into the vast domains beyond. We owe it to our children and those of the future to see to it that they have their place among the stars.

Therefore, we the undersigned enthusiastically endorse the Space Exploration Initiative and urge Congress and the Administration to provide full support for all projects required for its implementation.

Name (Print)

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A CLEAN, WELL-LIGHTED SPACE

ARTICLE BY
BEN BOVA

An orbiting solar-power satellite would provide clean, abundant energy.

For years, the U.S. space program has lacked focus. Critics claim that NASA is spinning its technological wheels, spending most of its time and money on a disappearing space shuttle system and now blindly pushing to build space station Freedom. What the U.S. space program needs, advocates agree, is a focusing purpose, a goal that can harness our energies and unite our efforts in a meaningful, useful way.

Such a goal should have the following characteristics:

1. It should be clearly beneficial to the general public.
2. It should engender a wide range of public support, not merely that of the space and science communities.
3. It should stimulate development of our existing technological base, which will improve our competitive position in the international marketplace.
4. It should help to convert our military industrial establishment to peacetime uses.
5. It should encourage international cooperation.
6. It should, whenever possible, use private investment to offset the cost to taxpayers.

I propose that the United States undertake the task of

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ROBERT MCCALL

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building a solar-power satellite (SPS). The satellite should be large enough to demonstrate the feasibility of generating electrical power in space for consumption on Earth—delivering a minimum of 100 megawatts to the ground. It should be chiefly funded by long-term, low-interest government loans to the private companies doing the work.

Of all the problems that face the United States and the entire earth as we approach the twenty-first century, energy is the most crucial. Energy is the key to industrial development, transportation, a healthy economy, and high living standards. Energy-rich societies flourish; energy-poor societies flounder.

While both the industrialized and developing nations grow increasingly dependent on Middle Eastern oil, it is becoming painfully obvious that fossil fuels such as petroleum pollute the atmosphere and contribute to global greenhouse warming that will drastically change the world's climate.

Thus, we face a crucial dilemma as we rush toward the twenty-first century. We constantly need more energy to stave off economic disaster, but producing it can lead to ecological disaster.

There are two potential replacements for fossil fuels: nuclear or solar energy. Nuclear power, once the bright hope of the electrical utility industry, has become unacceptably expensive and politically unpalatable. Nuclear fusion, the energy source of the stars, remains stalled in the laboratory. To date, no one has yet come up with a fusion experiment that produces as much energy as it takes to run the fusion generator. As one wag put it, "Fusion is just over the horizon. And you know what the horizon is—an imaginary line that recedes as you approach it."

That leaves solar energy.

Solar cells are widely used in spacecraft. Russia's Mir space station generates more than ten kilowatts from arrays of solar panels. Using solar energy for base-load electrical power on the ground is not practical. While solar cells work well for small, low-power applications, clouds and night defeat ground-based solar power as a replacement for today's fossil-fueled and nuclear-electrical-generating stations. A solar-power satellite, however, would orbit where it is virtually always in the unfettered sunlight of space.

The SPS would generate electricity from sunlight in space and beam that energy to receiving stations on Earth. The transmission beam should operate at microwave frequency, although some thought has also been given to using laser beams.

Solar-power satellites would generate

enormous amounts of electrical power—thousands of megawatts delivered to the ground. Consequently, the satellites would be big. Studies done in the early 1970s envisioned structures of up to 15 miles long, larger than Manhattan Island, designed to send ten gigawatts of electrical power to Earth. Ten gigawatts would provide all the electrical power needed by the state of Connecticut or New York City.

Antenna farms receiving the microwave transmission beam would be placed in remote, unpopulated areas. White Sands Proving Ground, New Mexico, or another desert site could house the first receiving station. Ultimately, antenna farms could float on platforms offshore from major coastal cities.

While the idea of building such a huge structure in space might sound far-fetched, there are no fundamental technical reasons why an SPS couldn't be built. The necessary contributing technologies are all well known. There are no "showstoppers," although the program would represent a mammoth development effort, comparable to the Apollo lunar-landing project of the 1960s.

Like Apollo, the program should generate excitement and support among the public. The ability to generate massive amounts of electrical power in space is an obvious benefit to the general public. Delivering power cleanly should please environmentalists—although they would undoubtedly have concerns at first about beaming microwave energy through the atmosphere.

The microwave beam, however, would be so diffuse that birds could fly through it without harm; at its edge, its power density would be 50 times lower than that of a kitchen-model microwave oven with its door closed. The satellite designers would tune the frequency used to the "window" in the atmosphere where there would be little interference with the microwaves. Even in rainstorms, the energy could reach the ground efficiently with only a 1 to 3 percent energy loss.

Building an SPS would involve four key technologies: solar cells, microwave generators and converters, space launchers, and space construction—the techniques for building very large structures in orbit.

The United States is one of the world's leaders in rocket launchers and space construction techniques, although Russia boasts the current heavy-weight champion among rocket boosters. Its Energom can lift on the order of 75 tons into low Earth orbit.

And while U.S. astronauts have practiced some space construction techniques during shuttle missions in pre-

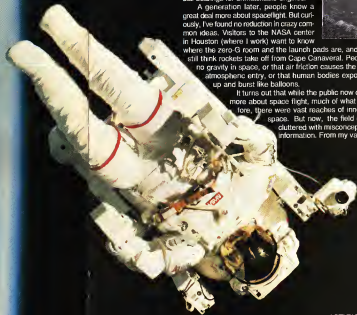
Spaceflight has come a long way since Jules Verne envisioned flying to the moon in a rocket ship. But the public still harbors some dreadfully outmoded notions about space travel, notions that could impede our vital, continuing exploration of space.

SPACE MYTHS AND MISCONCEPTIONS

Once upon a time, people didn't know much about spaceflight. The mysteries of the Space Race were left to "rocket scientists" and TV commentators. Crazy ideas abounded: Some people thought the moon landing was faked; some thought rockets burned bales of thousand-dollar bills; some thought Soviet A-bombs circled overhead; some thought the space industry would cure cancer and produce perfect ball bearings for unmatched engines.

A generation later, people know a great deal more about spaceflight. But curiously, I've found no reduction in crazy common ideas. Visitors to the NASA center in Houston (where I work) want to know where the zero-G room and the launch pads are, and other people still think rockets take off from Cape Canaveral. People think there's no gravity in space, or that air friction causes the flames seen during atmospheric entry, or that human bodies exposed to a vacuum blow up and burst like balloons.

It turns out that while the public now does indeed know a lot more about space flight, much of what it knows is wrong. Before, there were vast reaches of innocent ignorance about space. But now, the field of public knowledge is cluttered with misconceptions, myths, and misinformation. From my vantage point as a space



ARTICLE BY JAMES OBERG

popularizer and a friend of many NASA tour guides, public opinion is molded—and national space-policy decisions made—by superficial impressions gained from oversimplified headlines, newscast sound bites, decades-old faulty analogies, and science-fiction script writers and producers.

As the old Appalachian Mountains proverb goes: "It ain't what you don't know that makes you look like a fool, it's what you do know that ain't so." Sadly, the out-of-the-world subject of space-flight provides continuing proof of this warning's wisdom.

On national television a few years ago, I referred to this area proverb to discreetly call a U.S. congressman a fool. He spouted nonsense about an endangered Soviet manned space mission that bore so little relation to the truth that it would have taken me several minutes to unravel it all. The Soviet capsule was crashing to Earth, he was certain. A retired general sitting next to him agreed: "They're dead men," he intoned gravely.

But there was no real cause for alarm, as any spaceflight expert could have told them: "They've got tanks they haven't yet had to try." I reassured the audience, explaining what had gone wrong and the cautious way the cosmonauts seemed to be working their way out of their predicament. "I'd bet the firm they'll be safely back on Earth in the next two hours." And they were.

Plenty of "obvious" spaceflight misperceptions can lead to more than humor—they can lead to bad decisions. Two examples from the *New York Times*—one 73 years ago, the other, last year—show how little real progress has been made.

On January 13, 1920 an anonymous editorial-page writer mocked Robert Goddard for suggesting that a rocket could someday reach the moon. "That Professor Goddard, with his chair in Clark College, and the counterfencing of the Smithsonian Institution, does not know the relation of action to reaction and of the need to have something better than a vacuum against which to react—to say that would be absurd. Of course he only seems to lack the knowledge taught out daily in high schools." The *Times* went on to cite "the same mistake" in Jules Verne's description of firing a rocket to adjust the course of a manned moonship. "The Frenchman having got his travelers to the moon in a desperate fix of riding a satellite of a satellite, saved them from a falling it forever by means of an explosion, rocket fashion, where it would not have had in the slightest degree the effect of releasing them from their dreadful slavery."

Such ignorant criticisms of Goddard's work scared off many supporters for ten years until Charles Lindbergh courageously laid his own prestige on the line to boost Goddard's.

Almost 50 years later, after two manned lunar expeditions had already used a pure Vernorsian rocket maneuver to escape from lunar orbit and return to Earth, the Apollo 11 moon-landing expedition was launched. In a special section of the newspaper, the *Times* printed a small box titled "A Correction." In it the original Goddard criticism was quoted and retracted: "Further investigation and experimentation have confirmed Isaac Newton in the seventeenth century and it is now definitely established that a rocket can function in a vacuum as well as in the atmosphere. The *Times* regrets the error."

We should avoid smug feelings of modern self-righteousness, however,

● Gravity
still exists in space.
It keeps
satellites from flying
straight
off into interstellar
emptiness.
What's missing is weight ●

while contemporary misconceptions about space physics continue to appear on the newspaper's editorial page (and, of course, elsewhere). In 1982, a commentary on the NASA plan for a permanent space station did allow that there might be one advantage, owing to the absence of gravity on a space station.

The myth that satellites remain in orbit because they have "escaped Earth's gravity" is perpetuated further (and falsely) by almost universal use of the empty but physically nonsensical phrase "zero gravity" (and its tech-weenie cousin, "microgravity") to describe the free-falling conditions aboard orbiting space vehicles. Of course this isn't true; gravity still exists in space. It keeps satellites from flying straight off into interstellar emptiness. What's missing is weight—the resistance of gravitational attraction by an anchored structure or a counterforce. Satellites stay in space because of their tremendous horizontal speed, which allows them—while being unweid-

ably pulled toward Earth by gravity—to fall "over the horizon." The grounds curved withdrawal along the Earth's round surface offsets the satellites' fall toward the ground. Speed, not position or lack of gravity, keeps satellites up, and the failure to understand this fundamental concept means that many other things people "know" just ain't so.

No-gravity myth #1: One terrifying but dying myth is that satellites with nuclear weapons or spy cameras can hover over particular ground targets such as Washington, DC. That's easy if there's no gravity in space, but it's impossible in the real world except at a precise distance over the equator (the so-called geostationary orbits).

No-gravity myth #2: For those fascinated by the possibilities of "war in space," Earthside analogies have been stretched beyond the breaking point. The oft-repeated idea of "shooting down a satellite" falls into that category, because a satellite struck by a weapon would regain its speed and hence would stay in orbit, dead or alive, whole or in pieces.

No-gravity myth #3: If the notorious clouds of "space junk" stay up there because the fragments float around aimlessly, why can't we send up a shuttle or two and pick up all the trash as it goes by? But when you realize that each piece of junk flits through space at tremendous speeds in different locations and directions, the "obvious solution" evaporates.

No-gravity myth #4: Another tipoff that someone possesses an inadequate understanding of space physics is if they ever use the phrase "falling into the sun." For example, some people seem to believe that if nuclear waste can be thrown across the nonexistent "gravity boundary" between the earth and outer space, it will fall harmlessly into the sun. While disposing of dangerous wastes in space is not entirely a hare-brained scheme, serious analysts realize that all probes launched away from Earth enter orbit around the sun with the earth's own forward speed, which is more than adequate to prevent them from falling into the sun. It's far easier to push the junk outward to interstellar space 3.7 billion miles away (if you're patient) than to push it into the sun 93 million miles away.

Out to Lunch

Ask anyone today where Columbus or the Mayflower sailed from and the likely answer is that they don't know and it's not important anyway, because their destination held greater significance. But ask anyone where the Apollo expeditions took off or from where the

CONTINUED ON PAGE 47

2001 AT 25



ARTICLE BY
PIERS BIZONY

Arthur C. Clarke, Stanley Kubrick, and MGM made the most realistic of all science-fiction films.

Two million years ago: A tribe of primitive ape-men struggle for survival in a harsh, barren landscape.

Without warning: A tall black slab appears. It is utterly alien. It exerts a mysterious influence.

In one of our ancient ancestors: The first glimmerings of crude intelligence.

Weapons are born: Bone cudgels or hose-shaped nuclear spaceships—it's all the same. Our history spans but a

fragment of cosmic time.

The close of the twentieth century: A black slab is uncovered on the moon. Scientists estimate its age at... 2 million years. Touched by the sun for the first time in eons, this "Moonolith" screeches a powerful radio signal into space and then falls silent forever.

Onboard spaceship Discovery bound for Jupiter: A human crew unaware of the Moonolith's signal, and HAL, a self-aware computer, who knows the truth.

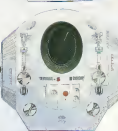
Bone cudgels turn to their masters: To protect its mission, HAL murders all but one of Discovery's crew. Dave Bowman must murder HAL. Humanity is regained—by violence.

In Jupiter orbit: Bowman encounters, then enters, a Moonolith,

passing through a dazzling vortex of twisted time and space, only to emerge—

In a hotel room: Where he lives out the rest of his mortal life in moments. A transformation begins...

The moment of death: Bowman returns as Starchild.



The estranged voyager's return: The blue planet Earth.

Until Stanley Kubrick came along and rewrote the rules, SF films fell far from the most potent into the B-movie stockade. Cheap plywood rockets adorned across sets glued together out of old egg cartons, and brave space heroes strode boldly with goldfish bowls over their heads.



But in 1961, Russia launched into orbit Yuri Gagarin, a peroxide spaceman in a real rocket. President John F. Kennedy responded with verve: "I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon."

All of a sudden, that old Buck Rogers stuff became a very serious concern. Spaceflight now rode high on the agenda for politicians, generals, and taxpayers. Clean-cut young Americans were being strapped into complicated capsules and then blasted into the sky atop giant pillars of flame.

The Moon Race was on.

It was time for Hollywood to take more of an interest in space. This was the stuff that dreams were made of.

