OMNI

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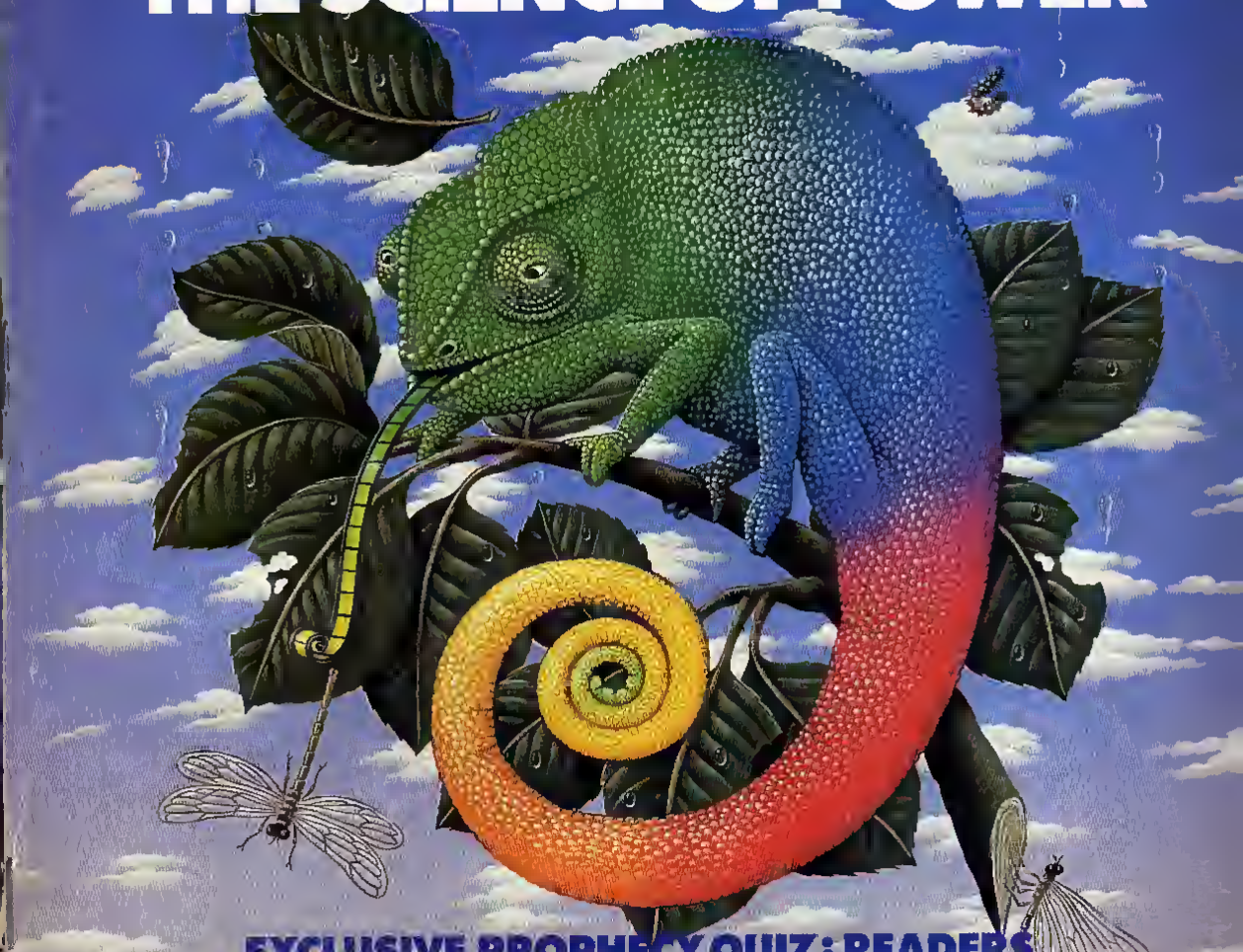

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OMNI®

VOL. 7 NO. 10 JULY 1985

CONTENTS

This month's cover is by British artist James Marsh, who works predominantly in acrylics. The artist uses the changeable chameleon with its celluloid tongue to represent his need to interpret the kaleidoscopic images that confront him

OMNI (ISSN 0149-6711) is published monthly in the United States and Canada by Omni Publications International Ltd., 1965 Broadway, New York, N.Y. 10023-5965. Second-class postage paid at New York, N.Y. and at additional mailing offices. POSTMASTER: Send address changes to Omni Magazine, 80 New Bridge Road, Bergenfield, N.J. 07621. Volume 7, Number 10. Printed in the U.S.A. by Meredith/Burda Corp. and distributed in the U.S.A., Canada, U.S. territorial possessions and the world (except the U.K.) by Curtis Circulation Company, 21 Henderson Drive, West Caldwell, N.J. 07006. Distributed in the U.K. by COMAG, Tavistock Road, West Drayton, London, UB7 7QE, England. Entire contents copyrighted. Nothing may be reproduced in whole or in part without written permission from the publisher. Any similarity between places or persons mentioned in the fiction or semi-fiction and real places or persons living or dead is coincidental. Subscriptions: U.S., APO—$24 one year; Canada and elsewhere—$34 one year. Single copies: $2.50 in U.S., APO and Canada. Telephone: 1-800-247-5470; in Iowa: 1-800-532-1272. The publisher disclaims all responsibility to return unsolicited matter, and all rights in portions published thereof remain the sole property of Omni Publications International Ltd. Letters sent to Omni or its editors become the property of the magazine.

FIRST WORD

By T. A. Heppenheimer

Are human clones a violation of nature? The answer depends on what century you are living in.

How close are we to being able to clone human beings? The basic idea is to take a newly fertilized ovum, remove the nucleus, with its 46 chromosomes, then substitute an appropriate nucleus taken from a person's cells. The ovum would then grow into a duplicate of that person.

This won't work using ordinary cells from skin or muscle, but there are many other tissues and cell types. At Switzerland's University of Geneva, Karl Illmensee and Peter Hoppe have cloned mice by transplanting nuclei taken from seven-day-old mouse embryos. Their technique opens the way to research that could find appropriate cells in adult mice—or humans.

Landrum Shettles, who pioneered the art of fertilizing ova outside the human body, has a list of candidate cells he would like to see studied. Among men, normal sperm cells have 23 chromosomes; but once in a while there are "diploid sperm," with 46. These might prove suitable. Among women, as an ovum matures it produces a "polar body" also with 46. "Don't let it go to waste; put it back in," Shettles suggests.

There is ample reason to carry out research on cloning. Think of being able to offer steaks cloned from genuine blue-ribbon steers at the Iowa State Fair. Or imagine a Kentucky Derby featuring a horse that is not merely a descendant of Man o' War, but that actually *is* Man o' War. Indeed, duplicate horses have already been produced using a form of cloning called artificial twinning. An embryo at a very early stage is cut in two; this can already be done quite safely. The two halves then go into separate wombs, to be born as identical twin horses. At Colorado State University George Seidel has used this technique to produce a matched pair of black colts, named Question and Answer.

There is also delayed twinning. An embryo can be quick-frozen in liquid nitrogen and stored indefinitely, then later thawed and placed in a womb. In Seidel's words, "One could make identical twin female embryos, freeze one of them, and transfer it to the other when she becomes sexually mature, so that a female gives birth to her identical twin sister."

Imagine then that there is a woman named Karen, no longer quite young but wanting a baby. She has no husband or significant lover, but she wants a child just the same. She could go down to her local fertility clinic and take her delayed-twin embryo out of the deep-freeze to grow into her new baby. What would the life of mother and daughter be like?

We can get some fascinating glimpses by considering studies of identical twins separated at an early age and reared apart. To psychologist David Lykken, of the University of Minnesota, who has worked with such twins, "the most important thing to come out of the study is a strong sense that vastly more of human behavior is genetically determined or influenced than we ever supposed."

Genetics, then, would also predetermine much of the behavior of a delayed twin or clone. As the daughter grew up, her mother would see the little girl reliving her own childhood in often poignant detail. The daughter, for her part, would learn that what Karen is today, she would be herself when grown. They would be unusually close; for who could be closer than a daughter who is not only like you but *is* you? As more women would have such daughters, it would become widely appreciated that these were very special family groups, indeed. Then, among husbands and wives, a woman who loved her man to an exceptional degree might show her love by bearing not merely his baby but his clone.

Such clones, of course, need not be carried by their identical-twin mothers; these embryos could go into any womb whose owner was willing, or they could stay in the liquid nitrogen. Such delayed twins then could offer new parents insurance against the heartbreak of a child's early death. The parents could then raise the delayed twin in full assurance that they were replacing, in every way, the lost child.

For adults, such twins would offer a form of immortality. Monarchs would rest assured that they could guard against being succeeded by incompetents. If we met the scion of an old family with a name like J. Beresford Tipton III, that name would be more than his parents' fond hope. It would be his literal description. The same would be true of a future queen like Elizabeth IV. There would be advantages in the United States, as well. If delayed twinning had been available in the past, the Democrats would not have had to declare that their recent candidates have stood in the tradition of Roosevelt and Kennedy. Instead, party leaders could have nominated the clones of FDR and JFK as a presidential ticket.

Are such techniques unnatural, a violation of nature? The answer depends on what century one is living in. A hundred years ago, eminent clergymen inveighed against the use of anesthesia to ease a woman's pain in childbirth. It was unnatural, they said, the Bible had declared that "in sorrow thou shalt bring forth children." To the present day, the Catholic Church asserts that birth control is unnatural. Indeed, as recently as 1972 it was illegal to sell contraceptives in Connecticut. Until early this year, the same was true in Ireland.

"I think that once cloning has been achieved, it will be accepted," says Shettles. "If a person wants to be cloned, it should be his right and privilege, just as much as to have an artificial insemination or any of the other procedures that we do." After all, these technologies all have a common theme: freedom of choice in the intimate and highly personal matter of having a baby. The time will come when opposition to cloning will appear as ludicrous as opposition to anesthesia in childbirth. OMNI

T. A. Heppenheimer, a frequent contributor to Omni, feels that one of him is enough.

CONTRIBUTORS

OMNIBUS


SWANWICK


GIBSON


CADIGAN


CLARKE


DOZOIS

Arthur C. Clarke is one of the most distinguished visionaries of our time. In 1945 he predicted that satellites would someday float in relatively stationary positions in space, where they could relay signals from one end of the earth to the other. Today 22,300 miles above the equator, space is crowded with such relay stations. In another feat of prophecy, he foresaw the evolution of the space movement from early rockets through the modern era of planetary exploration.

Clarke's messages, a unique blend of futurism and humanity, have always caught the pulse of reality. And now, summoning his latest revelations, he paints a vision of the future for *Omni*. To learn how Clarke might describe life in the twenty-first century, *Omni* editors *Robert Weil* and *Peter Tyson* drew up 50 questions on the future and sought Clarke's answers. The result of their effort, "The 2001 Prophecy Quiz" (page 38), covers topics from longevity to animal extinction to nuclear war. As you answer the questions, you can match your wits against the prodigious powers of Clarke.