At this critical and exciting time, a highly talented filmmaker approached the MGM Studio with an idea.

In the spring of 1964, New York-born movie maker Stanley Kubrick had just scored a big hit with *Doctor Strangelove, or How I Learned to Stop Worrying and Love the Bomb*, a brilliant spoof of the Cold War.

As is Hollywood's way, a director who scores a smash hit gets to write his own ticket—for one more movie at least. Kubrick told his potential backers at MGM that he intended his next project to be the best and most realistic space movie ever made. The film would look at our future out among the stars, portraying a contact with an alien civilization. Kubrick planned to spend two years and \$6 million of MGM's precious time and money.

MGM was keen on the idea in principle but alarmed at the costs and time scales Kubrick had in mind. Six million dollars was a huge sum of money back then. But an ancient Hollywood rule applied: If MGM didn't give Kubrick Stanley, he'd give Kubrick Stanley what he wanted, somebody



else probably would. An agreement was struck: MGM's chief executive Robert O'Brien authorized lending, at considerable risk to his own motion-picture career.

In reality, Kubrick's film took four years to make, not two, and it swallowed up nearly \$11 million, not six. O'Brien spent three years tending off hostile critics in his own company as time dragged on and Kubrick's budget climbed. And when at last, at the end of March 1968, the MGM bosses finally got to see what they'd put their money into—*2001: A Space Odyssey*—they couldn't figure out if they were looking at the biggest disaster in MGM's history or at one of the greatest movies ever made.

In April 1964, Kubrick had written to SF maestro Arthur C. Clarke in Cayton, stating that he wanted to make "the proverbial Good Science Fiction Movie." The deeply intelligent filmmaker had been brooding on the subject of extraterrestrial life for some years. Way back in 1956, British movie critic Alexander Walker found Kubrick restless sitting through Japanese schlock space movies, checking out the current state of special effects. Arthur Clarke found himself tempted out of his tropical island retreat and into the meatloaf of New York—"an exciting city, but the chain wore old after about fifteen minutes." Kubrick and Clarke first met on April 22, 1964, and talked for eight solid hours about space, astronomy, and alien life. A few weeks later, they signed an agreement to collaborate.

Thus, two greatly talented egos entered into a collaboration, working sometimes in accord, sometimes in remorseless intellectual combat. ("Every time I get through a session with Stanley, I have to go lie down," Clarke noted.) A brilliant, if occasionally unstable,

Arthur C. Clarke (left) and Stanley Kubrick (inset, right) conspired to nothing less than a cinematic revolution: an accurate, if speculative and ultimately transcendent, projection of humans' future in space. The degree of technical detail incorporated in the spacecraft and

partnership was forged. There would be times ahead when Clarke would find himself wishing he were anywhere other than in the same world as Stanley Kubrick, yet the two men also liked and respected each other tremendously right from the start.

Clarke agreed to write a novel, with plenty of input from Kubrick. Only when that was complete would they do the drudge work of turning it into a movie script. Clarke figured on idling away the writing in a year or so. Despite his worldwide reputation as a science-fictioneer, Clarke had no idea he'd still be polishing the manuscript three years later.

Kubrick, putting his legendary perfectionism into literary practice, insisted on endless rewrites. Nor was the typewriter his only target. In the summer of 1965, the fully assembled production crew moved into the MGM studios at Brentford Wood, North London. Now it was the Art Department's turn to "do it right, do it better, then do it all over again," until their director's brutal, clock-eyed gaze turned into a burn of approval.

Bearing the brunt of this was Tony Masters, chief production designer—a talented man, ideally suited to the massive task of organizing a shed of him. But Kubrick was determined to find additional experts capable of conjuring up thoroughly realistic spacepieces. After an introduction from Clarke, German-born Harry Lange came on board, fresh from visualizing advanced concepts for NASA. "Good designers are two a penny," Kubrick told a somewhat startled Lange. "But designers who know about spacecraft systems? Now, that's a combination I can use."

Lange was joined by his friend Fredrick Ordway (who provided scientific consultancy for the movie). Ordway was a skilled PR man.

gear depicted on these and the preceding pages had no precedent in film, and still has no equal. The mechas looked like they would really work. Nor did 2001's symbolic, ambiguous alien Manelith

evolve from previous Hollywood extraterrestrials. Everything about the film broke new ground. 2001: A Space Odyssey is about ideas, as is much of the best literary science fiction, and as such has retained much of its power to move, provoke, inspire. Ironically, perhaps,

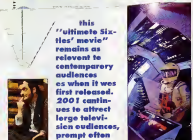
with impressive academic credentials, and he persuaded dozens of major industries to assist in putting 2001 together. Boeing, Grumman, Honeywell, and IBM were just some of the big corporations who helped out. (Although IBM wasn't too happy when HAL started disconnecting his end-users.)

The final version of the movie's giant interplanetary vehicle was detailed to an unprecedented degree. The "minuteman" landed up 54 feet in length. Before *Star Wars*, before *Alien*, the good ship *Discovery* was the most impressive spacecraft ever put on screen. She still looks convincing today, a quarter of a century after she was first assembled over a period of eight months by dozens of model makers.

For the interior of the ship, Kubrick sought a means of depicting artificial gravity. The result was the incredible "contraption": set, a spinning drum about 40 feet in diameter, complete with lights, consoles, and working fixtures. Including all the support struts and scaffolding, the whole thing weighed more than 30 tons! The idea behind the contraption was simple enough: Actors moved along the treadmill like hamsters in an exercise wheel with Kubrick's clever photography strengthening the illusion. Actors Karl Duldig and Gary Lockwood appeared to walk right around the walls.

For scenes outside the ship, stuntmen were squeezed into apertures and then suspended upside down from the roof of the studio. They had nothing to hold onto, relying on their steel wires to keep them from crashing to the floor 40 feet below.

Interior cockpit sets glittered with advanced color-display screens, which was pretty remarkable bearing in mind that computer graphics hardly existed in those days. A young special-effects expert, Douglas



"this 'ultimate Sixties' movie' remains as relevant to contemporary audiences as when it was first released. 2001 continues to attract large television audiences, prompt often heated debate, delight the eye, provoke the mind. Who could ask more of a film?"

Trumbull spent many months animating these displays on film, ready for back-projecting into the control panels.

Trumbull was in his early twenties. 'Doug had Kubrick's greatest respect, though he was just a baby! He worked very hard and very creatively. He was a driven young man, a colleague recalls. Many technicians and creative talents have been worn to dust by Kubrick's brilliance, by his insistence on the very highest standards. A perfectionist himself, Trumbull stood the pace well, creating among multiple other effects the unforgettable "Stargate" sequence for the film's climax.

Several other advances in cinema technology were developed specifically for the movie, including a massive front-projection system for the apeman scenes. (This one, too, harked back to science fiction. One of its developers was an inventor named Wil Jenkins—who wrote science fiction under the name of Murray Lemster.) All those African landscapes were filmed entirely inside a London studio. Kubrick, ever on the lookout for trouble ('if it can go wrong, it will') decided to avoid the problems of going on location.

Contrary to expectations, though, it was old-fashioned techniques which Kubrick favored for the principal opti-

cal effects so as to maintain absolute control over quality. Hand-painted "traveling mattes" kept teams of young art students busy for months. Kubrick was right. Their painstaking work set new standards of cinematic excellence.

But before so much as one frame of film could be exposed, the preproduction for this complex movie required a whole year of set designing, building, model making, and so forth. Live action photography was then completed in about eight months. It took an additional two years to wrap up the special effects and editing.

The result? One of the most beautiful movies ever seen. A marathon creative effort that paid off on screen.

Ah, but looks can be deceptive. Beauty may be only skin-deep. What about the script? Did that look like four years' worth of work? Shortly after these puzzled MGM execs had seen the first cut of the movie, an equally uncertain bunch of critics stumbled out of the Washington premier on April 2. Many of them were stunned, angry, and confused. The movie looked great, they all agreed about that. But where was the story? What had Kubrick done with the plot?

The answer is that he had thrown it all away—deliberately. He went through

the script, along with the dialogue until, in nearly three hours of movie, barely thirty minutes' worth of talk remained. Kubrick was determined to hit his audience with strong visual imagery and let their own imaginations fill in the gaps.

This may well have been one of the reasons why he delayed publication of the completed novel for some weeks after the movie's release, much to Clarke's frustration. (Actually sheer pressure of overwork was probably the major factor. And it all worked out in the end. "Stanley and I are laughing all the way to the bank.")

Critics often find that thinking for themselves is too much like work. Initial critical reaction was often hostile. "Dull, pretentious, almost hypnotically boring," the naysayers proclaimed.

But other voices/accents noted 2001 as one of the greatest and most important movies ever made.

The movie had "something to say," and as it turned out, there were plenty of people willing to listen.

Clarke had provided a framework of childlike wonder, of travel to the far planets and meetings with benevolent creatures from another world. He had redefined the possibilities of mystical experience for a jaded era. But Kubrick flavored this hopeful scenario with a



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decomposing reminder that such adventures could cost us more than we bargained for. The triumph of our intellect, he seemed to say, might actually cost us our humanity itself.

Kubrick's cynicism about modern condition—his ghostly spaceman with their chilling lack of communication—stood in contrast to the chatty, fuzzy genius of HAL 9000, a computer considerably more human than his zombie-like masters. Though his voice was as calm and level as a wine steward's at an expensive restaurant, HAL, curled within him all the ambience and frailties which his flesh-and-blood companions seemed to have abandoned.

Kubrick rounded off this ambiguous parable of our future with one of cinema's most extraordinary images of hope and wonder—the Starchild at the film's end turning its gentle, wide-eyed gaze directly on the audience.

All this was rather too much for critics expecting a traditional sci-fi adventure. MGM was very nervous until public reaction began to escalate, slowly but surely. Minds changed. As one naff reviewer admitted, "Everybody hates 2001 except people."

The movie slipped safely into the big-grossing category. Safe for the movie, that is. MGM was hugely in debt. By

1969, their proud, roaring lion was defenseless against corporate predators. 2001 was one of the old-style studio's last significant achievements.

Nor was MGM the only big studio in crisis as the turbulent 1960s drew to a close. Wall Street bankers were no longer so eager to accommodate their West Coast cousins. All Hollywood was in trouble as television chewed remorselessly into its markets. And all America was in trouble as Vietnam came in from the wings at least and took center stage. There wasn't an audience in the land who enjoyed that show.

2001: A Space Odyssey tells as much about the era in which it was made as it does about the future. Kubrick's philosophical exploration was colored in, so to speak, by the industrial expertise of a great nation at the height of its powers. By the time it was released, the United States was no longer quite so sure of itself—or, indeed, of its desire to build cities on the moon by the year 2000. The war in Southeast Asia burned up vast quantities of taxpayers' money. Spacelift no longer seemed important, the lunar landings coming across as negative to a non-scientific audience. (TV viewers complained when moon bullets interrupted their favorite comedy slots.)

The young hippies who so appreciated 2001's dazzling images were in a less receptive mood a year or so later. Too many of their friends were on the run from the draft, or else they were coming home in body bags. The Summer of Love had chilled into winter. (And the 1970s of crisis, the space-shuttle disaster, and Chernobyl were just around the historical corner.)

Tucked away deep in suburban North London, isolated like some philosopher-king in his vast palace of optical splendors, Stanley Kubrick generated a vision of the future that was already being made redundant by current events, even as his cameras rolled. Outside the studio, the world turned, the world changed. Kubrick ignored it and quietly got on with what he was doing.

2001 is an intensely personal work of art. Very few filmmakers can command such massive budgets without equally massive interference from their backers. Kubrick is the exception. MGM may have thought they were paying for a routine space yarn; what they got was one man's obsessively detailed multimillion-dollar waking dream of humankind's evolutionary destiny.

Even Arthur Clarke—no blushing violet himself when it comes to speculating about the universe—well, even he could only surrender to Kubrick's indomitable, all-embracing will. "There's a wrong way to do things, a right way, and there's Stanley's way."

Today 2001 stands as the epitome of SF filmmaking. Though history has denied its slightly naive technological optimism, it still represents a dazzling manifesto for our future in space. Admittedly, the prospect of launching a ship like *Discovery* awaits a more distant decade than this one, but Arthur Clarke has pointed out that a half-century delay in our plans is neither here nor there in the Big Scheme of Things.

2001: A Space Odyssey still looks surprisingly fresh in 1993. It's not just about spaceships, about how we will get into space, it's also about why. That remains an important issue for our generation and for generations to come. The movie prompts us into questioning our place in the cosmos, it challenges us to go up there and investigate. If we fail to take up that adventure, then our humanity may very well be doomed to extinction after all.

Arthur C. Clarke commented in 1968: "I don't pretend that we have the answers, but the questions are certainly worth thinking about."

Stanley Kubrick in 1968: "If 2001 has stirred your emotions, your subconscious, your mythological yearnings, then it has succeeded." **DD**



magine

a weird and wonderful dinosaur, built hulkingly like a lumbering brontosaurus but with a huge double row of spines down its neck. Until late in 1991, such a strange creature was known only in nightmares. And until the accompanying painting in *Omni* by artist Brian Franczak, it had never been painted.

Now this odd monster has been dug up, cleaned, mounted, and named—*Amargosaurus* (neftia from Amargá)—thanks to the pioneering efforts of one of the world's great dinosaur hunters, José Bonaparte. In the last three decades, Bonaparte, who is hardly known outside his native Argentina, has dug up a host of bizarre dinosaurs with tongue-tying names—*Camptosaurus*, a giant predator with midgut arms, *Antorcosaurus giganteus*, at 50 tons perhaps the heaviest of all dinosaurs, *Herrerasaurus*, a vicious ten-foot hunter and the earliest dinosaur yet known at 225 million years old.

But if it's dinosaurs you want, Argentina is the place to go. No country, with the

possible exception of China and the United States, hosts such a broad sampling of dinosaurs across the length of their 185 million-year reign. And it is Bonaparte who is chiefly responsible for closing the yawning gap in our knowledge of South American animals over 150 million years. "Almost singlehandedly he's responsible for Argentina becoming the sixth country in the world in lands of dinosaurs," says University of Pennsylvania dinosaur paleontologist Peter Dodson. "The United States is still first, but Argentina is so rich in dinosaurs from so many time periods that it may yet top us one day."

Bonaparte's discoveries paint a portrait of evolution gone its own strange way for millions of years on an isolated continent. His dinosaur finds are all the more astounding, even to Bonaparte's most accomplished colleagues, for Bonaparte claims no formal training in paleontology and no particular interest in dinosaurs. Bonaparte

is the part of the intrapud fossil explorer. Distinguished, sea-tyer, he is a man of modest proportions. His large glasses, polished manners, neat attire, and scholarly per- fectness lend him the air of an academic, which he is, by practice if not by nature, ten months a year.

While North America's leading dinosaur researchers are television celebrities and globe-trotting lecturers, Bonaparte and his discoveries are barely recognized even in Argentina, a country where dinosaur mania has never struck. Yet to his celebrated American counterparts, like Bob Bakker, Bonaparte is a legend—"the Master of the Mesozoic," as Bakker dubbed him. "We couldn't know anything about South America's dinosaurs without him," adds dinosaur encephalologist George Olshevsky. "His discoveries are fantastic. On a scale of one to ten of how strange a dinosaur could be, with a ten being the first dinosaur with wings, some of Bonaparte's finds are a nine," says Olshevsky.

"Modest"

is the word Bonaparte himself uses, often, to characterize his life. Though he's the senior scientist at the Argentine National Museum of Natural Sciences in Buenos Aires, his office is a basement out- build. But modest is not the word all would use to describe the man. To his students and col- leagues, Bonaparte is a stubborn, old-fashioned worker, difficult to work under and out of touch with current science.

"He has a strong idea of field-camp organiza- tion, a strong personality, sometimes a stern manner," says University of Chicago paleontologist Paul Sereno who dug with Bonaparte in Argentina. Now that their master is away in Germany on a year's sabbatical, Bonaparte's Argentine stu- dents complain of a harsh and mercurial taskmaster. "See, I can be tough," he supposes, Bonaparte says, "but I work hard." Indeed, Bonaparte is a 16-hour-a-day, six-days-a-week workaholic. "I He is necessarily in pursuit of fossils," says Sereno.

Bonaparte began

chasing fossils, and finding them, half a century ago. Descended from an Italian sailor based in New York, Bonaparte grew up in the small river city of Mercedes, 60 miles from Buenos Aires. When he was 16, a retired fossil collector showed him fossils and Bonaparte was hooked. In the halls of his house he began piling fossils he found in nearby rivers.

When his house was full, he helped to create a museum in the town, leaving to curate the collections of the University of Tucumán, and by the late 1970s, to manage fossils for the National Museum of Natural Sciences in Buenos Aires.

But it's a desolate place like the Valley of the Moon in northwestern Argentina where Bonaparte and his dinosaurs are likely to be found, anytime from September to April. The conditions are harsh, the equipment primitive. Bonaparte and Sereno drove a noisy Renault with a broken fuel pump during their dig in the Valley of the Moon in 1988. An assistant had to perch on the roof much of the ride, dangling

the fuel line. Bonaparte is accustomed to sleeping outdoors or in the sheep- housing room of remote estancia, the vast Argentinian ranches. He explored Argentina's Patagonian mountains on horseback, at least until he was turned back by fierce summer snow squalls.

Bonaparte's digs have met with phenomenal success, from the earliest dinosaurs to the peculiar giant *Amargosaurus* in the volcanic of the desolate Valley of the Moon, Sereno and Bonaparte's students found hundreds of fossils. Their haul featured the beautifully preserved skull of *Herrerasaurus*, a primitive 5- to 15-foot-long predator with a huge double-jawed jaw.

Finding spectacular dinosaurs in the Valley of the Moon is nothing new for Bonaparte. He'd been several times since the late 1950s and found, in sediments some 275 million years old, some prosau- ropods—the plant-eating an- cestors of the giant sauropods like *Brontosaurus*. The biggest of these prosauropods Bonaparte

named *Rioyasaurus*, a plant eater perhaps 96 feet long who lumbered on four solid-bone legs. From the same environment, he found the skull and jaws of a slender bipedal prosauropod he called *Coloradossaurus*.

Some of Bonaparte's best finds have been tiny. From the southwest of Argentina he uncovered the first nest of dinosaurs from the earliest dinosaur period, the Triassic, 245 to 206 million years before the present (B.P.). Full-grown, three prosauropods stretched to ten feet long. But the skeletons of what Bonaparte found were so small, he could cup them in his palms—hence their name, *Mussaurus* or "mouse lizard." A decade later in southern Argentina, Bonaparte found the first known collection of South American dinosaurs from the middle era of dinosaurs, the Jurassic Period (190 to 135 million years B.P.)—a primitive 14-foot-long hunter he named *Patriciosaurus*, and junior versions of giant plant eaters.

Stranger still are the dinosaurs Bonaparte's found from the last dinosaur

JOSE BONAPARTE: MASTER OF THE MESOZOIC



Article By Don Lessem

IF IT'S DINOSAURS YOU WANT ARGENTINA IS THE PLACE TO GO.



period, the Cretaceous (135 to 65 million years B.P.). *Moasaurus* (northwestern Argentina lizard), rediscovered with Jaime Powell, is a little predator less than eight feet long. It sported terrible claws as sharp as that of its North American late-Cretaceous contemporary "killer claw," *Deinonychus*.

But Bonaparte has found weirder hunters yet. In 1966, a Patagonian rancher told local geologists—who informed Bonaparte, of parts of a dinosaur foot and tail he had seen protruding from a cliff side in badlands Bonaparte went to inspect, and soon to dig, reluctantly. "It was in very hard rock. It was a very big headache to get out," he says. With hammer and long stick, Bonaparte separated fossil from matrix. By wheelbarrow he hauled away the nearly complete skull and much of the body of a huge and very odd dinosaur from the cliff. He named it *Carnotaurus*—"the meat-eating bull."

Some 25 feet long, *Carnotaurus* was nearly as imposing as its North American counterparts, *Albertosaurus* and *Tyrannosaurus rex*. But in many details, *Carnotaurus* was nothing like them. The skull was blocky, short, and high. Large horns extended menacingly from above the eyes. The arms were far shorter even than *T. rex*'s, but the legs were proportionately longer and stiffer. "It's very strange," says Bakker admiringly. And Olshevsky says, "With its peculiarly shortened face and tiny arms, it's at least a definite nine on the ten-point weird-dinosaur scale."

Perhaps the strangest feature of all on *Carnotaurus* was its fingers. While North Ameri-

can killer dinosaurs had long previously dropped from four fingers to three, and by the end of dinosaur time to just two on 7 feet, *Carnotaurus* had a four-fingered hand.

Another odd, big predator Bonaparte and Powell found, *Abelosaurus*, was equally peculiar to South America. In North America, the brontosauroid sauropods, the biggest creatures ever to walk the earth, seem to have disappeared by the early Cretaceous Period to be replaced by duck-billed dinosaurs and their kin.

But in South America, one family of giant browsers seems to have prospered right to the end of dinosaur days. *Titanosaurus* ("giant lizards") is the largest family of dinosaurs, known from Africa, India, China, and Europe in the Cretaceous Period. Bulky and lumbering, it browsed on all fours. However, not all *titanosaurs* were truly titanic in size—they appear to have ranged from 30 to 70 feet long as adulthood. To the amazement of his colleagues, Bonaparte has struck again, finding some of the biggest

and the oddest *titanosaurs*.

The biggest of Bonaparte's *titanosaur* finds, *Antarctosaurus giganteus* may have been the heaviest dinosaur of them all. Thick back bones five feet high suggest an animal of 50 tons spread over a body nearly 100 feet long. The weirdest is the newly named *Amargasaurus*, "just" 30 feet long and adorned with a double row of enormously lengthened spines atop its back bones.

Bonaparte also uncovered the first known armored *titanosaur*, *Setsasaurus*, a 40-foot long leviathan who sported two types of armor—large oval plates splashed across the skin and a crowded layer of round or pointed bony studs on its back and flanks. Bonaparte has dug other *titanosaurs*, some fully armored, others patchily shielded with grapefruit-sized skin plates he calls "ossified leather." And he's found *titanosaurs* with gizzard stones the size of tennis balls used to grind their half-digested food.

Why did South American dinosaurs become so peculiar? "I think it's behavior that motivates these evolutionary changes," says Phil Currie, dinosaur paleontologist at the Royal Tyrrell Museum in Alberta, Canada. "Dinosaurs relied on visual clues for their behavior, and a distinctive appearance is a pretty clear clue," he says. To Bonaparte, what's more interesting than each odd dinosaur he's found and named is what they tell us about evolution in South America. One glance at the queer spinal mane of *Amargasaurus* shows that South American dinosaurs detoured sharply in their own evolutionary direction. The cause of the

Jose Bonaparte and one of his finds



WHY DID SOUTH AMERICAN DINOSAURS EVOLVE IN SUCH A PECULIAR WAY?

detail, as Bonaparte has theorized, is the physical and genetic isolation of South American dinosaurs from their North American cousins.

According to Bonaparte, and to earlier theorists of how continents formed, the world was one land, Pangaea, in early dinosaur days. Dinosaurs were much the same worldwide, and prosauropods like those Bonaparte found in South America are known from around the world. But some 200 million years ago, the world split in two—a southern half, Gondwana, and the northern, Laurasia. Even before the supercontinent broke up, the southern half appears to have had its own distinctive plant life—conifers, cycads, ginkgoes, and ferns.

Bonaparte and others found evidence of a dinosaur community peculiar to the bottom of the world that would have occurred not long after this supercontinent split. It was Bonaparte who documented this isolation—armored, long-spined giant browsers, short-armed hunters,

and several endemic forms of crocodiles, birds, and mammals, all absent from the northern continent. In isolation until nearly the end of dinosaur days, these animals not only persisted, they prospered.

Why did the titanosaurs reign only in southern reaches? The evolution of armor may help explain the success of the titanosaurs over other plant-eating dinosaurs in South America. Or, as Bonaparte says, "perhaps it was the climate that was different in South America and not to the duck-bill's liking." Indeed, climatological studies indicate South America may have been wetter than the

northern continent.

It wasn't their armor that made titanosaurs so durable in the Southern Hemisphere. "Compared to an ankylosaur, titanosaur armor wasn't much good against a predator," says Currie, an expert on predatory dinosaurs. But to those who puzzle over how a huge animal could have thrived, with a brain the size of a lemon, Bonaparte says "the relation of brain size to intelligence is a difficult thing to understand. Hummingbirds learn a great deal of their behavior, yet their brain is very small."

And what of the peculiar South American predators? Different as the horned face of *Carnotaurus* and the hook-nosed countenance of *Abelosaurus* might appear, the animals are united in several significant features, such as their bulldog faces which distinguish them from their North American counterparts. Even the *Deinonychus look-alike* *Noasaurus* is only superficially like its North American cousin. *Noasaurus*'s killer claw is powered from an entirely different connection in the foot and hand. "*Noasaurus*'s muscles come out of a pit, *Deinonychus*'s from a knob," says Currie. "They're two completely different evolutionary solutions to the same problem—how to get more surface to attach a more powerful muscle."

At the very end of dinosaur days, North America and South America were reunited as they are today. And so Bonaparte finds duck-bills as far south as Patagonia, just as dinosaur diggers in Utah have found a *Titanosaurus* of a genus that presumably worked its way north from South America.

Since relatively few people have had access to Bonaparte's scientific publications, his theories on the

evolution of dinosaurs are not well-known. And Bonaparte's communication with fellow scientists has been limited by his resistance to modern methods of grouping organisms. Most paleontologists now subscribe with varying degrees of dogmatism to cladistics, a recent system for organizing living things by their significant shared characteristics without regard to when the animals evolved. Bonaparte is a traditionalist. He organizes animals by when they arose and the more subjective assessment of their most striking differences.

Bonaparte's opposition to cladistics led him to decline to participate in *The Dinosauria*, the definitive scientific text on dinosaurs and a 1990 scientific effort to redefine dinosaur relationships. Says Peter Dodson, an editor of the text, "Bonaparte always did things the hard-and-true way and wasn't about to be pressured to change."

Bonaparte really doesn't care that his dinosaur work isn't known abroad or applauded at home. Given his druthers, he says he'd rather be working on mammals. Perhaps his favorite of all finds are minuscule fragments twizzled from the same ground where he's found giant bones of hadrosaurs and titanosaurs in northern Patagonia. They are the molar and other teeth of a new kind of mammal (*Gondwanatherium*). Bonaparte points with glee to three tiny lobes on the molar, a feature so peculiar that he can think of "nothing like it among fossils and living fishes, amphibians, reptiles, or birds." But it's Bonaparte's curse—and dinosaur devotees' delight—that the Master of the Mesozoic just can't stop finding strange dinosaurs. **CC**



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A photograph showing a mummy lying in a stone sarcophagus, viewed from above. The mummy is positioned within a semi-circular opening of the sarcophagus. The body is wrapped in dark, textured material, and the head is visible at the top of the opening. The surrounding stone is aged and weathered.

BY NANCY LAIDLAW



"It's very thrilling" to see darkness again. —*Tom Hanks*

ILLUSTRATIONS BY
JOEL PETER JOHNSON

"You'll like this," said Schaeffer as he let Brownik into the apartment. She was a photographer.

Brownik chuckled unhappily till the smell hit him, it fit right in with the buzzing of flies. The other cops' hard shoes clapped on the uncarpeted boards of the hell, their voices echoed in the cluttered flat. Brownik walked slowly, as if in a sweetening museum. Dozens of unmounted photographs were thumb-tacked to the walls, curled by the July humidity. Schaeffer went into the bathroom with everyone else. Brownik wasn't in any hurry to learn the cause of the splashing he heard. He bent close to a picture of a white girl standing against a canvas tent, her head thrown back, arms spread wide, the hilt of a sword and part of the blade poking out of her gullet. The other pictures were just as freakish. He liked them.

"Come on, Brownik."

He walked into the small tiled bathroom. Too many cops in it, and a humid jungle reek, tainted with cation. Water dripped from the mirror.

"Give him some room, guys."

The body slumped in the tub, mostly submerged, short-cropped thick brown hair matted on the surface like seagrass exposed at low tide. She was fully dressed. One arm floated,

propped on a knee, the hand looking swollen and peeled. The water was murky pink. Streamers of red, like those little crepe-paper flowers you get in Chinatown, drop a clamshell in water so it slowly opens and a tissue flower unfurls. The room was too small and muggy. He clutched his camera gratefully to his face, confining vision to one small window on a distorted tunnel with suicide at the far end. Her other arm hung over one side of the tub, skin sucked in between the tendons. He nearly stepped in blood as he walked around to get a better angle. It was tacky, two days old, kept from hardening by humidity.