According to Weil, "This piece launches *Omni*'s celebrity quiz series, which will enable readers to test themselves against experts versed in areas as diverse as genetic engineering and the occult. He advises, 'Hold onto your Clarke quiz. Within the next fifteen years, you'll be able to . . . see how accurate you were.'"

Visions of the future include political fantasies, from East–West detente to nuclear holocaust or universal brotherly love. But in "The Biology of Power Plays" (page 68), *Omni* staff writer *Kathleen Stein* says that political behavior, no matter what its nature, is ancient—an evolutionary legacy older than man. It seems that we are innately territorial and prone to gather in hierarchically organized communities. If we compare human politics with politics in the animal world, we can begin to see the forces that shape civilization today.

To build her thesis, Stein draws from findings in the relatively new fields of ethology, sociobiology and biopolitics. She investigates the biology of dominance among primates and explores the relationships among power, hormones, and stress. And most important, she relates the research to politics in the human realm.

After months of research, Stein says, "I am convinced that the basis of our political behavior is absolutely amoral. It is based instead on derived evolutionary behavior. I see many ethological strategies played out in political campaigns and in Congress—self-serving coalitions, coercive lobbyists, and tit-for-tat reciprocal strategies. And it's interesting that apart from Pat Schroeder, a liberal Democrat from Colorado, no other politician was willing to discuss the biological roots of politics."

Although the drive for dominion pervades the animal kingdom, individuals and groups sometimes cooperate with one another, even at the risk of death. Hoping to explain this puzzling fact, provocative evolutionary biologist Robert Trivers introduced the concept of "reciprocal altruism," defined as the built-in expectation in all species that one good turn deserves another. Though the notion now seems obvious, a decade ago it managed to turn the field of sociobiology on its head. The subject of this month's Interview (page 76), Trivers, a seminal thinker in the field of sociobiology, spoke with *Omni* writer *Bill Lawren*. A former Fulbright scholar who has been a freelance journalist for the last eight years, Lawren says, "I first met Trivers while I was working on a story about altruism in vampire bats. I found him plainspoken and refreshingly frank. Lawren's book *General Groves and the A Bomb*, will be published by Dodd, Mead.

This month's fiction also revolves around various kinds of power plays. In "Dogfight" (page 44), writers *Michael Swanwick* and *William Gibson* introduce a seasoned champion and a young upstart challenger who battle in a simulated sky against the backdrop of a small Southern town. (Gibson just won a Nebula award for his first novel, *Neuromancer*.) And in "Roadside Rescue" (page 62), writer *Pat Cadigan* tells the story of a casual encounter of the third kind.

Finally, we are proud to announce that writer *Gardner Dozois* won a Nebula for his short story "Morning Child," published in the January 1984 issue of *Omni*. "I'm thrilled by the choice," says *Omni* fiction editor Ellen Datlow. "Gardner has been writing marvelous fiction for years, and finally he is receiving acknowledgment as a master of the short story."

LETTERS

COMMUNICATIONS

Faith Afoot

I enjoyed Peter Garrison's article ["Kindling Courage," April 1985] on the firewalking exploits of Anthony Robbins, but I was slightly annoyed by the author's implied unwillingness to recognize the importance of the human mind in this phenomenon.

I can appreciate the desire to find a rational, scientific explanation for Robbins's presumed miracle working, but the real point is that many lives were transformed by what was, for them, a liberating dose of their own willpower. Call it faith, call it positive thinking, firewalking is no less miraculous, even if—as Garrison correctly pointed out—that process can be explained scientifically.

Eddy Allman
Baton Rouge, LA

The Roar of the Cloud

Pamela Weintraub's essay "Hiss of the Fireball" [Earth, April 1985] brought back memories of my childhood, spent 70 years ago in northern Minnesota. On crisp, clear winter nights we had ample opportunity to hear the hisses and crackles that accompany the fiery suicide of meteors.

I remember another phenomenon of the northern sky, and it also involved sounds from great distances: the "voices" of the aurora borealis. On clear nights they were as varied as the instruments in a symphony orchestra. I recall hissings, rattlings, and scrapings, as well as organlike and pianolike tones, all caused by the northern lights.

I have sometimes wondered if the entire night sky might be an "antenna" for the reception of more input than we realize.

Kenneth Deardorf
St. Louis

Software Address

I appreciate the positive comments made about our new software products *Executive Writer* and *Executive Filer* [Artificial Intelligence, March 1985]. But the wrong address was given. We are located at 2612 Eighth Street, Berkeley, CA 94710. Our phone number is (415) 644-2116.

Ronald Ogg
Executive Vice President
Paperback Software International

Hole Truth

I always enjoy *Omni*, and I wish it a long and prosperous life.

In "Swiss-Cheese Universe," however [Stars, April 1985], Jeff Hecht states that a computer simulation of the universe produced giant "holes" that stretched 100 million miles. Such a hole would be only slightly larger than the distance from Earth to the sun. Did the author mean to write 100 million light-years?

Anyway, even if the universe isn't "holey," I still think it's quite divine.

Fred Bercovitz
West Hollywood, CA

Editors' reply: *We didn't mean to revise astronomy quite so drastically. Author Jeff Hecht is blameless for the errors appearing in "Swiss-Cheese Universe." We would not be where we are today if the universe were less than a centimeter large after "10 to 30 seconds," as we stated. That figure should have read* 10^{-30} *seconds.*

In addition, the size of the hole mentioned in the article should have been 100 million light-years, not miles.

Mime's the Word

I was appalled by Mitch Coleman's account of Dr. Byron Davies's work to control America's street-mime population [Last Word, April 1985].

Mimes are harmless, defenseless creatures, and yet Dr. Davies admitted that his tranquilizer darts leave them with terrible headaches. Have there been any studies made to determine if darts, tags, and radio collars have an adverse effect on the health and life expectancy of mimes?

I agree that controlling the population of these unique creatures is necessary, especially since they have few natural enemies. But Davies's studies should be conducted humanely. One solution would be to relocate them from urban centers to such underpopulated areas as Kansas and Colorado.

Mimes make artful contributions to society, and they must not be allowed to become extinct.

Karen Alexander
Galt, CA ◘

DIALOGUE

FORUM

Omni welcomes speculation, theories, commentary, dissent, and questions from readers in this open forum. We invite you to use this column to voice your hopes about the future and to contribute to the kind of informal dialogue that provokes thought and generates breakthroughs. Please note that we cannot return submissions and that the opinions expressed here are not necessarily those of the magazine.

Exposing a Medical Mystery

Thank you for Sherry Baker's magnificent article ["An Epidemic in Disguise," March 1985]. As Baker pointed out, a seemingly "harmless" yeast, *Candida albicans*, is making people "sick all over."

Here's why: For the past 35 years, humans and animals have been plied with antibiotics that wipe out disease-producing enemies as well as friendly germs. As a result, toxin-producing yeasts multiply in the body.

Since learning about these yeast-related health disorders from Dr. Orian Truss six years ago, I've been able to help thousands of people of all ages and both sexes. Their complaints range from autism and psoriasis to bad breath and bloating.

After a safe treatment program, many of these disorders improve or disappear.

William G. Crook, M.D.
Jackson, TN

My congratulations to Sherry Baker. I've been a health care professional for more than 25 years, and my personal observations of *Candida albicans* affirm my belief that Dr. Truss has made the greatest scientific breakthrough since before the flood. The medical and scientific community should work with these findings, not against them.

Phyllis Ruth Thompson, R.N.
Middletown, CT

Many thanks and congratulations for an informative and perceptive article. *Candida albicans* can have an incredibly extensive impact on body functions, and the medical community is only just beginning to wake up to this fact. Articles such as Baker's can help us all become more aware that there is indeed treatment for candidiasis.

We applaud Truss for his efforts and *Omni* for its perspicacity in featuring an article about this widespread disorder. You are in on what might be one of the greatest medical discoveries of the decade.

Holly Williams Thomas
Dayton Candida Support Group
Centerville, OH

This is the first time I've felt compelled to write to a magazine. "An Epidemic in Disguise" is a wonderfully researched article with more substance than most of the books I've read on the subject.

For 20 years I've had a chronic fungal infection and have been frustrated by regular medical professionals who I feel are incapable of treating the body as a whole system. They ignore problems that don't have a specific symptom to treat. Relief came after visiting a naturopath. Naturopaths treat the body holistically and are capable of seeing the connection between yeast infection and many illnesses.

I am slowly ridding myself of my infection, and I feel better now than I can ever recall. I hope *Omni* will continue to explore such controversial issues.

David C. Heiret
Lacey, WA

Finally candidiasis is getting the recognition that it deserves. Every day more of us are discovering our affliction. It is a confusing, complicated, and misunderstood illness, and there are many disbelievers, especially in the medical profession. Your article has helped my family and friends finally understand my condition. Thank you so much.

Mary Powers Olson
Minneapolis

I was pleased to read the informative "Epidemic in Disguise," but I wish to make an important point.

As a long-suffering victim of systemic candidiasis, I have communicated with and have been treated by numerous doctors. It is the opinion of these specialists that, although the *Candida* organism is transmittable from one individual to another (because it is present in almost all of us), the *illness* itself is not transmittable.

The individual must be susceptible due to overuse of antibiotics before the *Candida* already present in his own body begins to proliferate and cause a problem. The organism is as likely to be transmitted from a healthy individual as from one under treatment for the illness.

Name withheld by request

The observation in "An Epidemic in Disguise" that the microorganism *C. albicans* may be linked to many disorders is interesting. Nevertheless, it is important to investigate the nature of the underlying problem that allowed this yeast to proliferate. The answer may reveal that *C. albicans* infections are symptomatic of a disease we do not recognize and cannot cure merely by treating these infections.

My view of the problem stems from my experience with Tibetan medicine. In Tibet, disease is often seen as a discord between man and his environment [see "Tibetan Cure," *Life*, June 1985]. Treatment would deal with both the yeast infection and the restoration of the balance between microorganism (*C. albicans*) and macroorganism (man). This approach has only recently become appreciated in the West.

Vladimir Badmajew, M.D.
Brooklyn, NY

As a former medical student and a victim of candidiasis, I disagree with the tunnel-visioned view of many doctors and patients who believe that the yeast problem can be erased by a "magic bullet" cure.

Fortunately, within the healing profession, M.D.'s, osteopaths, chiropractors, naturopaths, and others are crossing traditional boundaries to find new, holistic treatments for the *Candida* problem.

It's important for us to support the hard-driving scientific approach of the Gesell Institute and the Critical Illness Research Foundation. But we must also realize that we can't continue to abuse our earth, interpersonal relationships, and our physical and spiritual health and still expect to enjoy optimum well-being. *Candida* is trying to tell us something, so let's please listen.