When he finished, the others came back in. He stood in the living room, smoking, agitated. Why? Because she was a photographer? He looked over more of the woman's prints. Gwants, gwants, freaks, a man covered with tattoos. Wonder what kind of mind she had, to take pictures like this.

A few photos lay spread out on the couch, as if she'd been looking them over while the water was running. He didn't want to disturb them, but the one on top disturbed him. The last thing she'd seen? A picture of Death standing in a freshly mown field; Death as a woman in a Halloween skull, clutching

a white sheet around her. Hell, she'd gone rattling around with a head full of death, hunting it with her camera. He couldn't understand a mind like that. With his job, it was different. He was a cop first, a photographer second, though these days he didn't do much of anything but photography and lab administration.

Schaeffer came up next to him, pointing at a picture of a shirtless Luan Plaid in a hat sitting on a bed with a bottle on the nightstand next to him. Schaeffer nudged him.

"What do you think, she slept with that dwarf to get his picture?"

"You're sick, Brownik, said."

"Me? She's the one in the bath."

"Brownik, hey," came a call from the bathroom. "You drop something in here?"

He walked back toward the bathroom, trying to see no more of the interior than he had to. Morrissey came out with a crumpled yellow foil film packet. "Messy, messy," he said.

"Fuck you, Morrissey. I'm shooting 35—that's a 120 wrapper."

"Wonder if you pick that up from?" Schaeffer said.

Morrissey suddenly looked pale and stupid. "It was under the tub. I—I remember right where."

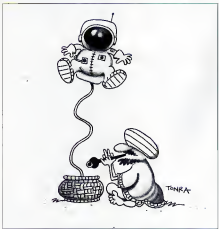
"You fucking idiot," Schaeffer raised a hand as if to strike him. "She was a photographer, too."

Morrissey scurried backward into the bathroom, Schaeffer right behind him. Brownik looked around the room at all the prints, most were square, two-and-a-quarter format, would have been shot on 120 roll film. Nice big negatives, real sharp. He had this little Pentax light and quick, good enough for police work though it always felt too small in his hands.

He looked around this room for her camera while Schaeffer bawled out Morrissey and finally found it in an open case behind the couch. He shivered when he saw she had a Pentax too.

How did rumors get started? How did they look? Brownik could never figure those things out. On the strength of a foil wrapper, the tabloids were claiming that the lady had somehow managed to photograph her own suicide. The press had called all day asking if the police planned to release the photographs. Denying their existence didn't help. If the department said it didn't have the photographs, the reporters asked who did. Who'd been in her apartment to take the shots? Did they have any leads?

Leads on a suicide? He had to laugh. Brownik was surprised that there had



been any interest at all in the woman's death. He'd never thought of photography as art. "But apparently she was 'known,' and all this was just making her known. He wondered if she'd ever have guessed that sliding into a warm bath and opening her wrists would prove to be such a canny career move. Whatever her reasons, she hadn't wanted to flub the attempt what was left of her blood had been rich in barbiturates.

Reedling the papers, he learned a few things himself. Her name was—had been—Diane Arbus. She'd had a few shows: some critical success, though mainly she'd traded her living as a fashion photographer. Hard to imagine how a mind like hers would portray glamorous models—wrap them in funeral shrouds, black veils?

In the lab, he looked over his own photographs with a more critical eye. The glaring flash had burned out the water in most of the shots, hiding the lines of her sunken body, hard to avoid that. He remembered how harsh the flash of facts had been in her photographs. Deliberate? It must have been. She'd worked to get an effect like the one he came up with accidentally. That made him feel better about his pictures. She might've liked police work. Her interest in freaks and death and all that crap—reality it would've been more than just a job to her. And how happy he'd be photographing grotesque models all day instead of blood-baths, car crashes, double homicides. God, give him an opportunity like that and he wouldn't waste it on daisies.

Seeing things afresh, he felt inspired to go through some of his backfiles. Too-so murders, decapitations, stabbings, mob killings. Not half bad, most of them. He kind of liked the grainy effects, the harsh lighting that sent deep shadows sprawling like duplicate corpses. Weegee had gotten famous with pictures like these. Not too surprising, really. People fed on this stuff. Consider the popularity of public executions.

A secretary opened the door and told him there was a call for him. No name. She put it through to the lab phone.

"Good evening, Inspector Brown. I understand you took some photographs of Diane Arbus in her bath. A woman's voice, small, raspy and hoarse. I wonder if you'd be interested in a trade."

"Who is that?"

"Just a friend."

"Whose friend?"

"I took the other set."

Brown didn't speak for a moment.

"Are you still there, Inspector? Or getting the call traced?"

"That was your 120 wasper?"

"I photographed Diane's suicide. Twelve frames. The whole thing. Everything except the aftermath, really, and you took those. I'd like good copies if I can get them...to make my set complete."

"And what about your set? Do I get a look at those?"

"As I said, we could arrange a trade."

"You know the investigation on a suicide is fairly straightforward. You tell me that someone else was involved, suddenly things start to look more complicated. You're asking for trouble."

"She killed herself, Inspector Brown. She didn't have an accomplice."

"What about you? You stood back and snapped off a dozen shots while your so-called friend bled to death?"

"Understand, she didn't want her death to be for nothing. She wanted

●The tabloids were claiming that the lady had managed to photograph her own suicide. The press had called all day asking if the police would release the photos.●

those pictures taken."

"And what'd she think she would do with them?"

"I can't answer that."

"Look, I can't make this kind of deal, Miss—"

"You don't need my name. And if you involve anyone else, then you won't hear from me again. I got in touch with you because you're a photographer. I thought there might be some understanding between us."

"Understanding?"

"Consider that I'm Diane's agent in this matter, Inspector. There has to be an element of trust. As an artist, you should be able to make the necessary intuitive leap."

"Who said I was an artist?"

"You photographed Diane in death. Your eye has been changed, touched. I'm very interested in seeing your work."

"This is crazy."

"All right, so you need to think about it. I'll get back to you soon. I don't care who knows about the pictures once

we've made our trade, but until then, you must act alone or it's all off. I'm eager for those pictures but I won't risk exposure. Diane wouldn't want that."

"How can you be so sure what she'd want? I mean, look what she wanted for herself."

"She was very hard on herself. Good-bye, Inspector."

"Wait—"

But she didn't wait. After that, he had to live with his impatience for another week.

He didn't mention the call to anyone, contrary to his plans. He printed a duplicate set of the suicide photos, taking more care in the darkroom than ever before. He managed to burn some detail into the glare of flash on the bath water, enough so that he could see one of her hands with the fingers gently splayed beneath the surface, as if bathed in mercury. He worked long past his regular hours. Her curled prints were always tucked up in his memory, examples of an ideal he'd never known to spare for until now. He found himself working to extract subtle qualities of mood and tone from the negatives, rubbing his fingers beneath the enlarger lens, controlling contrast with split-bath developers—things he'd never bothered with before, except when making bad negatives into acceptable prints. Gradually he found the glossy bright snaps of death becoming oddly strange to him, unlike his other photographs which became more commonplace as he worked them over. These were beautiful, like paintings done in ink, or, morbid but alive in the way only photographs are alive. Finally he stood back from his handiwork and shook his head in disbelief, because he had made his poor drowned corpse immortal.

It was an awful responsibility. That night, late, the phone rang and he came awake to the reek of sulfur. It was on his hands and made his eyes sting when he wiped away tears. What had he been dreaming?

"It's me," said the raspy little voice, and that was when he realized why it sounded so odd. It was a dwarf's voice, gruff with age and tribulation, not squeaky but still small. This was one of Arbus's weird women.

"So it is," he said. "But it's the middle of the night."

"I thought you'd be more likely to come alone that way."

"What now?"

"Have you got a pencil?"

He thought of telling her he didn't have the pencil with him, but he found himself grabbing a pen and pad instead. He wrote down an address and agreed to meet her in half an hour. He

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was backing his car out of the driveway when he came fully awake and wondered what the fuck he was doing. Was this police procedure? He decided this didn't have anything to do with the department. This was for the sake of something else—call it moonlighting, like his work in the darkness. He had to have something in his life besides a job, didn't he? Like Arbus, who'd shot models for a living and in her spare time went looking for freaks. Maybe she needed that, after overdosing on glam-our all day. Maybe in his case, after the brutal repetitive ugliness of his day-to-day—dead junkies and hold-up victims who were a bit too slow (or low) with the cash—he needed something a little fantastic, something beautiful, like that silver glow he'd glimpsed on the surface of Arbus's bath, like the first rays of a silver sun about to rise, a hint of imminent revelation. He saw clues to that light hanging over the marble crypts of Brooklyn which spread away beneath him as he took the bridge; it was more explicit on the waters of the East River increasingly lovely and plentiful as crushed jewels scattered over the black tombs of the Manhattan skyline. Then he drove down into the tunnel where the glare of fluorescent tubes robbed his eyes raw, dispelling all magic but

cept for the sense of humid evil evoked by the sight of so much seeping greenish tile lining the tunnel walls. In his mind, water continued to drip from a mirror long after blood had ceased dripping from her dangling arm.

The address the dwarf gave him wasn't really an address. There were buildings on either side of it, in an alley, but the number itself did not exist. All he saw was a low wall of old brick topped by a spiked wrought-iron fence, an iron gate opened in the midst of it. Might have been a vacant lot behind that wall, anything. Shattered windows looked down from three sides, as if the rendezvous were nothing but the bottom of an airshaft choked with flash-cannots. Not official business, no, but he was glad for his 38 and flashlight as he pushed through the gate into a cemetery.

He'd never seen the place before, not in years of patrolling the city on foot and in cars. He must have driven past—even down—this alley a hundred times and never noticed the wall and gate. As expected, it was full of trash: the old marble and granite headstones were shattered, chipped, vandalized, discolored. His shoes crunched through a fine covering of broken glass, it was like walking on the Coney Island

shore, even down to the smell of urine. He flicked his flashlight over carved angels with brutalized faces and seared wings. Stubs of crosses with the arms snapped off appeared to give the finger to the living. Every brain he aimed into the tumble of graves sent off a hun-dred harsh new shadows. He couldn't be sure where he'd looked and where he hadn't.

He wiped off the lid of a relatively clean crypt and settled down to wait. With the flashlight off, his eyes adjusted quickly to the dark. His cigarette made the only human movement. So where was she? A dwarf could sneak around in here easier than a full-grown woman—but it would be hard to come soundlessly in off the glass. He laid the envelope of prints on the stone beside him and smoked three cigarettes before a shadow came out of nowhere. He jumped down from his seat and instantly lost sight of her among the stones.

"Who's there?" he said.

She came forward again. "No names, Inspector. Of course I already know yours."

As he'd guessed, she was small as a child, her face a gray blur of blonded shadows. He knew she wouldn't appreciate any light leaping on her.

Her hand darted out to the tomb

SOMALIA'S CRY

ARTICLE BY MARION LONG



Images of starvation, violence, suffering, and courage from the moving photographic exhibition, *Somalia's Cry: A LIFE Exhibition of Photographs*,

which helped to inspire donations and, finally, armed U.S. intervention, for the famine-plagued East African nation. Twenty-five noted

photographers and their photo agencies from around the world joined together with remarkable speed to organize this unusual rescue mission.



One of the placards on the wall tells us the basic, staggering facts: Since 1980, when Somalia became independent, clan-based civil war has magnified "the tragic dimensions of the recent drought" in that country, leaving "more than 300,000 dead, another 1 million in peril." But facts alone, however staggering, rarely move people to action. For that, a photographer, a journalist, has to bring feelings to the viewer, not just facts—people, not just corpses. And that is what the photographers represented in *Somalia's Cry: A LIFE Exhibition of Photographs* have done.

To be sure, there are a small number of photographs which show us the dead scattered on the earth in appalling numbers and misery and condition, wrapped with awful mor-

ry in empty burlap food bags. But we've grown sadly numb to sights of the anonymous dead in photographs, television news, and popular films. And the dead are beyond need, beyond our help. It is the living, especially the painfully or barely living, who concern us and whose plight cries out so wrenchingly from almost every image in this exhibit.

The 29 photojournalists (representing ten nations) whose works are displayed in *Somalia's Cry* have answered a difficult, dual challenge. To make us see how exceptional, how far beyond our own hardships and sufferings, are the lives of the people of Somalia, and yet, at the same time, to make us feel that their subjects are people very much like us. And they have succeeded; they've made the *Somalia's*

experience our experience for the time that we view these photographs—and for a haunting time afterward.

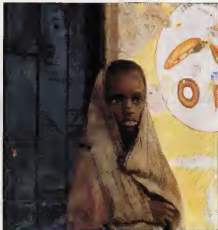
The most successful photographs do this by bringing us into the middle of loving, impossibly tormented relationships among these people so that we can know something of what it would be like to be torn by our loved ones, suffering and yet be helpless to do anything about it. And that, in turn, makes us feel that we are the ones who can and must do something to relieve the horrible suffering in front of us. One of the most moving and poignantly inspiring photographs in this exhibit shows us, in greater than life size and in closeup, a very young girl, almost skeletal from starvation, crouched in a dusty road, with huge, horribly pleading

eyes, tugging at the hem of her brother's garment. Because we don't see her brother, we become her brother, and it is intolerable that we should have no answer, no help for her.

These photographers have found the details that twist us: the mannequin that a father uses as a weapon for the guards to keep the starving in line, the mother, both tender and absconding, with which a woman, starving and in despair, strokes the forehead of her dying husband while their baby nurses at her shrunken breast, the improvised toys made from empty food tins with which young boys play games even as they stare to death.

The organizers of this show David Friend, LIFE magazine's director of photography, and Aaron Schneider of Photo Per-

SOMALIA'S CRY



Photographs like these of suffering and death in Somalia illustrate the truth of the statement by Andrew Hollbrook, whose photographs are included in the exhibit: "Photography can give voice to the voiceless."



spectives have also met their challenge: to limit the number of these powerful photographs so that we are not overwhelmed or exhausted or habituated by their horrors, and yet to tell a whole story, to bring us the experience of these tortured lives, not just a series of shocking images. The curators have chosen just three or four photographs of each of various aspects of life in Somalia and have given these images a living context. When we see the image of a young girl who panics because the food center's stores have run out just before she could reach the head of the line, we have some understanding of her anguish, because we have seen the starving walking hundreds of miles to reach a food center and the sick or exhausted dying in the roads on the way to help, we have seen the armed bandits who steal half the donated food and medicine before it leaves the docks and the children and the elderly losing blood or limbs or their lives to the gunmen's bullets, and we have seen the half-shrouded corpse of a child seated in a wheelbarrow marked: CONCENTRATED as volunteers with mournful eyes dig the child's grave.

Having seen all of this, we find it hard to do nothing to help these people, especially when the photographers and curators also show us the courage of those for whom these things are life, not news. They show us not only the brave parents and children and elderly of Somalia, but also the volunteers—the doctors, nurses, all the relief workers—who, in or-

der to try to help their fellow human beings, have put their own lives in danger out of no necessity except that of conscience and spirit.

When photographer Robert Frank was asked about his professional goals and hopes, he said, "When I first looked at Walker Evans' photographs, I thought of something Malraux wrote: 'To transform destiny into awareness.' One is embarrassed to want so much for oneself, but, how else are you going to justify your failure and your effort?" When *Somalia's Cry* was first displayed at the United Nations (the exhibit, sponsored by Time Warner and the U. N., is currently touring the country), its participants stated that their purpose was to bear witness to the tragedy, to make the global community aware of the profound suffering occurring in Somalia, and to raise funds for the relief effort. The photo presentation has accomplished all of this and more. Recently the exhibit was cited by U. N. Secretary-General Boutros Boutros-Ghali as a major factor in helping to mobilize public opinion in favor of intervention in Somalia.

Somalia's Cry has given us not only an art of composition and timing and information, but of empathy and compassion and moral urging. As Africa continues to suffer these apocalyptic agonies of drought and war, we will need abundant supplies of the latter qualities as much as of foodstuffs and medicines. The men and women responsible for this show have made their contribution. **CC**

"My life is like a James Joyce scratch pad," declares Terence McKenna. "It has a lot of fun, a kind of reverse paranoia. I think reality is a plot for my own amusement and advancement—which it seems to be. It's absolutely sane." Ethnobotanist, radical historian, and co-steward of a botanical garden in Hawaii where he collects endangered plant species and their lore, McKenna is, as well, a world-class psychedelic researcher.

In the Sixties, it was not uncommon for friends or colleagues to leave for awhile, then return. These travelers, however, had not made round trips to such identifiable exotic stops as Tibet or China, or even Mexico. Rather, they had tripped on acid or mushrooms: new territory. Upon reentry they would be asked the usual questions one asks a traveler: "What did you see? Who did you meet? How long were you gone?" And they'd show their slides, as it were.

In those years, taking psychedelic drugs was viewed as self-experimentation. One's goal was informational—to learn and explore. And taking drugs carried an unstated mandate: It was incumbent upon you to contribute to the unofficial databank—report the efficacy of various doses, the effect of varying settings, elapsed duration, potential uses, and so forth. It was not uncommon to ask, "Why did you take it?"—truly a statement of inquiry. Terence McKenna comes from this tradition.

Born in 1946 in western Colorado, McKenna moved to Los Altos,

INTERVIEW



TERENCE MCKENNA

EVERYBODY, LET'S GET STONED. A WORLD-CLASS MUSHROOM EATER AND VISIONARY SAYS THAT HUMAN EVOLUTION ADVANCES VIA ORGIASTIC PSYCHEDELIC EXPERIENCE. PHOTOGRAPHS BY TOM ZIMMEROFF

California, when he was in high school. He graduated from the University of California at Berkeley with a major in shamanism and the conservation of natural resources. Collecting Asian art in the East, for years he also made his living as a professional butterfly collector. In his 1992 book *Food of the Gods*, McKenna delineates a radical history of drugs and human evolution, chronicling our descent from "stoned apes" and extolling the virtues of psilocybin mushrooms and DMT (dimethyltryptamine), a potent psychedelic compound. Eve achieves top billing in our collective history as "the mistress of magical plants."

Harassed by some as the "New Scientist," McKenna admits that "defenders of orthodox science find me a pain." When he was younger, this so bothered him that he sought the counsel of Gunther Stent, the pioneering Swedish genetic biochemist. McKenna sat in front of his hero and earnestly laid out his research theories, and ideas of science. "What I am interested to know is," McKenna concluded, "are these ideas fallacious?" Rising from behind his desk, Stent crossed the room, placed his hands on McKenna's shoulders, and delivered the following: "My dear young friend, they aren't even fallacious!" Although crushed and shattered by the encounter, McKenna persevered to become a high-voltage speaker, storehouse of remarkable information, and prolific writer of worldwide repute. Before this interview, McKenna offered friend and interrogator Sukie Mel

THEN SOMETHING CATCHES MY ATTENTION. A DMT HALLUCINATION IS POURING OUT OF THE AIR, INTO THIS HOUSE, AND INTO THE ROOM! THIS IS NOT SUPPOSED TO BE HAPPENING! THIS IS NOT PERMITTED!

lar the following tip: "Being able to pun, sing, or nod'de will usually get you through fairy checkpoints. To deal with real faeries is to enter a realm of riddles and puzzle settings where what they punish is stupidity and what they love is intellectual cleverness."

(Editor's note: Sukie Miller, Ph.D., is a practicing psychotherapist in New York City, a former director of *Esalen* and the Director of the *Death and Dying N Project*.)

Q: You've been called a prophet, madman, the most important visionary scholar in America, a bard of our psychedelic twilight, and (quote) "I did you grow up? Was there something in the water at your house?"

McKenna: I was born in a Colorado cattle and coal-mining town of 1,500 people called Paonia. They wanted to name it Peary but didn't know how to spell it. In your last year of high school, you got your girlfriend pregnant, married her, and went to work in the coal mines. An intellectual like someone who read *Time*. My mother went to secretarial school and had a very large vocabulary. She was aware of classical music and writing and was my grandfather's favorite daughter.

His meter was language. He frequently used the phrase "the sudden an fidgets from Zimmerman!" I reconstructed it. It means "a shrewish fishwife from a town named Zimmerman." Whenever he got excited, he'd yell, "Great God!" said the woodcock when the hawk struck him." A nut, a poet is what he was.

Q: How early in your life were you into altered states?

McKenna: Until I was three, I lived in my grandfather's house. I've had regression hallucinations where I see

myself in my child body playing with my trine alone in that living room. Then something catches my attention and I turn and look. A DMT hallucination is pouring out of the air, into this house, into the room. This is not supposed to be happening. This is not permitted? It was as if an invisible teapot were beginning to pour some heavy, colored liquid swimming with objects and shapes, a flowering geometry. It was as if reality got broken, like a window could get broken, and the outside—poured



LIFE COMPASS:

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RECENTLY WRITTEN:

Food for the Gods: The Search for the Original Tree of Knowledge: A Radical History of Plants, Drugs, and Human Evolution (Bantam)

CAUSE OF HUMAN WOES:

The ego, "a maladaptive behavioral complex that gets going like a tumor."

WHO SHOULD TAKE DRUGS?

"Not everybody. Those should be free to pursue the drug whose interest or research leads them. They should not have to go through to a Calvinist government."

through the teapot—came rushing in. I go to find my mother to show her. Then, of course, it's not there.

Q: And now? Toward what end is your research directed?

McKenna: I can't stomach the human tragedy of somebody going to the grave ignorant of what is possible. I make the analogy to sex. Few people can avoid some kind of experience with sex—sex informs the experience of humanness; sex is a great joy and travail. I don't like to think about someone going to the grave without ever having contacted it. This work is that big. It's ours. It makes available an entire domain of being that somehow got lost to our detriment.

Q: What is DMT's effect?

McKenna: My best guess is that it mediates attention so that when you hear a noise coming from someplace within your peripheral vision, you turn and focus on what the noise might be. Somehow this very rapid focusing of mental functioning is driven by DMT. It is also a Schedule I drug. So technically, we are all bustable all the time! The paradox is that DMT is the safest and quickest hallucinogen to leave your system—safest, that is, in terms of any accumulated detriment to the organism.

Q: Food for the Gods relates DMT to psilocybin. What's the connection?

McKenna: Psilocybin and DMT are chemically near relatives. My book is about the history of drugs, it tries to show drugs' cultural and personality-shaping impact. People have attempted—unsuccessfully—to answer the question of how our minds and consciousness evolved from the ape. They've tried all kinds of things to account for this evolution, but to my

mind, the key unlocking the great mystery is the presence of psychoactive plants in the diet of early man.

Q: What led you to this startling conclusion?

McKenna: Orthodox evolutionary theory tells us that small adaptive advantages eventually become genetically scripted into a species. The species builds upon this minute change to further its adaptive advantage until ultimately it outbreeds all of its competitors for a particular niche or environment.

Orrin: So prehistoric humans got a leg up on the apes by ingesting a drug?

McKenna: Yes. Lab work shows that psilocybin eaten in amounts so small that it can't be detected, as an experience, increases visual acuity in the Sereis, Roland Fisher at the National Institute of Mental Health gave graduate students psilocybin and then a battery of eye tests. His results indicated that edges were visually detected more readily if a bit of psilocybin was present in the student's body. Well, edge detection is exactly what hunting animals in the grassland environments use to observe distant prey! So here you have this chemical factor, when added to the diet, it results in greater success in hunting. That in turn, results in greater success in child rearing and so increases the size of the next generation.

As we descended from the trees and into the grasslands, began to experiment with bipedal gait and omnivorous diet, we encountered mushrooms. At low doses, they increase visual acuity; at midrange, they cause general central-nervous-system arousal, which in a highly sexed primate means a lot of haring around, which means there is more pregnancy among females associated with psilocybin-using behavior. Higher dosages of psilocybin leads to group sexuality and dissolved boundaries between individuals. The ego dissolves and you experience boundary ecstasy. We can assume that as the level of ingestion became high enough, egoless states were quite common.

The way I analyze the modern predicament—pollution, male dominance, there are a million ways to say it—the overriding problems are brought on by the existence of the ego, a maladaptive behavioral complex in the psyche that gets going like a tumor. If it's not treated—if there's not pharmacological intervention—it becomes the dominant constellation of the personality.

Orrin: How did all this play out?

McKenna: From 75,000 to about 15,000 years ago, there was a kind of human paradise on Earth. People danced, sang, had poetry, jokes, adlibs, intrigues, and weapons, but they

WHAT IS DMT?

Dimethyltryptamine is chemically related to the LSD, psilocybin class of hallucinogenic drugs. It is a serotonin agonist, that is, it mimics the neurotransmitter serotonin, but interferes with its normal action. This class of drugs enhances the brain's sensitivity to many kinds of incoming information. As an agonist, DMT locks into receptors of neurons usually available to serotonin and competes with—often "winning out" over—serotonin at the receptor site. To find out more about DMT's mechanism of action, we consulted leading neurobiologist and serotonin investigator, Dr. George Aghajanian of the Yale University School of Medicine.

Aghajanian: I'm finding that except for the fact that it has a very short duration of action—30 to 45 minutes—DMT has the same effects on various receptors, particularly the serotonin 2 (5-HT₂) receptor as the other hallucinogens—LSD or mescaline—that can have effects for up to eight hours.

Orrin: Is 5-HT₂ a postsynaptic receptor?

Aghajanian: Yes. DMT also works on a presynaptic receptor, but that is not the action responsible for its hallucinogenic effects.

Orrin: Since DMT binds at these receptors, does that mean it is found naturally in the brain?

Aghajanian: Enzymes able to synthesize DMT exist in certain tissues, such as in the lungs. But there's no evidence that more than a trace of DMT exists in the body, not enough to have any pharmacological effect.

Orrin: What's the difference between DMT and LSD, psilocybin, and so forth?

Aghajanian: All the other psychedelic hallucinogens I've looked at in issue—brain slices—have a remarkable prolonged effect. So it's interesting that in the same preparation, DMT has a short-lived effect corresponding to its brief action clinically.

Orrin: Why do the other psychedelics have more prolonged effects?

Aghajanian: I think the other hallucinogens are taken up in lipid [fat] compartments of the brain, cell membranes, and elsewhere and that the drug is released slowly from these compartments. The persistence of effects depends on the continued presence of the drug. DMT is not very lipid soluble, so it's not stored in the lipid compartments and thus washes out rapidly.

didn't possess the notion of ego as we've allowed it to crystallize in Western societies. The reason for this lack of ego was a social style of mushroom taking and an orgasmic sexual style that was probably familiar in its timing. Nobody went more than three or four weeks before they were redirected into pure feeling and boundary dissolution. Community loyalty, altruism, self-sacrifice—all those values that we take to be the basis of humanness—arose at that time in a situation in which the ego was absent.

Orrin: If this was all so wonderful, why did it end?

McKenna: The most elegant explanation is that the very force that created the original breakthrough swept away its conditions. The climatological drying of Africa forced us out of the forest canopy onto the grasslands, and into bipedalism and omnivorous diets. We lived in that periacidic grasslands situation, but the climate was slowly getting drier. Mushrooms began to be less available. There could've been many strategies for obtaining mushrooms, all detrimental. The first would be to do it only at great holidays, and only a certain class of people—shamans, for example.

Eventually the mushrooms only existed around water holes in the rain shadows of certain mountains, finally the mushroom was gone. At that moment, under great pressure from the drying climate, agriculture was invented. Agriculture represents an intellectual understanding of how cause and effect can be separated in time. You return to last year's camp, look where you discarded the trash, and there all in one place are the food plants you so

carefully gathered. Women, the gatherers, put this together. Wow! Bury food, come back a year later, and it's there. This was a watershed in the development of abstract thought.

At the same time, men were understanding that the sex act, previously associated with this group orgasmic stuff, was the equivalent of burying food and coming back a year later. Male paternity is recognized as a phenomenon. The road to hell is paved—eight lanes!—from that point on. The man thinks my—my children, not our children—and there

love, animals I kill are food for my women and my children. Women are seed as property. The ego is rampant and in full force.

Omer: How does data on psilocybin support your theory?

McKenna: Well, here's the problem: Psilocybin, discovered in 1953, not chemically characterized until 1967, became illegal in 1966. The window of opportunity to study this drug in humans was only nine years. People working with psilocybin never dreamed they'd be labeled den by law to work in this area. When LSD was first released into the psychotherapeutic community, it swept through with the same impact that the news of the splitting of the atom touched the physics community. People thought, "Ah-ha! Now we're going to understand mental illness, trauma, and obsession, this being only the first of a family of drugs that will lead to an operational understanding of the genesis and curing of neuroses!"