Woody Wilson
Seattle

SECRET SHUTTLE

SPACE

By Randall Black

The space program and the press are old friends. But this relationship may be in jeopardy. The Department of Defense (DoD), which holds the purse strings of a space budget already twice that of NASA, informed the press last December of its official policy regarding information on military payloads. There will be no announcement of launch time, no photographs or description of the cargo, no formal press conferences on the mission and no air-to-ground video or audio reports during the mission.

The first military shuttle cargo, flown in June 1982, carried an experiment that tested the atmosphere to see whether one could detect cruise missiles moving through it. The DoD provided reporters with some background on the mission, and partly because of its limited significance, the launch drew only passing interest from the press. An all-military secret mission in January, however, was more controversial. Freedom of the press collided head-on with national security.

Before the launch, the DoD issued stern warnings. Air Force General Richard Abel stated that publication or broadcast of information would harm national security. Furthermore, those journalists even speculating on the nature of the launch would be investigated.

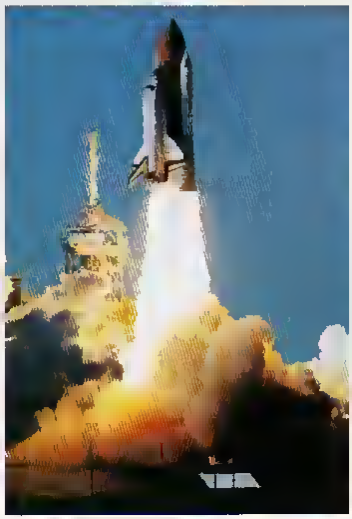
Although Abel later said he meant that the DoD would investigate the source of the leaked information, not the reporters, his original statements spurred some of the press corps into action. While the Associated Press, the three major television networks, and several publications that knew about the payload complied with the blackout, *The Washington Post* did not. An article in the *Post* revealed that *Discovery* would carry an electronic surveillance satellite to monitor communications in the Soviet Union.

During a TV interview, a furious Defense Secretary Caspar Weinberger stated that the *Post* story had compromised national security and given "aid and comfort to the enemy. "The Soviets gained untold spy hours by acquiring knowledge of the satellites purpose so easily, according to the DoD. "I see journalists write a lot on waste and inefficiency," says Craig Covault, senior editor of *Aviation Week and Space Technology*. "But what good is it to give the bad guy the information that is going to make your spacecraft inefficient and therefore waste the money invested? Some information is worth holding."

Some contend that the *Post* was merely exercising its constitutional right and point out that the incident has several historical precedents.

"It has something to do with the McCarthy period and a lot to do with Vietnam," says Charles Nesson, the Harvard Law professor who defended Daniel Ellsberg during the Pentagon Papers trial. As a result of these crises, Nesson says, "the notion that the central government and patriotism were one and the same thing broke up a little bit. The press started to see itself as having a quite independent role, as a watchdog over the government."

The military's involvement with the space program isn't new. Before the Apollo program ended in the early Seventies, Congress instructed NASA that their next project, a reusable space plane, would not be funded unless it could accommodate the military's needs.



NASA scrapped its blueprints for the shuttle and redesigned the craft to fit DoD specifications. And while NASA cut other programs such as planetary exploration in order to develop the shuttle on a shoestring budget, the DoD spent money on ways to use the new space truck once it was built. The Defense Department commissioned various payloads and began work on the $2.5 billion launch facility at Vandenberg Air Force Base, in California. According to Jerry Grey, publisher of *Aerospace America*, there has been some talk that the Air Force could take over the fleet of orbiters entirely and rename the program Blue Shuttle.

The DoD is preparing Vandenberg for its first shuttle launch, now slated to lob a military payload into polar orbit sometime in early 1986. No one knows how much access the press will have.

"We recognize that the first launch at Vandenberg, like the first launch at the Cape, will have intense congressional and media interest," says Major Ron Rand, an Air Force spokesman. "We may have to make some exceptions. But the initial thinking is that because of the geographical, safety and security restraints, it's going to be awfully hard to put many general-public viewers at Vandenberg."

Could the new climate of secrecy hamper America's progress in space?

"Technology fertilizes technology," says newsman Daniel Schorr, veteran of CBS and Cable News Network. "The price of doing it secretly is that, as in the Soviet Union, in the end secrets tend to have a repressive effect on creativity."

SPACE/TIME

July 1 Germany's *Helios 1*, the solar observation craft, will be 160 million miles from the earth.
July 2 *Giotto*, the European Space Agency spacecraft that will probe Halley's Comet, will be launched from the Guiana Space Center, in French Guiana.
July 15 *Challenger* shuttle launch.
July 16 to 24 Spaceweek will be celebrated in 100 cities.

CHOWCHILLA'S CHILDREN

MIND

By Bill Lawren

On a scorching July day in 1976, the lives of 26 children from Chowchilla, California, were transformed forever when they became victims of one of history's strangest kidnappings. Three gun-toting abductors wearing stocking masks commandeered the bus on which the kids were riding home from school. The men herded the children into two blacked-out vans, then buried them alive in a subterranean bunker made from an old truck trailer. Only after a 27-hour nightmare of captivity were the children able to dig themselves free.

For San Francisco psychiatrist Lenore Terr, the kidnapping amounted to a study of pure terror. At Chowchilla there were none of the physical horrors—deaths, injuries, mutilations—that mark most disasters. Because the children suffered no physical harm, the aftermath of the kidnapping afforded what Terr calls a "unique opportunity to look at children who had undergone an experience of pure psychological fright." The experience marked them for life.

It was an opportunity for which Terr had been searching. For years she had been surveying literature on group trauma in childhood. Until the mid-Seventies her work had been confined mostly to studies on the effects of war, and she realized that no one had really looked at such trauma from the children's point of view. Instead, investigators tended to rely on the parents' descriptions of their children's attitudes and reactions.

To Terr this was not very informative. "I wanted to know what really happened when the children went through the experience without the parents' reactions determining those of the children."

Four months after the Chowchilla kidnapping, Terr read a newspaper article in which some of the parents described the recurrent problems the children were having. To Terr it sounded like a cry for help. She immediately set up a meeting with eight families. That led to other meetings, and for the next eight months Terr traveled the 110 miles to Chowchilla every Saturday.

She interviewed 23 of the 26 children extensively. She also managed to track down two of the three remaining children whose parents had whisked them from town immediately after the kidnapping. Four years later Terr returned to do a comprehensive follow-up on the 25 victims.

Her intensive interviews yielded a new picture of childhood trauma. The study's findings range from the obvious to the unprecedented. There were the children's expected fears—fear of the kidnappers, fear of strangers in general, fear of being alone in their own bedrooms. One nine-year-old girl said she was "afraid of being afraid." There were repetitive, frightening nightmares, which often were instant replays of the kidnapping. And there was an almost universally vengeful attitude toward the kidnappers. "Lynching them, starving them—fantasies of revenge," says Terr.

Though all these fantasies and feelings were to be expected, there were others that took Terr by surprise. First, many of the children felt an embarrassment about the incident, a sort of mortification over what Terr calls their "exquisite vulnerability" during the kidnapping. Some children even denied the kidnapping had occurred or that they had ever lived in Chowchilla.

Four years later Terr noted that the mindset of terror was beginning to take on a number of other aspects that were disturbingly surreal. Several of the children engaged in thinly disguised reenactments of the kidnapping. Thirteen-year-old Elizabeth described one game she played with her nine-year-old sister Mary (a fellow victim) and their cousin Brian (not a victim). "We kidnap one another," she says. "We tie Brian up and hide him from the other one. Sometimes we play it in the dark and pretend we're leaving the person. We've scared each other badly with that game."

Many of the children—19 of the 26—concocted signs, omens, or portents that, in hindsight, they thought should have warned them something terrible was about to happen. Many blamed their parents for sending them to school that day, inadvertently shifting the responsibility from the kidnappers to people closer at hand. One girl, now nineteen years old, recalled that she had stepped on an unlucky square that day. "If I hadn't," she said, "it still would have happened, but not to me." Billy, who was eight at the time of the kidnapping, had participated in a treasure hunt that day at school but had come up empty-handed. "Nothing ever happens to me," he had lamented at the time. Four years later, he remains convinced that his simple complaint had somehow triggered the kidnapping. "People who have been overcome by some traumatic experience," Terr says, "will think of some way that they could have avoided that experience ahead of time, and they'll develop an omen. All this is because we cannot bear to think that we've lost control of our own lives."

Perhaps the strangest expressions of the kidnapping trauma occurred in the children's dreams. After four years "instant replay" nightmares had been superseded by more general dreams of terror. Fourteen of the children began to have dreams in which they died—a type of dream that had never been reported in children. In many of them the children felt themselves leave their bodies and float over scenes of their own burials, a description strikingly reminiscent of near-death experiences.

The circumstances surrounding the

CONTINUED ON PAGE 114

ANCIENT SUNS

STARS

By Terence Dickinson

Even under the best of circumstances, measuring the age of stars is not a simple task. But when the stars are buried in a cluster of a million suns 17,000 light-years out in space, the obstacles are more formidable than usual. At that distance a star the size of the sun will be 50,000 times fainter than the dimmest star the naked eye can see on a very dark night. Despite these problems, an international team of astronomers has managed to analyze a group of these remote suns and in the process has established a new, more accurate benchmark for astronomers probing the age of the universe.

Using the largest telescope in the southern hemisphere—the 158-inch er at Cerro Tololo, Chile—the team has determined that the star cluster 47 Tucanae is approximately 16 billion years old. That is as old as the oldest known celestial object. And the new analysis is subject to an error of only 1 billion years either way, according to astronomer William Harris, of McMaster University in Hamilton, Ontario.

As an object of study, 47 Tucanae has been a popular cluster for astronomers. For one thing, it is relatively close. For another, its position well away from the Milky Way makes it easy to examine. There is practically no interstellar dust to obscure an earth-bound view of it, and there are very few unrelated stars that surround it and could confuse stellar readings of it.

Harris and colleagues Bruce Atwood, Doug Tody, James Hesser, and Don Vandenberg based their age estimate of 47 Tucanae on a well-known property. Stars age at rates proportional to their mass. The greater the star's mass, the faster it will move through different stages of stellar evolution. For example, a star with the mass of our sun takes about 5 billion years to become a dense, dim white dwarf star.

The key to dating 47 Tucanae, Harris explains, was to find the most massive stars in the cluster and determine their ages from studying them.

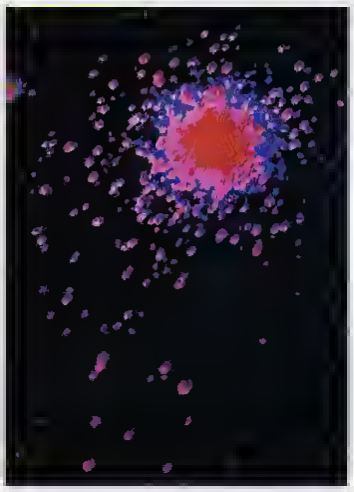
As stars move into an end stage of their life, a late-life crisis known as the red-giant phase, they give off an identifiable spectral signal. Since the more massive stars would be reaching that stage first, the astronomical team searched for the signs of stars ending their main sequence, or prime of life.

The next challenge was to compute the masses of these stars. They did this first by measuring the stars' brightness and then figuring in the distance to 47 Tucanae.

It is a little like being asked to estimate the wattage of a light bulb from a distance. It is possible to make a specific reading of a bulb's brightness. Once you have calculated that and you know how far away the bulb is, you can make a reasonably accurate guess of the bulb's size.

Similarly, it is possible to measure a star's apparent brightness—what we see here on Earth from a distance of millions of miles—then factor in the distance from Earth. This yields a star's intrinsic brightness. Once that figure has been determined, astronomers can compute a star's mass.

Since the distance to 47 Tucanae has been well substantiated by a half century of observations, it was a relatively simple matter to calculate the size of its most massive suns. The survey found nothing more massive than stars with 85 percent of our sun's mass. Using well-established solar models, the astronomers concluded that it took stars that size about 16 billion years to reach the pre–red giant phase. Because all the stars in 47 Tucanae were born at the same time, that figure represented the age of the cluster as well.



Globular cluster. Look for the geezer stars.

There are about 130 aggregations similar to 47 Tucanae that are known to orbit the center of the Milky Way galaxy. They're called globular clusters. These star systems contain anywhere from 60,000 to 2 million stars. They are of particular interest to astronomers because they are believed to be the first class of celestial objects to have formed after the creation of the universe. As the gaseous material of the primal universe swirled and collected into denser knots, the globular clusters were born. Sometime later, possibly as many as 4 billion years after the Big Bang, the pancake-shaped Milky Way galaxy emerged. Billions of years after that, in one of the spiral arms, our sun, its planets, and their moons were born.

These star clusters have long been known to contain extremely old stars, but techniques for dating them were not precise. The margin of error was so great that previous age estimates of 47 Tucanae ranged from 13 billion to 17 billion years. The accuracy of this new survey may make it possible to tell which globulars are older than others and may give a sharper estimate of the age of the universe.

Since the universe obviously cannot be younger than its oldest stars (and probably is at least 1 billion years older), the new observations set a minimum age for the universe of 16 billion years. So unless there is something wrong with the theories on the life cycles of stars, it is likely that the 4.6-billion-year old Earth has been around for only about one quarter the life history of the cosmos.

Some of these numbers could change however. The team has moved on to study another globular cluster, M92. The new cluster has low levels of heavy elements (anything but hydrogen and helium), which is a sign of an aging system, and astronomers suspect it may turn out to be even older than 47 Tucanae.

CONTINUUM

THE GREAT SPLEEN CONTROVERSY

All John Moore knew was that his life was in danger. Doctors at UCLA had told him that his spleen, which had been grossly enlarged by a rare type of blood cancer known as hairy-cell leukemia, was about to burst. The spleen, said UCLA oncologist David W. Golde, would have to be removed—and the sooner the better. Moore agreed, and in October 1976 surgeons at UCLA Hospital excised the diseased organ, which by then weighed more than 14 pounds.

The operation may well have saved Moore's life. But the eventual fate of his spleen tissue has triggered a controversy that now, almost ten years later, has patient and doctor staring at each other from opposite sides of a courtroom. The issue is the right of patients to retain a share in products developed from their own cells, and the stakes could run into the millions.

In granting consent for the splenectomy, Moore had signed a standard release form that gave UCLA doctors the right to "dispose" of the damaged spleen. In most cases, "disposal" would have been a matter of throwing the severed tissue into a crematorium. But in analyzing Moore's spleen, a UCLA pathologist found that, in apparent response to the leukemia, tumors, the organ's cells had secreted an impressively broad array of lymphokines—blood-cell growth factors thought to be important in stemming such diseases as cancer and AIDS. Though lymphokines were not discovered until 1975, their potential as disease fighters had already aroused the interest of researchers and drug companies.

The pathologist sent Moore's lymphokine-bearing cells to Golde. In tandem with UCLA technician Shirley Quan, the researcher used Moore's tissues to culture an experimental line of cells that could be used as organic factories, producing large quantities of lymphokines. In 1978 UCLA, Golde, and Quan took out a patent on the new cells, which they called the Mo-line—presumably after their progenitor. Moore now claims that all this was done without his knowledge. "All they told me," he says now, "is that my blood had rare qualities and that they were doing research on it." Golde told Moore that he would like to continue testing him, and Moore agreed. Between 1977 and 1983 Moore was shuttled between his Seattle home and UCLA five times.

As time went on and the testing continued, Moore began to grow curious. He saw newspaper accounts of the fortunes made in biotechnology and became aware that university researchers sometimes develop products that have commercial value to pharmaceutical companies. He began to ask Golde whether his cells might be of any value. "I was told," he says, "that they were being used purely for scientific research and development."

But by 1983 Moore had become increasingly dissatisfied with what he considered to be Golde's evasive answers. He sought legal help, and his Los Angeles attorneys quickly turned up the 1978 patent. "It was extremely shocking," Moore says now. "They had taken something of mine, something very intimate, and had tried to make something valuable of it without letting me know." Moore's attorneys filed a lawsuit, charging UCLA, Golde, and Quan with conversion—a polite civil-courts euphemism for theft.

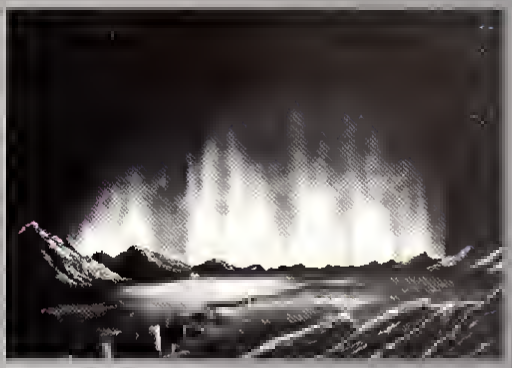
Golde has since maintained that he did inform Moore of the patent in a 1980 phone call. Although he concedes that lymphokines of the sort produced by the Mo-cell line could potentially be valuable, he says that subsequent developments have reduced the value of the line itself to virtually zero. "No one's going to use Mo-cells now," he says. "Why should a pharmaceutical company use something that's under litigation when there are now thousands of other cell lines producing lymphokines?" Calling the controversy "ridiculous" and "tiresome," he says, "I've never received any royalties from the Mo-cell line, and I don't expect I ever will."

For Moore, the question involves more than money. "How many people," he asks, "have a chance to make a significant contribution to medical history? I feel they've tried to cheat me out of that contribution." He says he will continue to press the suit.

Whether the question is money or medical immortality, researchers are beginning to take note of Moore's unprecedented case, realizing that it could bring about wholesale changes in the relationships among patients, doctors, research institutions, and manufacturers. "Based on common sense," says University of Washington bioethicist Arno Motulsky, "if a researcher is going to make money on those cells, then the donor should benefit, too." Motulsky sees a bevy of Moore-like lawsuits arising in the future. "But instead of dealing with it in the courts," he says, "I'd like to see it handled on a much broader societal basis, with lawyers, scientists, ethicists, and laypeople getting together and coming forward with some guidelines."

"As the Moore case gets more and more attention," he concludes, "it might spur just such an effort."—*BILL LAWREN*

CONTINUUM



Neptune may have a ring or at least a partial ring that could pose problems for Voyager 2 when it passes by the planet in 1989

LOOK OUT, VOYAGER

Something strange seems to be orbiting Neptune It appears to be a fragmentary or uneven ring and it is more than just a mystery a sate 3 billion miles away In 1989 the *Voyager 2* space craft will pass near Neptune and it may have to be re-routed to avoid damage or destruction from passing through the ring

The object is too faint to see directly Astronomers can detect it only when it passes in front of a distant star and blocks part of the starlight Separate French and American groups saw that happen on July 22, 1984 Because they were at two Chilean observatories 60 miles apart the object they saw must be at least 60 miles long and about 10 miles wide, says William B Hubbard, of the University of Arizona That sounds like a small section of a ring They saw just one dip in starlight, however, not the two that would occur if both sides of the ring passed over the star Earlier observations had not shown any ring at that distance from Neptune

The ring could be continuous but with some parts too thin to block much light "A broken ring is possible says Andre Brahic of the University of Paris, "but we dynamicists don't like it " He is intrigued because the object seems so different from the rings around Saturn Jupiter and Uranus Now astronomers are searching old records and planning new observations trying to find out what's orbiting Neptune before *Voyager* runs into it —Jeff Hecht

"It's a poor memory that only works backward "

—Lewis Carroll

"He is always right who suspects he makes mistakes "

—Spanish proverb

WET JOCKSTRAP

A precisely dampened jockstrap may help thousands of infertile couples to conceive by cooling overheated testicles

The sperm-producing cells in the testicles require lower-than-body temperatures to multiply properly—which is why testicles hang outside the body, where they are exposed to refreshing breezes The blood entering the genitals in the arteries is normally cooled by an exchange of heat with the chillier blood returning in the nearby veins In perhaps as many as 75 percent of men with fertility problems this exchange doesn't take place because the blood in the veins flows the wrong way Some of these men have a condition called a varicocele an enlarged vein that twists around the testicles In others no varicocele can be identified but the temperature of the blood is elevated anyway adversely affecting the number motility and shape of the sperm

Until recently the only treatment for the problem was an operation to tie off the misdirected veins, a procedure that works only 50 percent of the time Then in December 1984 urologist Adrian Zorgniotti and engineer Andrew Sealfon received FDA permission to market a noninvasive alternative to surgery the testicular hypothermia device (THD)

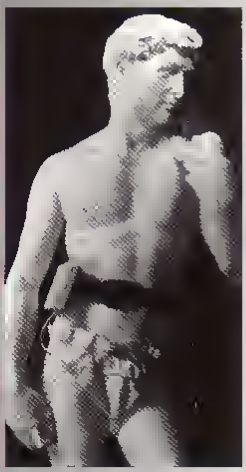
The THD available by prescription from Repro-Med Systems Inc is a primitive genital air conditioner that hooks onto the pants A cotton suspensory it is connected by fine tubes to a small plastic box containing distilled water

A plastic pump with a metered valve regulates the water flow to keep the suspensory in a perpetual state of therapeutic dampness

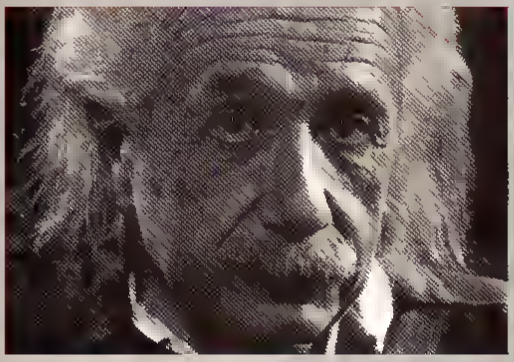
The damp suspensory will not show under loose-fitting dark clothes Worn under the shirt the reservoir box makes a slight bulge worn outside it looks a bit like a doctor's beeper The only side effect is minor "A few patients had a worsening of jock itch " Dr Zorgniotti says "but it went away when they stopped wearing the device "—Leah Wallach

Each of us is a surprise for everyone else

—Naomi Bliven



The THD Air-conditioned relief for the infertile



Albert Einstein. A sugar cube-size chunk of tissue from his left parietal lobe is the latest mystery confronting neuroanatomy

THE SECRET OF EINSTEIN AREA 39

What genius lurks in a tiny cube of Albert Einstein's brain: a segment known as Area 39?