When the scientific establishment was informed that there would be no government grant support for psychedelic research, they just bowed their fuzzy heads and went along with it. The consequences of their failure to stand up to that decision is a mangled society and a science that hasn't fulfilled its agenda. In no other instance has science laid down so gullibly and allowed the state to tell it how to do its business.

I'm not trying to make a revolution in primate archeology or theories of human emergence. My scenario, if true, has enormous implications. For 10,000 years, with the language and social skills of apes, we've pursued an agenda of beasts and demons. Human beings created an altruistic communal society then, by withdrawing the psilocybin or having it become unavailable, we had nothing to fall back upon except old primate behaviors, all tooth-and-claw dominance.

Omer: You're giving an enormous amount of power to a drug. What can you tell me about psilocybin?

McKenna: We don't know what DMT means. It's like Columbus sighting land and somebody says, "So you saw land is that a big deal?" And Columbus says, "You don't understand, it is the New World!"

For the last 500 years, Western culture has suppressed the idea of disembodied intelligences—of the presence and reality of spirit. Thirty seconds into the DMT flash and that's a dead issue. The drug shows us that culture is an artifact. You can be a New York psychotherapist or a Yoruba shaman, but these are just provisional realities you're

committed to out of conventional or local customs.

Omer: Well, it gives one something to do. Terence?

McKenna: Yes, but most people think it's what's happening. Psilocybin shows you everything you know is wrong. The world is not a single, one-dimensional, forward-moving, causal, connected thing, but some kind of multidimensional nexus. Omer: If everything I know is wrong, then what?

McKenna: You have to reconstruct. It's immediately a tremendous permission for the imagination. I don't have to follow Sartre, Jesus or anybody else. Everything melts away and you say, "It's just me, my mind, and Mother Nature." This drug shows us that what's waiting on the other side is a terrifyingly real self-constant modality, a world that stays constant every time you visit it.

Omer: What is waiting? Who?

McKenna: You burst into a space. Somehow you can tell it's underground or an immense weight is above it. There's a feeling of enclosure, yet the space itself is open, warm, comfortable, upholstered in some very sensual material. Entities there are completely formed. There's no ambiguity about the fact that these entities are there.

Omer: What are they like, Terence?

McKenna: Trying to describe them isn't easy. On one level I call them self-transforming machine elves, half machine, half elf. They are also like seed-dribbling jeweled basketballs, about half that volume, and they move very quickly and change. And they are, somehow, aware. When you burst into this space, there's a cheer! Pink Floyd has a song, "The Gnomes Have Learned a New Way to Say Hoody." That they come forward and tell you, "Do not give way to amazement. Do not abandon yourself." You're amazingly astonished. The most conservative explanation for these elves, since these things are speaking English and are intelligent, is that they're some kind of human beings. They're obviously not like you and me, so they're either the prenatal or postnatal phase of human existence, or maybe both, if you follow Indian thinking. You're saying, "Heart beat? Normal. Pulse? Normal." But your mind is saying, "No, no, I must be dead. It's too radical, too fucking radical. It's not the drug, drugs don't do stuff like this." Meanwhile, what you're seeing is not going away. Omer: What are these elves, these creatures about?

McKenna: They are teaching something. There is a higher dimensional language that condenses as a visible syntax. For us, syntax is the structure of

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meaning. meaning is something heard or felt. In this world, syntax is something you see. There, the boundless meanings of language cause it to overflow the normal audio channels and enter the visual channels. They come bouncing, hopping toward you, and then it's like—all this is metaphor, they don't have arms—it's as though they reach into their intestines and offer you something. They offer you an object so beautiful so intricately wrought, so something else that cannot be said in English, that just gazing on this thing, you realize such an object is impossible. The best comparison is Faberge eggs.

The object generates other objects, and it's all happening in a scene of wild movement and confusion.

Ordinarily language creates a system of conventional meanings based on pathways determined by experience. DMT drops you into a place where the stress is on a transcending language. Language is a tool for communicating, but it fails at its own game because it's context dependent. Everything is a system of referential metaphors. We say, "The skyline of New York is like the Himalayas, the Himalayas are like the stock market's recent performance, and that's like my moods—a set of interlocking metaphors."

We have either foreground or background, either object or being. If something doesn't fall into these categories, we go into a kind of loop of cognitive dissonance. If you get something from outside the metaphorical system, it doesn't compute. That's why we need astonishment. Astonishment is the reaction of the body to the ineffectiveness of its descriptive machinery. You project your description, and it keeps coming back. Rejected. Astonishment breaks the loop.

Omni: What other experiences can you liken to the DMT trip?

McKenna: The archetype of DMT is the three-ring circus. The circus is all bright lights, ladies in spangled costumes, and wild animals. But right underneath it's some fairly dark expression of Eros and freaks and unrootedness and mystery. DMT is the quintessence of that archetype. The drug is trying to tell us the true nature of the game. Reality is a theatrical illusion. So you want to find your way to the impresario who produces this and then discuss his next picture with him.

Omni: So the circus is really just a doorway. How does it end?

McKenna: This crazy stuff goes on for 90 seconds, then you fall away from it. They bid you farewell. In one case

they said to me, "Dèjà vu, dèjà vu!" Omni: You've devoted a good part of your life to mapping the DMT and psilocybin terrain. How would you interpret all of it?

McKenna: These drugs can dissolve in a single lightning stroke all our personal programming. The drugs carry you back to the truth of the organism that language, conditioning, and behavior are entirely designed to mask. Once on the substance, you are reborn outside the envelope of culture and of language. You literally come naked into this new domain.

Omni: What do you say to doubters?

McKenna: DMT is utterly defeating of the drug phobias. We could get rid of all drugs but DMT and psilocybin and have thrown out nothing. The fact that DMT is so brief and intense makes it look as if it's designed for doubters. Someone will say, "I can't risk five hours on a drug. It's nuts." The unspoken thing they're saying is, "My career, my life, will be ruined, so keep it away from me." But if you say to these people, "Look, you're making these statements about drugs. Can you invest ten minutes?"

DMT is inhaled. The entire trip lasts that long with no after-feelings. They feel that they are, with a native version

CONTINUED ON PAGE 30



Altered States



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ANTIMATTER

MARTIAN MYSTERY:
Is the Red Planet host to a third
lunar body or UFOs?

When a Soviet probe spun out of control near Phobos, one of two Martian moons, experts called the accident an unavoidable hazard of venturing on high. But to some members of the UFO community, the crash was the evil handiwork of aliens based on Phobos for years.

Fueling this otherworldly rumor, it seems, was a statement by none other than Alexander Dursiyev, chairman of the Soviet Space organization responsible for the space probe, named *Phobos 2*. The doomed craft, Dursiyev stated, had photographed the image of an odd-shaped object between itself and Mars. The object could have been "debris in the orbit of Phobos," Dursiyev suggested, or perhaps the spacecraft's jettisoned "autonomous propulsion subsystem." But his tone of uncertainty—and the fact that the Russians never released the spacecraft's final photographs—left saucer buffs guessing the mysterious object had been a genuine UFO.

Their suspicions were heightened just recently when retired Soviet Col. Marina Popovich made a trip to the United States. Speaking at a press conference in Los Angeles, UFO advocate Popovich stated that the object had measured a whopping 25 kilometers, or 15.5 miles, in length. A former test pilot and the wife of a highly decorated cosmonaut, Gen. Pavel Popovich, the vesting colonel said she had received the alarming photo itself from cosmonaut Alexei Leonov, her friend.

But in Washington, DC, astronomer Tom Van Flandern, formerly of the U.S. Naval Observatory and now head of his own group, Meta Research, is correct, the failure of the probe was no mystery at all. The Soviets had long said that the craft had spun out of control because of an erroneous ground command on March 27, Van Flandern discovered, yet the photo of the mystery object had been dated March 25. "It was



The Martian moon Phobos

unlikely," he explains, "that the object in the photo had anything to do with the spacecraft's demise."

To determine the identity of the object, however, Van Flandern analyzed the picture. "The first thing that stuck me," he explains, "is that the object was similar in brightness to Phobos, an asteroidlike body that is carbonaceous and dark." It did not reflect light as a metallic, artificial object would.

Van Flandern also examined the timing of the *Phobos 2* camera, set to track the motion of the Martian moon. Anything not matching the moon's relative motion would appear to streak or trail across the photographic page. Thus, the "streak," thought to be 25 kilometers long was, in fact, a much smaller object imprinting its motion, not its length, across the image. Only the very end of the elongated streak hints at the object's true shape: rounded but irregular, with one end narrower than the other. To Van Flandern, the clues suggest the mystery object was a moonlet, or a third, miniature Martian moon.

Of course, Van Flandern's conclusion has not pleased everybody. One German researcher says the image is just an artifact produced by the malfunction of the *Phobos 2* camera in space. And Popovich contends the object may be an alien craft. To make her point, she has even given a copy of the telling photo to Don Ecker, director of research for *UFO Magazine*, based in Los Angeles. Ecker, delirious to "the facts as presented by the Russians," favors the notion of a Mars-based UFO.

But Van Flandern contends the lack of alien involvement in the image should not detract from its importance. "It is an exciting astronomical discovery," he contends, "and means that instead of just two moons revolving around Mars, we may have three."

—PATRICK HUYGHE



ANTIMATTER



Paranormal cops: hunting ghosts in style

WHO YOU GONNA CALL?

Have things been going bump in the night fairly often lately? Do objects fly across the den for no apparent reason? Do strange voices come out of your blender or the bathroom's walls? Who you gonna call?

If Lloyd Auerbach, author of *Reincarnation, Channeling, and Possession* (Warner, 1993), has his way, you'll turn to his Orinda, California-based Office of Paranormal Investigations (OPI), a real-life counterpart to the Ghostbusters. OPI investigates reports of apparent paranormal phenomena and looks for a normal explanation. Maybe the things going bump in the night are your upstairs neighbors practicing for a rumba contest; maybe the flying objects are being thrown, behind your back,

by your spouse. Auerbach, who holds a master's degree in para-psychology, states this, "Most of the time people are not crazy, but they're often mistaken about what they think is going on."

Nonetheless, not all of OPI's investigations result in debunking the paranormal. "I've come up with some cases that indicate the presence of real ghosts," he notes, "even though skeptics won't believe me."

In one such case, he notes, "some information was relayed to us from an apparent ghost by a young boy. The information was later verified by the only living relative of the woman who was supposedly identified as the ghost. We eliminated all other possible normal sources for the information the boy gave us."

To come up with such conclusions, OPI provides

clients with an entire staff of specialists, including a clinical psychologist, a private investigator, an audio-visual specialist, as well as experts in computer graphics and archival research. "I don't mind comparing myself to the Ghostbusters," says Auerbach, "but that's not really what we're doing. We chase ghosts, but we

don't slap handcuffs on them. We're not toting around guns, although somebody has offered us a linear accelerator for our next investigation." OPI charges from \$25 to \$50 per hour, depending upon the circumstances of the case, and will usually complete an investigation in two or three hours.

—Kerth Hovary

MILLENNIUM NEWS

When 20,000 members of a Christian sect in Korea recently sold their worldly goods and waited for God to zap them to heaven, folklorist Ted Daniels was not surprised. In fact, as the year 2,000 approaches, Daniels believes, we'll see ever more people waiting for the end.

Daniels should know. At his Philadelphia-based Millennium Watch Institute, he gathers information on some 600 groups who tie the new millennium to such terrestrial transformations as the second coming of Christ, the arrival of aliens, and the cataclysmic end of the world. Daniels, who covers these predictions in his monthly newsletter, *Millennium News*, also has a prophecy of his own. "As we get to the end of the

millennium," he notes, "ideas about world transformation will become an important cultural phenomenon."

End-of-the-world theories have historically popped up with greatest frequency at the close of a century, Daniels notes. And this time around, the prophecies are particularly dark. "Even some New Agers are talking more about the death of two-thirds of the population, artificial plagues, and nuclear holocausts that will cleanse the earth before a new Eden comes," Daniels explains. But, he adds, dire speculations about a global disaster are not limited to fringe groups. "Economists and environmentalists are coming out with these ideas, too. And scientists are talking about Earth possibly colliding with a comet early in the next millennium." —Sherry Baker

PRENATAL CLASSROOM?

Can we recall our time spent in the womb? And if we possess such ancient memory, can we carry the lessons of gestation to bear on the rest of our lives?

According to California obstetrician F. Rene Van de Carr, the answer to both questions is yes. In fact, for the past 13 years, Van De Carr has been designing and testing what he terms "a comprehensive program of prenatal stimulation." Now, Van de Carr's new book, *Prenatal*

fetus through a tube pressed against the mother's abdomen, patting and rubbing the abdomen rhythmically, until baby kicks back; shining a flashlight through the abdomen, and even playing music that the fetus can hear. These exercises, Van de Carr contends, "stimulate the brain areas responsible for socialization and increase the baby's ability to give and receive affection."

Toronto psychiatrist Thomas Vermy thinks Van de Carr is generally on the right track, although he adds that his own prenatal

sold on Van de Carr's approach. "Americans are determined to do what's good for their children, so there will be a market for a book that promises to tell you how to have a healthier, happier, smarter baby," he says. "But I haven't seen any independently refereed scientific papers supporting Van de Carr's claims."

Van de Carr, meanwhile, hopes that such evidence will be available in the near future. "Similar programs have recently been carried out in Venezuela and Thailand," he states, "and the researchers in those places are reporting the same type of beneficial effects found by us."

—Keith Harary

"WHILE INSIDE THE UTERUS, THE BABY IS ABLE TO FEEL, LEARN, AND TELL THE DIFFERENCE BETWEEN DARK AND LIGHT," SAYS OBSTETRICIAN F. RENE VAN DE CARR. "BY PLAYING LEARNING GAMES WITH A FETUS, IT MAY BE POSSIBLE TO IMPROVE THE CHILD'S INTELLECTUAL CAPACITY FOR LIFE."

Classroom, coauthored with psychologist Mark Lehar and published by Humanics Publishing Group, makes the exercises accessible in a simple, step-by-step guide. By playing learning games with a developing fetus beginning five months after conception, Van de Carr claims, parents may improve the child's intellectual capacity for life.