In December 1978, *Omni* reported that Einstein's brain was languishing in a cardboard box under a beer cooler in a biological laboratory in Wichita, Kansas.

At that time, as today, the brain of the most celebrated genius of our time was in the custody of Thomas Harvey, medical supervisor of the Wichita lab and the pathologist who performed the autopsy on seventy-six-year-old Einstein in 1955.

A few years ago, Marian Diamond, a neuroanatomist at the University of California at Berkeley, tracked down Harvey (who has since moved to Weston, Missouri) to ask him for samples of Einstein's final legacy.

Three years later, she finally got what she wanted: four sugar-cube-size pieces of brain tissue from the cortex that conquered the mysteries of relativity and the space-time continuum. The four cubes (which were well preserved, according to Diamond) came from two areas in the brain known to be involved with higher brain functions: the frontal cortex and the inferior parietal (lower rear) lobe.

In these four small samples, Diamond detected a unique characteristic in the brain of the great physicist: They contained more glial cells per neuron as compared with 11 other men of apparently average intellect. The glia, which nourish and support the neurons, are known to increase in number with learning. In previous studies, Diamond had found this changing ratio in rats living in stimulating environments. So she figured that if Einstein's brain were more active in some areas, she would find more glial cells there.

Diamond discovered that the increase in glial cells was most statistically significant in the sample from Einstein's left inferior parietal lobe. The parietal lobe in general is thought to be involved in complex thinking and imagery. But what about the specific cube of cortex, a segment called Area 39, that Diamond studied? This particular morsel has been described as the "association area of association areas," but beyond that, little is known about the region.

However, Dr. George Ojemann, a neurosurgeon at the University of Washington School of Medicine, has been using electrical stimulation on living subjects to pinpoint where specific intellectual functions reside in the brain. At a recent conference in New York City, Diamond urged Ojemann to use this technique to discover the special function of Area 39.—Connie Zweig

"Luck can't last a lifetime unless you die young."
—Russell Banks

COMMERCIAL KILLER

Now there's a gadget that lets you record television programs *without* their commercials.

The device is the CCU-120, made by Vidicraft of Portland, Oregon. It recognizes TV commercials and commands your videocassette recorder to erase them.

The $400 unit reacts to the telltale changes in audio and video levels when a commercial comes along, says Doug Field, Vidicraft's assistant marketing manager. The CCU-120 allows the VCR to continue recording until the regular program comes back on, then double-checks its reading by measuring the length of the suspect segment. (Was it a multiple of 30 seconds?) If this checks out, the device signals the VCR to back up over the offending material and resume recording over it. The device is accurate at least nine out of ten times.

There is a drawback, however. The time it takes to rewind leaves up to 14 seconds of the program unrecorded. Field feels that buyers can live with that flaw given that a commercial break lasts as long as five minutes. When he tried it on a three-hour tennis match, he missed only two points, he says. "It doesn't work as well for basketball games, in which many time-outs are called toward the end of the game. Then it wipes out some of the game."

This flaw could be remedied by a Long Island civil engineer who has patented a different design for an ad remover. Albert Novak's circuits would achieve perfect accuracy, he says, by previously taking an electronic "fingerprint" of any commercial chosen, filing it in memory, then pausing the VCR when the commercial recurs so that no program would be lost by rewinding.
—Anthony Liversidge

"If we cannot imagine, we cannot foresee."
—Gaston Bachelard

CONTINUUM

DENTAL FACE-LIFTS

People who want a face-lift but would prefer to avoid a surgeon's scalpel now have an alternative that yields similar results: a tooth lift.

New York City dentist Irwin Smigel invented the procedure he calls "plastic surgery without a scalpel" and teaches it nationwide. Smigel "plumps" the back tooth on each side of a patient's mouth or inserts a similarly raised denture. This technique, Smigel explains, "raises the cheekbones, softens radial lines that run from the corner of the nose to the edge of the lips, and gives the face a balanced appearance."

The procedure takes about an hour to perform on each tooth and can be previewed using wax. Actors, politicians, and other notables including Kaye Ballard and Jerry Vale have expressed satisfaction with the results Smigel describes as "immediate and dramatic."

Smigel developed the procedure after finding he could eliminate "denture look" by raising false teeth to compensate for bone sinking. "Patients often looked better after getting the dentures than they did before," he says. Although Smigel cautions that the procedure, for various reasons, is not for everyone, the dental face-lifts are available in most major cities. —Allan Maurer

"Light is darkness, lit up."
—John Bradbury

COMEDIANS

Are you a paranoid school dropout who nobody seems to understand? If so, you fit the profile of the typical comedian.

That is the conclusion of a psychologist who has interviewed more than 90 successful comics, including George Burns, Milton Berle, Alan King, Richard Pryor, David Brenner, Phyllis Diller, and Lily Tomlin.

"Comedians are so amazingly identical that they're really like peas in a pod," claims psychologist Sam Janus, clinical professor of psychiatry at New York Medical College in New York City. Janus, after working his way through graduate school as part of a comedy team, developed the urge to study top comics and find out what makes them tick.

Comedians are screw-ups who start out as class clowns and use their humor to excuse their academic failures, he says. "The older generation of comics tend to have dropped out of high school, the younger ones from college."

"Their paranoia," he says, "really originates from not quite fitting in as kids. They become suspicious that everyone is out to steal their comedy routines and that "bad" audiences behave that way deliberately." But paranoids are usually introspective, he adds, "and it is from deep inside themselves that comedians get their humor."

Because comedians feel virtually no one understands them, Janus says, they are driven to explain themselves to the world. "They will say stuff that is really bizarre," he says, "but it comes across as funny. —Eric Mishara

Before (left) and after (right) photos of dental-face lift patient show the effect of 'plumping' the back tooth on each side

Richard Pryor: Another comic who didn't quite fit in?

"She made him feel that when she straightened his tie she straightened much more."
—Nathanael West

ADOLPH HITLER, CONSERVATIONIST

During his reign of terror Adolph Hitler ordered the murder of millions of people. But 40 years after his death, thanks to an ironic twist of fate, the German dictator is indirectly responsible for the protection of scores of animals and plants that might otherwise face extinction.

Scientists have discovered that Hitler's Westwall, a fortification comprising 20,000 bunkers built by the Nazis along Germany's border with France, is teeming with flora and fauna whose normal habitats have been disrupted or destroyed by chemical fertilizers and pesticides.

"Hedgehogs, bats, owls, salamanders, reptiles, and varieties of seldom seen birds like goldfinches and red-backed shrikes flourish in the bunkers, as well as some relatively rare plants,

like wild grapevines," points out Robert Stuber head of the State Government of Rheinland-Pfalz s Department of Welfare Health, and Environment

Although Westwall is currently a haven for endangered species, it may not be for much longer Stüber points out that the West German government wants many of the bunkers destroyed

"The bunkers were dynamited after the war, and some of the walls and ceilings are precariously suspended and could collapse The government is particularly afraid of curious children being injured, ' he explains

Although the Bonn government has spent the equivalent of $9 million to destroy parts of Westwall some local officials, backed by scientists and environmentalists are flatly refusing to cooperate with any more tearing down of the bunkers

"We want to preserve what's left and give nature a chance to recover from the pesticides and fertilizers states Armin Osterheld, a spokesman for the Environmental and Natural Protection Association in Mainz West Germany

Some compromise measures were recently put into effect—including the installation of heavy iron gates..which keep people, but not small animals out of the bunkers Unfortunately, the gates have also hindered scientists

We need to come up with guidelines that will protect animals plants *and* people But we have to remember that researchers want to study all the life discovered living in Westwall Stüber emphasizes

"Right now scientists are often forced to try to do their work by peering through tiny holes in the walls "

—Sherry Baker

Not generally regarded as a nice guy Adolph Hitler did love animals and inadvertently built a huge game and plant reserve

"The great masses of people will more easily fall victim to a great lie than to a small one '

—Adolph Hitler

NONELECTRIC LIGHT BULBS

And now a light that shines ten years without any need for power supplies..

Karl Haff and colleagues at the Oak Ridge National Laboratory in Tennessee have taken radioluminescent lights, usually too weak to serve as anything more than exit signs in theaters and planes and souped them up 'orders of magnitude' in power so that they shine up to 100 times brighter

The pressurized tubes contain tritium an isotope of hydrogen that bombards a phosphor lining with beta particles, making the bulb glow No radiation escapes from the bulb And there's no need to plug one into a power line since it works without electricity

The new designs are bright enough to use for highway signs and to mark landing strips for rapid deployment of military forces They ll also serve to outline civilian runways in such remote regions as Alaska Tests conducted there indicate that the new lights are visible up to ten miles away

News of the advance brought Haff 140 telephone calls from eager investors many of whom imagined screwing in a set of bulbs at home and office and then forgetting all about electric-light bills for ten years

Radioluminescent light No need for electricity

Haff had to tell them that unfortunately such hopes were futile The luminous light tubes won t come in regular bulb shapes 'We ve made them that way, he explains, "but it's difficult and expensive.' And the power of the new luminescents, though greatly multiplied, still can't compete with incandescent or fluorescent lighting ' You couldn t really read by one They're more like nightlights '

But they do come in wonderful colors depending on the phosphor mix he says 'Red blue, yellow yellow-green, pale lilac—any color you want "

—Anthony Liversidge

"I'm a physicist because every other way of looking at the world is too difficult for me '

—Thomas Ingerson

"One must pay dearly for immortality, one has to die several times while still alive "

—Friedrich Nietzsche

CONTINUUM

FLAMING HAIR CREAMS

Still using that greasy kid's stuff to slick your hair? If you are then read the label to make sure your hair cream doesn't contain the highly flammable petroleum derivatives petrolatum, petroleum oil or petroleum jelly warn physicians Andrew Munster and Rebecca Bascom, of the Johns Hopkins Baltimore Regional Burn Center Five of their patients received nasty burns to scalp, face lungs, and airway when their greased hair ignited

Three of those patients caught fire while lighting cigarettes another was at a barbecue, the fifth was at a stove

And Dr Bascom says, when rock superstar Michael Jackson's hair ignited not too long ago during the filming of a TV commercial greasy hair cream was likely the culprit "The manner in which Jackson sustained his injuries is in line with the experiences of our own patients says Bascom a surgeon and director of the burn center 'My understanding is that he was hit by sparks that set his hair aflame Normally, human hair even if you hold a burning match to it, doesn't flame, but just smolders That is unless one is wearing a petroleum-based styling grease

'The bottom line is that this stuff is dangerous " Bascom says and if people insist on using it, they ought not to smoke or go near open flames"

A safer alternative he says are hair creams that contain water lanolin or glycerol as the primary ingredient and are free of petroleum-derived grease

—Eric Mishara

Was Michael Jackson another victim of flaming hair cream?