Van de Carr's exercises include such techniques as talking directly to the

program, *Nurturing the Unborn Child* (Dalcorte, 1982), "calls for examining the relationship between the pregnant mother and her mate as well as establishing a loving bridge between mother and baby. Any program that leads to enhanced prenatal bonding," notes Vermy, "is all to the good."

But University of North Carolina psychologist Anthony DeCasper is not



The Artist

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I should have known —



It was only one of his passing Phancies!



SPACE

CONTINUED FROM PAGE 36

ention for building Freedom, the Russians have steadily enlarged their Mir space station. Incidentally, Mir's solar panels apparently use gallium-arsenide solar cells rather than the more common silicon cells. Gallium-arsenide solar cells are more efficient and withstand the rigors of the space environment better than silicon cells, two important benefits for an SPS.

Building a demonstration SPS of 100 megawatts would undoubtedly create the need for rocket boosters capable of lifting heavy tonnages at relatively low cost, encouraging the aerospace industry to move toward heavy-lift boosters that could lower the cost of putting payloads in low Earth orbit from the current \$5,000 per pound to \$500 per pound or less. It would offer a peacetime market for the aerospace industry, hard hit by the end of the Cold War and the scaledown of the U.S. military.

Peter Glasco inverted the SPS concept. A vice president of Arthur D. Little, he points out that Japan leads the world in two of the key SPS technologies: microwave generators and solar cells that convert sunlight to electricity. But the Japanese don't incorporate those technologies into their space program. Instead, they use them in manufacturing solar-powered pocket calculators and microwave ovens, product areas in which they lead the world.

"By developing these commercial-appliance markets," Glasco says, "the Japanese are earning huge sums of money while they set up the industrial capacity to build solar cells and microwave systems for an SPS and continue to work on SPS-related technology and demonstration programs."

Pointing out that energy already represents a trillion-dollar-a-year global market, Glasco believes the economic superpowers of the twenty-first century will be those who develop and market new energy technologies.

"Japanese strategic planners look ahead thirty years as a matter of course," he says. Major Japanese corporations have smaller planning groups that look even further ahead, up to a hundred years.

At press time, Japan planned to test in April a microwave transmission system in space that would beam one kilowatt of energy from a spacecraft to a satellite. It's the first step in Japan's SPS 2000 program, which calls for testing a ten-megawatt system in orbit, presumably around the year 2000.

Would a major U.S. effort to build an

SPS encourage international cooperation? Or might we see a new space race in a few years, a race to be the first to deliver electrical power from space at a profit? That trillion-dollar global market in energy will grow even larger in the next few decades.

What would the oil-rich nations of OPEC do? Nations dependent on oil exports might begin to see that they should invest in SPS technology as a hedge against the inevitable. Nor only could oil dollars be a considerable source of capital for SPS developers, but existing desert oil fields could be convenient sites for SPS receiving stations, remote from large population centers and blessed with clear, dry skies.

How much would a demonstration SPS of 100 megawatts cost? It depends on many factors yet to be evaluated: gallium-arsenide solar cells versus silicon, launch costs, size of the SPS itself, trade-offs between robotics and human crews in space, development costs for new construction techniques, and the costs of maintaining construction crews in orbit. Even the possibility of mining most of the SPS's raw materials on the moon should be considered.

However, it seems clear that an SPS program would require a major financial commitment. A Department of Energy study concluded in 1980 that the capital cost of the first SPS would be on the order of \$15 billion. Glasco insists that this is much too high and adds that no matter how much the first SPS costs the second and all subsequent ones would be no more expensive to build than a nuclear power plant, some \$900 million apiece.

How would such a program be financed? Not the way the U.S. space program has been financed so far. Allocating tax dollars from the federal budget directly to the space program suffers from two major, interlinked problems.

First, it makes the program dependent on the political whims in Washington each year. No one who receives federal funding can count on support from one year to the next.

Second, and closely connected to the first problem, political support for a program depends on popular support among the taxpayers. The typical member of Congress holds much more interest in pork-barrel programs that will bring federal money to his or her state than in programs that send federal dollars to other states. The space program draws most of its political support from those states where space dollars are spent: Florida, California, and Texas.

To soundly fund a program as large and long-range as the development of a solar-power satellite, the capital



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must come from somewhere other than the Capitol.

There is a way—a way that has worked in the past. As Stephen L. Galt and I showed in "Spaceward Ho!" in the July 1991 issue of *Cosmos*, in the early years of this century, the federal government and private entrepreneurs successfully worked together to build the massive hydroelectric power dams of the western United States. The same funding technique could finance development of a demonstration SPS.

The big power dams were financed by long-term, low-interest federal loans, not grants. For example, Hoover Dam paid off its 4-percent loan in 1966, 50 years after it first started selling electricity to customers in the Southwest. Money for an SPS could likewise come from federal loans or by federal guarantees for commercial lenders, much the same way that Washington helped bail out Chrysler in 1979. The program would undoubtedly need some federal seed money to get started. NASA might serve as the government's local agency, much as the Bureau of Reclamation served on the power-dam projects. If NASA's role in an SPS is confined to managerial oversight of private companies, the bulk of the space agency's talents (and budget)

could be turned back to what NASA does so well: exploring the universe.

Glasser believes in a "terraced" approach. Rather than building the first SPS from scratch, he feels that a series of intermediate goals would help develop the necessary technical and industrial prowess. NASA used a similar approach to get to the moon, starting with the one-man Mercury flights, continuing with the two-man Gemini missions, and including the unmanned Ranger and Surveyor lunar probes.

One such "terrace" might be beaming electrical power from a ground-based station to a remote site. Glasser suggests that electricity could be generated at geothermal power stations in Hawaii, for example, and beamed to other islands. Power could travel across intercontinental distances by relaying microwave beams reflected off satellites the way communications signals are relayed by comets.

A successful demonstration SPS could cut the United States (and any other nations that join the effort) at the forefront of energy technology. By using federally based loans rather than outright grants, the program could generate private investment in space development.

Such a program would stimulate the growth of the kind of infrastructure in

space necessary to further develop this New Frontier. An SPS demonstration program would take at least a decade to certify out, requiring living quarters in orbit for sizable numbers of construction workers, engineers, astronauts, and support personnel such as medical doctors.

Once the first SPS is finished, those facilities—and those highly skilled and trained men and women—would be ready and able to do more in space. Moreover, the technological advances generated by the project would create new jobs and whole new industries, just as personal computers and modern medical sensors were the offspring of the Apollo program.

While the first demonstration SPS would probably consist entirely of terrestrial materials, eventually it would become cheaper and more efficient to mine the raw materials for solar-power satellites and other space facilities on the moon. Samples of the lunar regolith returned by the Apollo astronauts are rich in silicon, aluminum, oxygen, and other valuable natural resources.

Meanwhile, that first SPS would be generating electricity to be sold while providing a test bed for studies of the long-term biological effects of microwave transmissions. Nations would build more solar-power satellites, and a new industry would arise: electrical power delivered cleanly and cheaply from space.

Cheaply? Yes, in the long term. For while an SPS would cost a lot to build, it would be cheap to operate: no fuel bills because the power would come from sunlight.

And perhaps some fraction of the vast amounts of electricity generated in orbit by solar-power satellites could go to powering extremely sophisticated spacecraft as they probe the planets of our solar system and beyond.

This should be the focus of the United States' efforts in space. It's time to use space technology to benefit the taxpayers who have invested in its development. It's time to make a visible profit from space. Only then will we have the ungrudging support of the general public in further exploration and development of this New Frontier.

It was John F. Kennedy, architect of the New Frontier, who pointed out, "Now is the time to take longer strides—taller for a great new American enterprise—time for the nation to take a clearly leading role in space achievement, which in many ways may hold the key to our future on Earth."

He was speaking of reaching for the moon, but his words are even more valid today. □



MYTHS

CONTINUED FROM PAGE 40

current space shuttle missions are launched, and the answer with equal consistency will be Cape Canaveral. People should stick to the sailing-ships answer, because for manned spaceflights, Cape Canaveral is wrong.

"Maybe people are fooled because the pads are so near the beach," suggests a NASA press official. "But the shuttle pads are on an island mostly separated from Cape Canaveral by the Banana River." As clearly shown on all official NASA documents and standard topographic charts, the pads lie inside the Kennedy Space Center on Merritt Island, located to the north and west of a long, sandy island that for more than 400 years (except 1963 to 1973, when it was "Cape Kennedy") has been called "Cape Canaveral."

"The first space shoes really were from the Cape," explains an old-time newsmen who has retired to nearby Cocoa Beach, "so people just got into the habit." But since the last manned space flight from Cape Canaveral was 30 years ago, more force of habit must be at work. To say the Cape conjures up far more idyllic visions of space adventure than does the sterile acronym "KSC" or "Merritt Island." Right or wrong, it sounds good, and there seems to be no harm in "knowing" what, in this case, "isn't so."

At least there's no intentional fraud here. The Soviets deliberately created their own geographic confusion, trying to conceal the location of their manned space center. By 1967 CIA spy planes had spotted the pad near the Central Asian railway station of Tyura Tam, which CIA analysts proceeded to misapprehend after as "Tyuratam." In 1961, the Soviets, in a vain attempt at ex post facto geographic disinformation, named their launch site "Baikonur," which was itself a clumsy transliteration of Belykoye, a small mining village hundreds of miles from the space base. When Kazakhstan became autonomous in 1991 and took nominal sovereignty over the spacecraft, no leaders began referring to it as "Baikonur." Perhaps someday the Russians can drop the now-admitted fraud once and for all and name the space base for the man who founded it, Sergei Korolev, than all the world's maps could carry a single—and honorable—designation.

Blow Up

Special-effects wizards love space-vacuum scenes. In *Total Recall* (test on Mars) and a dozen other Hollywood

space westerns, movie makers take the standard gory approach of plankily pulling force and grape-like bursting eyeballs to show what happens to a human thrown out into open space. Such an imaginary tale is enough, wrote veteran spacewriter Michael Collins in his lyrical autobiography *Carrying the Fire* to make a spaceman think long, encouraging thoughts about "the little old ladies and their gluapots, who assemble each NASA spacecraft by hand."

But one Hollywood director, Stanley Kubrick, was much more accurate about this (and so much else) in his 1968 cult classic, *2001: A Space Odyssey*. Deep-space voyager Bowman outside the psychotic autopilot HAL, by jumping into an open airlock without his helmet and then boarding the ship to lobotomize the mulous microchip. Actually, author Arthur C. Clarke got it right first, back in the 1950s. He knew that the physical toughness of the human body allows it to resist deformation even in a full vacuum. A human will suffocate and double over in pain from the bonds—and lapse into unconsciousness in just seven seconds—but at least the eyeballs won't pop out.

"What you should expect as to feel a lot," notes a space-machine expert at Cape Canaveral.

In a spaceflight tragedy in 1971, three Soviet cosmonauts went to vacuum in shirt sleeves during an accidental depressurization during their return to Earth. Recently released top-secret Soviet space films show them receiving emergency resuscitation after landing. They had gone without air too long—about 30 minutes—to be revived, but their bodies were not physically deformed by the exposure to vacuum.

Running Out of Oxygen

Being trapped in space is a science-fiction nightmare, and on a few occasions, it has been a real-life spaceflight threat. In 1968, a Soviet crew had to remain in space for an extra day when control problems confused its onboard computer. (This, by the way, was the occasion of my confrontation with the margin-forned congressman mentioned earlier.) And, in 1990, two Soviet spacewalkers found their main airlock hatch too damaged to close properly, they later used a backup hatch. To enhance the drama of their 30-second narratives, the news media usually breathlessly describes the impending death of the crew members when their oxygen runs out. But in reality, nobody trapped in space will die from lack of oxygen. They may die, but there will be plenty of oxygen left in their cabins or spacesuits when they do.



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What can kill a person in a spacecraft (or a locked room on Earth) is not the oxygen running out but the exhaled carbon dioxide building up. After a while, the body can't expel any more waste gas into the air through the lungs because the air breathed into the lungs from outside contains too much carbon dioxide already. Ultimately, the waste-exhaled blood becomes poisonous to the body and kills it. But while this occurs, there will be plenty of breathable oxygen left in the room, although it will be poisoned by high levels of carbon dioxide.

Burn, Spaceship, Burn!

How many times have we heard about how spacecraft turn into blazing fireballs when they reenter the atmosphere due to "the heat of friction." True, spacecraft hit the upper atmosphere at Mach 25, and there are flames. But if the friction of air rushing across the spacecraft's skin really causes those flames, then how could the space shuttle's fragile protective tiles, which even a fingernail or a raindrop can damage and which come off with small hand tools, survive such a hypersonic blast without wearing or tearing away?

It turns out that the friction of air rubbing against spaceship skin (the boundary layer) has little to do with the fireball. Rather, compression mostly creates the heat as the thin air is squeezed in the shock layer ahead of the crushing spacecraft. The air can't get out of the way fast enough, like snow in front of a plow, so it piles up.

Heating from air compression is familiar to anyone who's ever blown up an air mattress or a tire and felt the warmth with their hand, but it occurs on a much greater scale with speedflight. The compressed, lower-speed superheated air forms a mass of glowing plasma a meter or so in front of the descending spacecraft, and the air then moves through the shock layer to the boundary layer, transmitting heat to the spacecraft's surface by direct physical conduction. That's why the glass-tile insulation of the tiles works so well: It transports heat very slowly along the fibers, and it radiates much of it back out into space. Meanwhile, the air that's in contact with the tiles moves across them much more slowly than the speed at which the spacecraft itself rushes through the atmosphere.

Where did this misconception come from? It's an old concept handed down by newsmen and writers from generation to generation. Frictional heating actually did cause great concern back in the 1950s when streamlined supersonic rocket planes pushed to the

Mach 3, 4, or 5 speeds. The plane designers did all they could to minimize drag so a rocket plane's engine could accelerate it to higher speeds despite the air holding it back. The passing air did indeed rush across the skin's surface, forming a physical phenomenon called the boundary layer, in which air friction caused dangerous heating of the plane's skin. The aircraft needed special protection to keep the skin from burning off, and the same still applies for rocket-plane designs today.

But as soon as flights to space and back started, the object of aerodynamic design changed, and so did spacecraft shapes. The designers no longer had to figure out how to speed up the craft more efficiently during thrusting, but instead, how to slow down with the least heating of the surface. Engineers worked to minimize the heating of falling space vehicles through the use of blunt shapes. This, in turn, created the shock layer, the compressional heating, and the famous flames.

The Impact of Space Myth-takes

For visitors coming to NASA's Houston center in search of the fabled "zero-gravity room" used for training astronauts, the shock of reality can be harsh. When they're told that it doesn't exist, they sometimes argue with the guides. "We've seen it on television," some insist, confusing half-remembered images of the Boeing 707 zero-G airplane (nicknamed the "Vomit Comet" for what its rider gymnasts do to passengers' stomachs) and the pool where astronauts get accustomed to moving around in their spacesuits. Most accept the guides' explanations grudgingly, but others refuse to disbelieve the myths. One U.S. UFO lecturer even tours the country describing his visit to the zero-G chamber, now classified, he says, "above top secret."

These kinds of misconceptions are amusing and mostly harmless because they don't have far-reaching impacts. Much more serious is the pollution of mythical knowledge among politicians and government officials. These people often attempt to base plans for the third millennium on eighteenth-century stereotypes, analogies, and paradigms. The resulting decisions don't work because they don't recognize the realities of spaceflight.

To comprehend the nation's options for the doctrines, strategies, and tactics for the future, this sadly astronomical gap between what people "know" and what is must be narrowed. Otherwise, the people who look foolish in the eyes of future generations won't be just the mistaken ones; they'll be all of us. ☐

ARBUS

CONTINUED FROM PAGE 42

stone surface and stole away the envelope holding his prints. She slid them into her hand and made a frantic gesture for his flashlight. She turned away from him, crouched over and laid the prints on the ground. Shielding the light with her body she switched it on.

He heard her gasp then further sounds of pleasure. He tried to make out details he might use later to recognize her under other circumstances, but her silhouette was as empty as a doorway into a starless sky, with only little wisps of reflected light peeping through her spiky hair like bursts of solar flares. He grew impatient listening to her. She sounded like a starving animal scolding down a huge meal.

"All right," he said finally "you've seen enough." As he stepped toward her she shut off the light and jumped back. The prints lay on the ground between them like a dozen stray windows into a glassier world. He had the feeling that if he stepped on one he might fall into it—fall into that bathtub full of radiant blood. He could almost see the glare of the flash shining from the time-frozen surface. Even in black and white, it had a reddish tint.

"Come on, you said a trade. Let's have your dozen."

She didn't move. He could tell she was measuring him, reading his character in a way he'd never experienced before, eating him up with the dark sunken pits in her face. He made a grab for his flashlight, warning superstitiously to shoo a beam into those hollows and fill them in with eyes.

She backed away, being small enough that an edge of crypt shadow nearly swallowed half of her. Another stupid move and the rest would disappear. Without the light he felt more helpless than if she'd taken his gun. He held his ground, stooping to gather her prints.

"I showed you mine," he said, trying to keep the edge out of his voice. "You're the one who talked about trust."

"Mine didn't come out," she said.

"What do you mean?"

"I mean the roll was fogged, all twelve eggs burned black, pure white prints. Nothing on them. I thought it could bring them with me, but it didn't work."

Was a minute. You telling me there's no tracks? Now he was pissed, and ready to make a grab at her. She was little. She could elude him. He'd have to be fast. "Well fuck if I'm giving you my prints."

"I saw them, that's enough. They came out good. You're a fine photographer. I can tell how much work you put into them. And I appreciate that."

That was it for Brown. Her whole story of being an accomplice, nothing but a lie to get a look at private records. This was suddenly more than personal; he would make it official, too.

He hurried the prints at her. They curled off in twelve different arcs, like a blossom opening around him as he leapt to cut her off.

She gasped, springing away, and found herself trapped in a corner where a tall family mausoleum backed up against the back of the surrounding buildings, below a high row of broken windows. Nowhere for her to go.

He stooped for the flashlight, which she'd dropped. "All right, lady," he said, and switched it on.

The light caught her for a glancing instant, and that was all it took—all he got for his pains and for his memories. He saw that her skin was shimmering black, her short-cropped hair silvery gray, and the very centers of her eyes brilliant white. Then she shrunk to nothing and disappeared, like a little woman-shaped balloon deflating instantaneously to the size of a speck of lichen on the marble tomb, then even smaller, gone.

The beam hit nothing but the chipped brick wall and a slab of marble with some cryptic gaudy hieroglyphs streaking the side.

He backed up, swinging the beam to and fro up and down, looking for the crack she'd slid away through, the secret door that had opened to swallow her up, the rabbit hole, anything. Nothing. None of those things would explain what he'd seen, anyway.

In the time he'd had to look at her really look—and it was an almost subliminal impression—he'd seen that she wasn't any dwarf. She had none of the characteristic squashed features, no stubby fingers or any of that. For her size, she was perfectly proportioned—like a normal grown woman who had shrunk in the wash. This remained true as she vanished. All proportions stayed constant as if she were zooming backward down a tunnel with her eyes fixed on his, until she blinked out. The last thing he remembered was her faintly wounded look, and her color—that shifting silvery black like nothing he'd ever seen in a person—though tentatively familiar.

Brown hunkered through the cemetery till the sun came up, but he didn't find anything except his twelve dented scratched prints. He showed them in a crypt to rot and hurried back to his car.

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or her mind. Everyone should be free to do it and be well informed of the option. Drug information isn't that much different from sex information. We make a gesture toward sex education in schools. And we've come a long way. We no longer make adulterers stitch large letters on the fronts of their clothing. But the issues of drugs are more complicated because there's a vast spectrum, from aspirin to heroin, and each has to be evaluated on its own strengths and weaknesses.

QWERTY: Would you want education on the joys of drugs in high schools?
McKenna: Absolutely, because these kids are already self-educating and informing each other through an underground body of unsanctioned, scientifically unexamined knowledge. We stand with the issues of drugs where we were with sex in the Twenties and Thirties. You learn by rumor. So people have funny ideas, knowing far more about crack than they know about marijuana or psilocybin.

Animal life has been transfused with something either willfully descended in to matter or trapped by some cosmic drama. Something in an unseen dimension is acting as an attractor for our forward movement in understanding.

QWERTY: How is a point in the future that affects us in the present. For example, if you were to do your Christmas shopping in July, then Christmas is an attractor for your summer shopping habits. Our model that everything is pushed by the past into the future, by the necessity of causality, is wrong. There are actual attractors ahead of us in time—like the gravitational field of a planet. Once you fall under an attractor's influence, your trajectory is diverted.
QWERTY: Does the attractor have a kind of intelligence?

McKenna: I think so. It's what we have naively built our religion around. God, totipot. It's an extradimensional source of immense caring and reflection for the human enterprise.

QWERTY: How will science explore the after-death state?

McKenna: By sending enough people into this other dimension to satisfy themselves that this is clarity. Here the analogy of the New World holds. A few lost sailors and shipwreck victims like myself are coming back saying, "There was no edge of the world. There was this other thing. Not death and desolation, not sea monsters and catastrophe, but valleys, rivers, cities of gold, highways." It will be a hard thing to swallow, but then the scientists can go back to doing science on after-death states. They don't have to throw out

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their method.

Ozmi: Where is your hope?

McKenna: With psychology and young people. They have what we never had: older people who went through a psychedelic phase. I'm meeting old freaks in Berlin, London, who are mentoring this thing and trying to keep it away from what we perceive as our mistakes, mainly political confrontationism. LSD was a direct frontal assault on society. An inept undergraduate in biochemistry with his roommate's \$20,000 trust fund can turn out 5 to 10 million hits of this drug in a long weekend. This immediately created pyramids of criminal activity of such size and potential earning power that the government reacted as though a gun had been pointed at its head. Which it had. The proper strategy is stealth, subversion, and bombing from within.

Ozmi: Terence, my friend, does anything scare you?

McKenna: Madness. People always ask: Will I die on drug A, B, or C? That's the wrong question. Of course you can die, but what is at risk is your sanity, because it seems as though the deconstruction of reality has no bottom, and you can just move out into these places. I worry about not being able to contextualize these things, losing the thread allowing me to return to the human community. We're trying to build bridges here, not just fall off.

Ozmi: How do you see the future?

McKenna: If history goes off endlessly into the future, it will be about scarcity, preservation of privilege, forced control of populations, the ever-more-sophisticated use of ideology to enchain and delude people. We are at the breakpoint. It's like when a woman comes to term. At a certain point, if the child is not savored from the mother and launched into its own separate existence, toxemia will set in and create a huge medical crisis.

The mushroom said clearly: "When a species prepares to depart for the stars, the planet will be shaken to its core." All evolution has pushed for this moment, and there is no going back. What lies ahead is a dimension of such freedom and transcendence that once in place, the idea of returning to the womb will be preposterous. We will live in the imagination. We will quickly become unrecognizable to our former selves because we're now defined by our limitations, the laws of gravity, the need to eat, excrete, and make money. We have the will to expand infinitely into pleasure, eating, attention, and connectedness. If nothing more—and it's a lot more—it's permission to hope.

by OMNI

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GAMES

READERS' REPORT CARD

The results are in for the world's hardest IQ test

By Scot Morris



Last December I printed here the Quest Test, an analogy-based, 58-question IQ test specifically designed to test high IQs. I invited readers to have their IQs computed for a small fee, and I promised to reveal the test answers in the May Q&A. Printing the answers, of course, renders the Quest Test invalid for admission to any of the high-IQ societies. Regardless, Daryl Inman, the test's creator, will continue to score tests under the rules explained in the December issue.

At press time, Inman had received and scored 911 responses, figuring the raw score and then computing the IQ. Inman had previously assigned each of the questions a weight for the IQ-computation purposes; these scoring weights remain confidential.

So far Brian Platt of Woods Cross, Utah, has the highest IQ, 160; he correctly completed 48 questions.

Mary J. Brew of Washington, DC, scored highest of all the female respondents; she has an IQ of 156 and, like Platt, a raw score of 48. The average IQ of Q&A readers came out to be 127.

Matthew Jones of Centerville, Utah, was the youngest respondent. A 13-year-old in the eighth grade, he got 28 questions right, achieving an IQ of 144.

Most of the answers can be found in a typical desktop dictionary. For explanation of some of them, send a self-addressed envelope with 25 cents postage to Quest Test Answers, 324 W. Windover Avenue, Suite 205, Greensboro, North Carolina 27408.

1. Mother: Maternal
2. Stepmother: Novacul
3. Cub: Ave / Clawform
4. Delabiform
5. Cook: Food: Pressure
6. Cooker: Kill Germs
7. Autoclave
8. Water: Air: Hydraulic
9. Pneumatic
10. Prediction: Demo: Proof
11. Anderson
12. Raised: Surken: Cameo
13. Inglio
14. 7: 1: 14: Pound: Stone
15. Malay: Amok: Eskimo
16. Women: Pibikto
17. Sexual Intercourse: A
18. Virgin: Bearing: Chicken
19. Nulpara
20. Jaundice: Vomiting
21. Hemorrhages: Syndrome
22. Jaundice: Prodrone
23. Guitar: Colla: Segovia
24. Casals
25. Bare: Leaves: Eagle
26. Star
27. Roll: Aileron: Yaw
28. Rudder
29. 100: Century: 10,000

Myriad

15. Surface: Figure
16. Mobius: Klein
17. Logic: Philosophy: To
18. Know: Without: Conscious
19. Reasoning: Nology
20. Alive: Parasite: Dead
21. Saprophyte
22. Sea: Land: Strait
23. Isthmus
24. Moses: Floral: Noah
25. Diluvial
26. Remnant: Whole
27. Meteorite: Meteoroid
28. Opium: Kangaroo
29. Wombat: Marsupial
30. Salmon: Sturgeon: Shad
31. Anadromous
32. Twin: Clones: Alchemy
33. White House: President
34. Metonym
35. Sculptor: Judoka: Fine
36. Martial
37. Dependent: Independent
38. Plankton: Nekton
39. Matthew: Mark: Luke
40. John: Gospels: Joshua
41. Mosiah: Prophets
42. Luminous: Flux: Lumen
43. Sound: Absorption: Sabin
44. 2: 3: He: Li
45. Growth: Temperature
46. Pituitary: Gland
47. Hypothalamus
48. Spider: Arachnoidum
49. Snake: Ophidianism
50. Epigams: Anthology
51. Foreign: Passages
52. Chestomathy
53. Pathogen: Thermometer
54. Lethal: Wave: Dosimeter
55. Russia: Balalaika
56. India: Sitar
57. Involuntary: Stereotomy
58. Voluntary: Emuncatory
59. Unusual: Hunger: Bulimia
60. Hunger: For: The Unusual
61. Pica
62. Blind: Stag: Tiresias
63. Actaeon
64. River: Fluvial: Rain
65. Pluvial
66. Country: City: Tariff

Octet

38. 3/Dollar: Logogram: 3,
39. 5: 14: 20/Cent: Cryptogram
40. Lung Capacity: Spirometer
41. Arterial: Passions
42. Sphygmomanometer
43. Cold: Ductile: Ceramic
44. Fictile
45. 7: 8: Uranium
46. Neptunium
47. Judaea: Messiah: Israh
48. Mahdi
49. Sight: Amaurosis
50. Small: Ancema
51. Cassini: Coustou
52. Close: Encounters: of the
53. Third Kind: Hynak
54. Diamond/Kimberlite: Per-
55. morph: Fungus/Oak
56. Endophyte
57. Compulsion: to Pull
58. One's Hair: Trichotillomania
59. Imagine: Oneself as a
60. Basil: Zoanthropy
61. Cross: Neutritant
62. Hexagram: Zoream
63. Wing: Tail: Fuselage
64. Empennage
65. Bell: Loud: Speak
66. Write
67. Benevolence: Beg
68. Philanthropist: Mendicant
69. 10: Doornal: 20
70. Vgeometal
71. 5-sided: Polyhedron
72. Pentahedron: Faces of
73. Parallelepiped: Bounded by
74. a Square: Hexahedron
75. Motor: Helicopter
76. Arrow: Autogyro
77. Man: Ant: Borer
78. Trophalores
79. United States: Soviet
80. Union: Cubism
81. Constructivism
82. State: Supind: Church
83. Paband
84. Motorcycle: Bicycle
85. Metadrome: Velodrome
86. Transparent: Porous
87. Obidian: Pumice
88. 4th: 1st/2nd: Cylinder
89. Cone: DD