"We forgive once we give up attachment to our wounds '
—Lewis Hyde

MIAMI VICE

In Miami even the state attorney s wallet is tainted with cocaine residue—thanks to the common practice of using currency for snorting and then returning the bills to circulation Cocaine may also rub off on currency when handled by drug dealers

Toxicology Testing Service found 10 out of 11 bills donated by prominent Miamians had traces of cocaine And money from Seattle and other cities also has been found to have trace quantities of the highly soluble cocaine

It all began when Toxicology's Dr William Lee Hearn was contacted by an attorney whose client was nabbed by drug-sniffing dogs "I told him that there's a good chance dogs were attracted to drugs on the money from people using it to snort cocaine ' says Hearn

'I went to seven banks and got seven batches of twenties one batch of fifties and some hundreds and found cocaine in all cases Later *Miami Herald* reporters got wind of the finds and brought bills from the wallet of straitlaced state attorney Janet Reno to the testing service All but one uncirculated bill had coke residue.

Using a gas-chromatograph mass spectrometer Hearn figures that Miami's cash has an average of 35 micrograms per bill Seattle has only one or two micrograms per bill Los Angeles cash is currently being tested Hearn says

The cash is not destroyed in the tests Bills are rolled in test tubes and rinsed in methyl alcohol which is evaporated into coke-laced residue

Cocaine is absorbed rapidly into paper and cloth and when bills used for snorting are placed in contact with other cash the coke gets transferred People don't keep one special bill for snorting—it's a status symbol to pull out a fresh bill, and when the coke is gone to put it back in circulation" says Hearn He hopes to use data on average cocaine buildup in currency as a way to estimate drug use in a population —Ben Barber

Ten of eleven Miami bills contained traces of coke

' It's a small world But I wouldn't want to paint it '
—Steven Wright

HAIRY-NOSED WOMBATS

The hairy-nosed wombat an engaging little creature with a generous nature appears to be staging a comeback from near extinction in arid south Australia where a series of severe droughts has reduced its already dwindling numbers to a mere 30 or so

That is the opinion of conservation biologist Pamela J Parker of the Chicago Zoological Society who spends much of her time counting heads in the wombat warrens of Australia's Nullarbor Plain at the 14,000-acre Brookfield Conservation Park near Blanchetown "Conditions are ideal ' she explains referring to spring rains that improved the

Wombat The hairy nosed variety of south Australia victimized by hunters and rabbits has a very useful rear end

edible vegetation "If they don't make a comeback now they never will"

But then life has never been easy for the hairy-nosed wombat As the name implies it's an unattractive beast that would much prefer to bask in the sun outside its burrow than to cope with encroaching habitat destruction and periodic drought or to compete for grass and plant life with such other vegetarians as sheep, kangaroos and rabbits

Throughout the years, farmers have poisoned it bounty hunters have shot it aborigines have dined on it feral cats have harassed it and uninvited rabbits routinely move right into its complex warrens, some of which are 100 yards long dug laboriously out of the calcrete rock

About the only defense the placid noncombative wombat has against all these predations is to scurry into its burrow, twist hurriedly around and clamp its rear end like a manhole cover up against the burrow's opening in the hope that the wombat's hide will be tough enough to discourage intruders

The peace-loving wombat could endure all of this Parker says if it weren't for the droughts Annual rainfall sometimes drops below 10 inches, which limits the wombat's diet reduces its weight from 50 to 20 pounds and critically damages its sex life

"One of the features of wombat reproduction the conservationist explains "is the nutritional requirements of its food intake That's why late winter rainfall is so important Only one young wombat can be produced per year Ovulation is tied tightly to the quality of forage early in the spring, so if late winter rains are lacking the females forgo reproduction for that year —George Nobbe

"Every cubic inch of space is a miracle"

—Walt Whitman

SEXY BARITONES, WIMPY TENORS

Opera butts have long claimed that different types of singers fall into distinct categories

Typically tenors are short stocky broad chested and bullnecked arrogant and difficult to work with Baritones and basses are usually taller less emotional, and have a greater sex drive

Lower-voiced female singers—mezzos and contraltos—are stereotyped as taller, less "hysterical" and of higher libido

Scientists do recognize some connections between the voice and hormonal processes and a 1977 German study found tenors had lower ratios of plasma testosterone (male sex hormone) to estradiol (female sex hormone) than did baritones and basses Could opera fans be right?

Tenors Stocky, arrogant but lower in testosterone?

Glenn D Wilson, a psychologist at London's Institute of Psychiatry wanted to find out He had 91 singers many associated with Covent Garden and the English National Opera, rate their own and other singers personalities He then compared their ratings with one another and against a control group of nonsinging associates

Wilson found the results generally consistent with the public's stereotypes Higher-voiced singers displayed more so-called feminine traits such as emotionality, while lower-voiced singers exhibited more masculine characteristics, such as sexual appetite

Based on both the self-reports and the ratings of other singers higher-voiced singers were rated as being more emotional unreliable, conceited, and difficult than were lower-voiced singers of the same sex

Lower-voiced singers were taller and thinner than higher voiced singers, but sopranos were not so fat nor tenors so short as sometimes pictured The association between low voices and sex drive was less clear-cut, but baritones and basses rated themselves as less faithful sexually and they reported more affairs with fellow singers than did the tenors

—Marcello Truzzi

CONTINUUM

Some shy children actually exhibited physical symptoms

INHERITED SHYNESS

If you're a shy person, you're far from alone. As many as 84 percent of Americans have considered themselves shy at some point in their lives. Now a growing body of evidence suggests that many of those cases may be genetic.

Wellesley College psychologist Jonathan Cheek has analyzed questionnaires given to more than 800 sets of high-school age twins. He graded the answers according to such things as self-perceived awkwardness and tension in social situations. He found that identical twins were more than twice as likely to share shyness traits as fraternal twins. Cheek says that indicates a genetic link. Identical twins share the same genetic makeup; fraternal twins are no more alike than any two siblings.

In a related study, psychologist Jerome Kagan, of Harvard University, spent several years testing children he had categorized according to shyness or boldness. He found that about half the shy children showed certain physical symptoms. When they met new people, their "stress circuits" became activated—their pupils dilated, and their heart rates increased. Because the children were so young, their stress reactions must have had a biological cause. "Their stress circuits are more excitable," says Kagan. "We think some kids come into the world this way."

He further found that some shy children became less timid as they grew older. But those who had exhibited the stress reaction never lost it—further signs of a biological component.

Both researchers stress that they haven't pinpointed a specific shyness gene. "We're talking about pieces of a puzzle," says Cheek. "None of the studies is convincing in itself, but together they're adding up to a powerful package."

—Douglas Starr

"Of course any science student can tell us more about Nature and her laws than can Descartes or Newton—but what can he tell us about the human spirit?"
—Antoine de Saint-Exupery

"A thunderbolt from Zeus is for the scientist an electric spark like any other."
—Konrad Lorenz

"No one is too small or mean to be ignored."
—Henry Miller

SCIENCE-FICTION QUIZ NO. 2

Science fiction has often been called the literature of ideas. It is also the literature of *heroes*. Most science fiction stories feature a heroic protagonist who battles against the forces of nature or against dastardly villains or both. Can you name the heroes described, the stories in which they appear, and the authors of those stories? (The answers are given at the end of the quiz.)

1. An American space scientist of the early twenty-first century who, after sending a mission to the planet Jupiter (or was it Saturn?) that ended in disaster, goes on a second mission himself to find out what happened to wreck the first one.

2. A Virginia gentleman, former captain in the Confederate cavalry, who becomes the finest swordsman on another world and is ultimately named Warlord of Barsoom.

3. The jut-jawed, steely-thewed Earthling who battles the evildoers of Eddore in a series of interstellar epics.

4. The messianic figure known as Muad'Dib who leads his people in rebellion while transforming the desert world on which they live.

5. The soldier who fights for Earth in an interstellar war that spans many centuries in a single human lifetime because of the time-warping effects of traveling near the speed of light.—Ben Bova

Manly Flash Gordon was one SF hero. Can you name five others?

ANSWERS

1. Heywood Floyd in *2001: A Space Odyssey* and *2010: Odyssey Two*, by Arthur C. Clarke.
2. John Carter in Edgar Rice Burroughs's series of novels that begins with *A Princess of Mars*.
3. Kimball Kinnison in the Lensmen series, by E. E. Smith.
4. Paul Atreides in *Dune*, by Frank Herbert.
5. William Mandella in *The Forever War*, by Joe Haldeman.

"But toward the extinction of the passion between the sexes, no progress whatever has hitherto been made."
—Thomas Malthus

"All art is knowing when to stop."
—Toni Morrison

"It was so cold it was all the way down to Celsius."
—Don Novello

THE 2001 PROPHECY QUIZ

BY ROBERT WEIL AND PETER TYSON

Match your visions of future life with Arthur C. Clarke's

PHOTOGRAPH BY ERIC MEOLA

"Can you guess what life will be like for you and your children in the next century? Are you as forward thinking as the perceptive Arthur C. Clarke?"

How well do *you* know the future? Can you guess what life will be like for you and your children in the next century? Are you as forward-thinking as Arthur C. Clarke?

When it comes to charting the unknown, predicting *accurately* how man's future world will unfold, few have been more perceptive than Arthur C. Clarke, one of the most distinguished visionaries of our time. His sense of the future is legendary for its accuracy. In 1945, Clarke foretold a world ringed with telecommunications satellites. His visions of space, filling more than two dozen books, constitute the most perceptive analysis of the future since H. G. Wells.

For these reasons *Omni* approached Clarke for his current thoughts on the future. We wanted to know: How many people will be living in space on New Year's Eve of 1999? When will personal robots be used widely in American homes? Will we see a vaccine for the common cold in our lifetime? These were some of the items in our exclusive prophecy quiz: 50 carefully selected questions about the future of man, science, technology, and the evolutionary course of our stars.

For each question, circle the response you think Clarke gave. How well do you rate against the great prophet of the Space Age? The objective is to respond in the way you think Clarke might have.

On page 94, you will find his answers. To receive your score, tally the number of times your own response matches Clarke's. Then check your score against the Omni Future Quotient, a personalized profile that analyzes how farsighted you are.

1) When will an ordinary person be able to buy a ride on the space shuttle?
a. by 1995
b. by 2000
c. by 2010
d. by 2020
e. after 2020

2) Will we establish extraterrestrial contact in the twenty-first century?
a. yes
b. no

3) Which of the following events will occur first in space?
a. a birth
b. a marriage
c. a murder
d. a suicide

4) Which of the following high-tech birthing techniques will be most prevalent in the year 2000?
a. in vitro ("test-tube") fertilization
b. surrogate mothering
c. cryogenics (embryo freezing)
d. choosing the sex of your baby

5) If sex selection becomes reliable, which of these three alternatives will twenty-first-century parents choose?
a. a majority of boys
b. a majority of girls
c. 50/50 ratio

6) In the coming years, which *one* chore will people come to rely on their home robot to accomplish the most?
a. housecleaning
b. cooking
c. laundering
d. serving as a burglar alarm
e. teaching children
f. acting as a pet or companion

7) What percentage of the American labor force will work at home via computer modem in 2000?
a. 1 percent
b. 5 percent
c. 10 percent
d. 25 percent
e. 50 percent
f. 75 percent

8) Will there be a World War III?
a. yes
b. no

9) If World War III comes to pass, will we survive it?
a. yes
b. no
c. no, but we will seed other planets with our species

10) What do you think the typical twenty-first-century American family will be like?
a. a single woman with children
b. a mother and father with children (traditional family)
c. communal groups of couples who share child rearing and other tasks
d. a childless couple
e. single adults without children

11) What do you think the typical twenty-first-century Third World (or developing country) family will be like?
a. a single woman with children
b. a mother and father with children (traditional family)
c. communal groups of couples who share child rearing and other tasks
d. a childless couple
e. single adults without children

12) In the year 2000, what percentage of American fathers will assume the traditional role that mothers once assumed—staying at home, raising the children, performing household chores, and so on?
a. under 1 percent
b. 1 to 5 percent
c. 6 to 10 percent
d. 11 to 20 percent
e. over 20 percent

13) By the year 2010, how many years will you be able to add to your life with life-extension drugs and techniques?
a. none
b. 1 to 3
c. 5
d. 10
e. 20
f. over 25

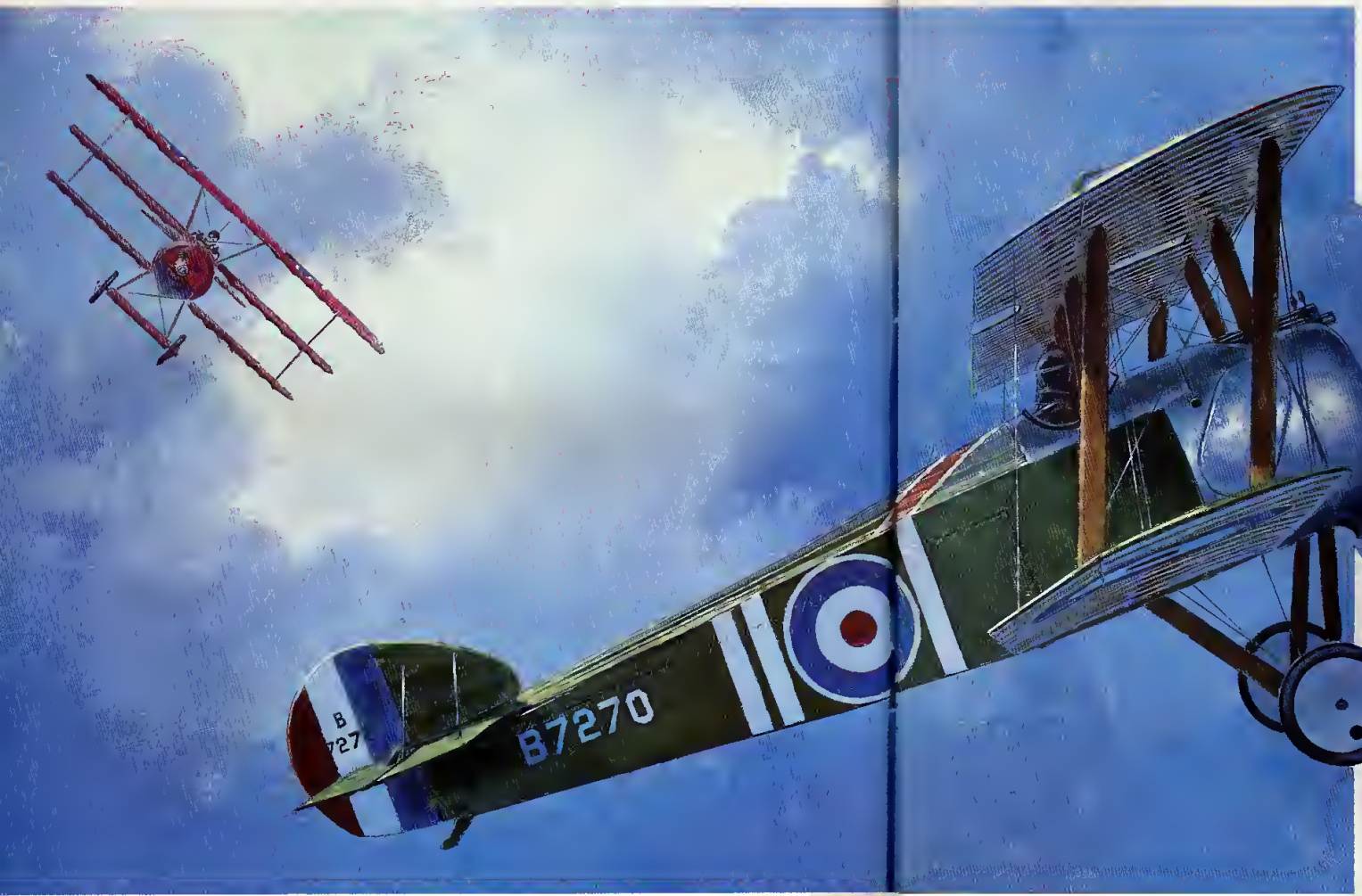
CONTINUED ON PAGE 90

DOGFIGHT

FICTION

The war was in the air, but the casualties were earthbound

BY MICHAEL SWANWICK AND WILLIAM GIBSON



He meant to keep on going, right down to Florida. Work passage on a gunrunner, maybe wind up conscripted into some rat-ass rebel army down in the war zone. Or maybe, with that ticket good as long as he didn't stop riding, he'd just never get off—Greyhound's Flying Dutchman. He grinned at his faint reflection in cold, greasy glass, while the downtown lights of Norfolk slid past, the bus swaying on tired shocks as the driver slung it around a final corner. They shuddered to a halt in the terminal lot, concrete lit gray and harsh like a prison exercise yard. But Deke was watching himself starve, maybe in some snowstorm out of Oswego, with his cheek pressed up against that same bus window and seeing his remains swept out at the next stop by a muttering old man in faded coveralls. One way or the other, he decided, it didn't mean shit to him. Except his legs seemed to have died already. And the driver called a twenty-minute stopover—Tidewater Station, Virginia. It was an old cinder-block building with two entrances to each rest room, holdover from the previous century.

Legs like wood, he made a halfhearted attempt at ghosting the nobons counter, but the black girl behind it was alert, guarding the sparse contents of the old glass case as though her ass depended on it. *Probably does*, Deke thought, turning away. Opposite the washrooms, an open doorway offered GAMES, the word flickering feebly in biofluorescent plastic. He could see a crowd of the local kickers clustered around a pool table. Aimless, his boredom following him like a cloud, he stuck his head in. And saw a biplane, wings no longer than his thumb, blossom bright-orange flame. Corkscrewing, trailing smoke, it vanished the instant it

PAINTING BY ATTILA HEJJA

struck the green-felt field of the table.

"That's right, Tiny," a kicker bellowed, "you *take* that sumbitch!"

"Hey," Deke said. "What's going on?"

The nearest kicker was a bean pole with a black mesh Peterbilt cap. "Tiny's defending the Max," he said, not taking his eyes from the table.

"Oh yeah? What's that?" But even as he asked, he saw it: a blue enamel medal shaped like a Maltese cross, the slogan *Pour le Merite* divided among its arms.

The Blue Max rested on the edge of the table directly before a vast and perfectly immobile bulk wedged into a fragile-looking chrome-tube chair. The man's khaki workshirt would have hung on Deke like the folds of a sail, but it bulged across that bloated torso so tautly that the buttons threatened to tear away at any instant. Deke thought of Southern troopers he'd seen on his way down off that weird gulf-heavy endotype, balanced on gangly legs that looked like they'd been borrowed from some other body. Tiny might look like that if he stood, but on a larger scale—a forty-inch jeans inseam that would need a woven-steel waistband to support all those pounds of swollen gut. If Tiny were ever to stand at all—for now Deke saw that that shiny frame was actually a wheelchair. There was something disturbingly childlike about the man's face, an appalling suggestion of youth and even beauty in features almost buried in fold and jowl. Embarrassed, Deke looked away. The other man, the one standing across the table from Tiny, had bushy sideburns and a thin mouth. He seemed to be trying to push something with his eyes, wrinkles of concentration spreading from the corners.

"You dumbshit or what?" The man with the Peterbilt cap turned, catching Deke's Indo proleboy denims, the brass chains at his wrists, for the first time. "Why don't you get your ass lost, fucker. Nobody wants your kind in here." He turned back to the dogfight.

Bets were being made, being covered. The kickers were producing the hard stuff, the old stuff, liberty-headed dollars and Roosevelt dimes from the stamp-and-coin stores, while more cautious bettors slapped down antique paper dollars laminated in clear plastic. Through the haze came a trio of red planes, flying in formation: Fokker D VIIs. The room fell silent. The Fokkers banked majestically under the solar orb of a two-hundred-watt bulb.

The blue Spad dove out of nowhere. Two more plunged from the shadowy ceiling, following closely. The kickers swore and one chuckled. The formation broke wildly. One Fokker dove almost to the felt, without losing the Spad on its tail. Furiously, it zigged and zagged across the green flatlands but to no avail. At last it pulled up, the enemy hard after it too steeply—and stalled, too low to pull out in time.

A stack of silver dimes was scooped up.

The Fokkers were outnumbered now. One had two Spads on its tail. A needle-spray of tracers tore past its cockpit. The Fokker slipturned right, banked into an Immelmann and was behind one of its pursuers. It fired, and the biplane fell, fumbling.

"Way to go, Tiny!" The kickers closed in around the table.

Deke was frozen with wonder. It felt like being born all over again.

Frank's Truck Stop was two miles out of town on the Commercial Vehicles Only route. Deke had tagged it out of idle habit from the bus on the way in. Now he walked back between the traffic and the concrete crash-guards. Articulated trucks went slamming past, big eight-segmented jobs; the wash of air each time threatening to blast him over. CVO stops were easy makes. When he sauntered into Frank's, there was nobody to doubt that he'd come in off a big rig, and he was able to browse the gift shop as slowly as he liked. The wire rack with the projective wetware wafers was located between a stack of Korean cowboy shirts and a display for Fuzz Buster mudguards. A pair of Oriental dragons twisted in the air over the rack,

> *"There was a hot glint of terror in Tiny's eyes that spoke an eternity of fear and confinement, two edges sawing away at each other endlessly."*

either fighting or fucking; he couldn't tell which. The game he wanted was there: a wafer labeled SPADS&FOKKERS. It took him three seconds to boost it and less time to slide the magnet—which the cops in DC hadn't even bothered to confiscate—across the universal security strip.

On the way out, he lifted two programming units and a little Batang facilitator remote that looked like an antique hearing aid.

He chose a highstack at random and fed the rental agent the line he'd used since his welfare rights were yanked. Nobody ever checked up, the state just counted occupied rooms and paid.

The cubicle smelled faintly of urine and someone had scrawled Hard Anarchy Liberation Front slogans across the walls. Deke kicked trash out of a corner, sat down back to the wall and ripped open the wafer pack.

There was a folded instruction sheet with diagrams of loops, rolls and Immelmanns, a tube of saline paste, and a computer list of operational specs. And the wafer itself: white plastic with a blue biplane and logo on one side, red on the other. He turned it over and over in his hand. SPADS&FOKKERS. FOKKERS&SPADS. Red or blue. He fitted the Batang behind his ear, after coating the inductor surface with paste, jacked its fiberoptic ribbon into the programmer and plugged the programmer into the wall current. Then he slid the wafer into the programmer. It was a cheap set. Indonesian, and the base of his skull buzzed uncomfortably as the program ran. But when it was done, a sky-blue Spad darted restlessly through the air a few inches from his face. It almost glowed. It was so real. It had the strange inner life that fanatically detailed museum-grade models often have, but it took all of his concentration to keep it in existence. If his attention wavered at all, it lost focus, fuzzing into a pathetic blur.

He practiced until the battery in the earset died, then slumped against the wall and fell asleep. He dreamed of flying in a universe that consisted entirely of white clouds and blue sky with no up and down, and never a green field to crash into.

He woke to a rancid smell of frying krill-cakes and winced with hunger. No cash, either. Well, there were plenty of student types in the stack. Bound to be one who'd like to score a programming unit. He hit the hall with the boosted spare. Not far down was a door with a poster on it: THERE'S A HELL OF A GOOD UNIVERSE NEXT DOOR. Under that was a starscape with a cluster of multicolored pills, torn from an ad for some pharmaceutical company, pasted over an inspirational shot of the 'space colony' that had been under construction since before he was born: LET'S GO, the poster said, beneath the collaged hypnotics.

He knocked. The door opened, security slides stopping it at a two-inch slice of girl-face. "Yeah?"

"You're going to think this is stolen." He passed the programmer from hand to hand. "I mean because it's new, a virtual cherry, and the bar code's still on it. But listen, I'm not gonna argue the point. No. I'm gonna let you have it for only like half what you'd pay anywhere else."

"Hey, wow, *really* no kidding?" The visible fraction of mouth twisted into a strange smile. She extended her hand, palm up, a loose fist. Level with his chin. "Lookahere!"

There was a hole in her hand, a black funnel that ran right up her arm. Two small, red lights. Rat's eyes. They scurried toward him—growing, gleaming. Something gray, streaked forward and leaped for his face.

He screamed, throwing hands up to ward it off. Legs twisting, he fell, the programmer shattering under him.

Silicafe shards skittered as he thrashed, clutching his head. Where it hurt, it hurt—it hurt very badly, indeed.

"Oh my God!" Slides unsnapped, and the girl was hovering over him. "Here, listen, come on." She dangled a blue hand towel. "Grab onto this, and I'll pull you up."

He looked at her through a wash of tears. Student. That fed look: the oversized sweatshirt, teeth so straight and white they could be used as a credit reference. A thin gold chain around one ankle (fuzzed, he saw with

CONTINUED ON PAGE 95

How do cats, fish,
and snakes see the world?
Now we know

VISIONS

BY KATHLEEN McAULIFFE

From the Svengali-like gaze of the common house cat to the furtive glance of the timid gerbil (pages 50 and 51), animals eyes are distinctive: they also see the world differently from the way we do.

"Nature has displayed enormous creativity in the design of the eye," says Sandra Sinclair, author of the newly published book *How Animals See: Other Visions of Our World*. So to understand how creatures view their surroundings, Sinclair enlisted the aid of leading wildlife photographers, whose specialized craft enabled them to record the world as various animals perceive it. Using special effects, for example, her photographic collaborators were able to reveal what insects see through their compound eyes—the multifaceted structures that frame the antenna (right). Unlike our eye, with its solitary lens, a compound eye may contain up to 30,000 separate tiny lenses, enabling an insect to see objects close up in great detail and without distortion. Initially, scientists thought compound eyes fragmented objects into crude mosaiclike images similar to the butterfly photograph below (top left). But they now believe that the more highly evolved flying insects combine multiple images into a single picture. Some insects, such as butterflies, can also see ultraviolet rays. Flowers to these insects look like landing pads with lightened pollen centers and darkened petals (bottom left).

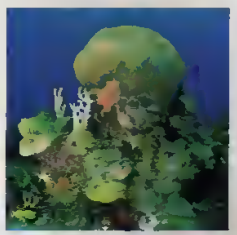
Facing page: the compound eye of the harlequin beetle. Right: the more spherical compound eye of the robber fly. Top right: flowers from the fly's point of view. Top left: a butterfly as seen by a primitive insect. Bottom left: what a daisy looks like to an insect with ultraviolet vision.

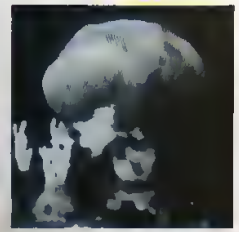
VIEW FROM DOWN UNDER

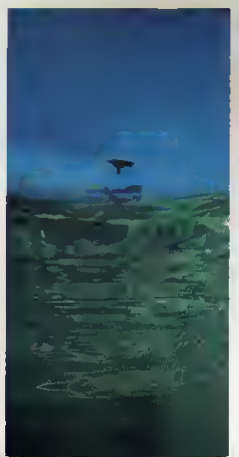
When scientists first descended into the ocean's depths, they were struck by the darkness. But they were even more amazed when, below 150 meters, that murky darkness was filled with stars. Because very little light can filter to such depths, many deep-sea inhabitants produce their own light called bioluminescence. Such light, though faint, allows the enormous photoreceptors of most deep-sea creatures such as the hatchetfish (left) to perceive objects. But color is seen differently at these depths, even by human eyes. All wavelengths of light except for the blue part of the spectrum are filtered out. 'A deep-sea diver who cut his hand would actually see his blood as green,' says Sinclair.

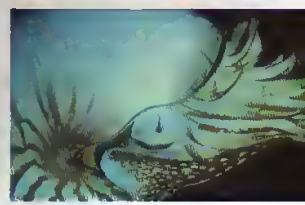
Fish that live near the surface of the water can see much more color. They can also peer up into the air-filled world. Their vision above water, however, is limited to a 98° cone-shaped window. And because light rays bend where sea and sky meet, the sizes of objects above the surface are distorted. While a fisherman looking down through the water will see his quarry magnified in size, the fish in turn sees its hunter as smaller than he actually is (bottom left).

Other sea creatures, such as the chambered nautilus (bottom right), a cousin of the octopus and squid, have eyes that take a long time to focus on an object. In fact, they are often unable to see rapidly moving schools of fish that pass by.









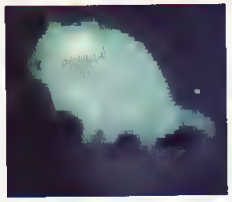
Facing page: the hatchetfish sees by the light of bioluminescence. Left: how a fisherman looks to a fish underwater. Top left: coral seen through human eyes. Top right: the same coral seen through the lensless eyes of the chambered nautilus. Above: the nautilus.

A SLIT-EYED PERSPECTIVE

When snakes emerged from a long evolutionary period underground, some of them had gained the ability to see heat—a visual adaptation that knows no parallel in the animal kingdom. Pit vipers such as the rattler, and boids such as the python, combine both visual and thermal information into one image. (Their view of a gerbil appears below at left.)

Not all snakes have that ability, however. The vine snake (far right) has grooves that sweep like brows across its head and function like a sight on a gun, focusing its slit eyes on targets within striking range. The barrellike protuberances that surround the eyes of the Senegalese chameleon (bottom right on this page) provide incredible optical mobility, enabling the animal to look in two directions at once. Its split-screen image of the world, however, merges when the chameleon gets ready to strike an insect. Then it brings both eyes into focus on the prey. The Tokay gecko, pictured directly above the chameleon, is equipped with another unusual visual feature. Like only a few other creatures, this nocturnal lizard has a stenopaic pupil: a slit that contracts to form two small apertures per eye, allowing sharper focus over great distance.

Like many animals, some reptiles may also have good color perception. The Australian skink (below) displays a dramatic coloration that may serve as a warning to other skinks, as well as predators.



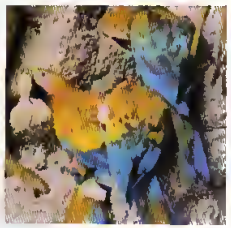
Facing page: the vine snake. Above left: a gerbil as seen by a snake with infrared sensors. Above right: the nocturnal Tokay gecko, with its two-holed pupil. Top: the Australian skink flashes its tongue. Right: the mobile eyes of the Senegalese chameleon.

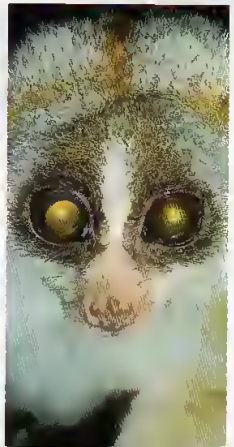
WIDE-EYED AND COLOR-BLIND

In the age of dinosaurs, mammals were nocturnal and inhabited the trees. With arboreal life came the development of the hand and the ability of the mammals' eyes to change focus for objects up close or far away. But because mammals were creatures of the night, color perception developed later. The slow loris (bottom left), for instance, can distinguish only between the brightness of different hues. Its eyes perceive green to be brighter than yellow.

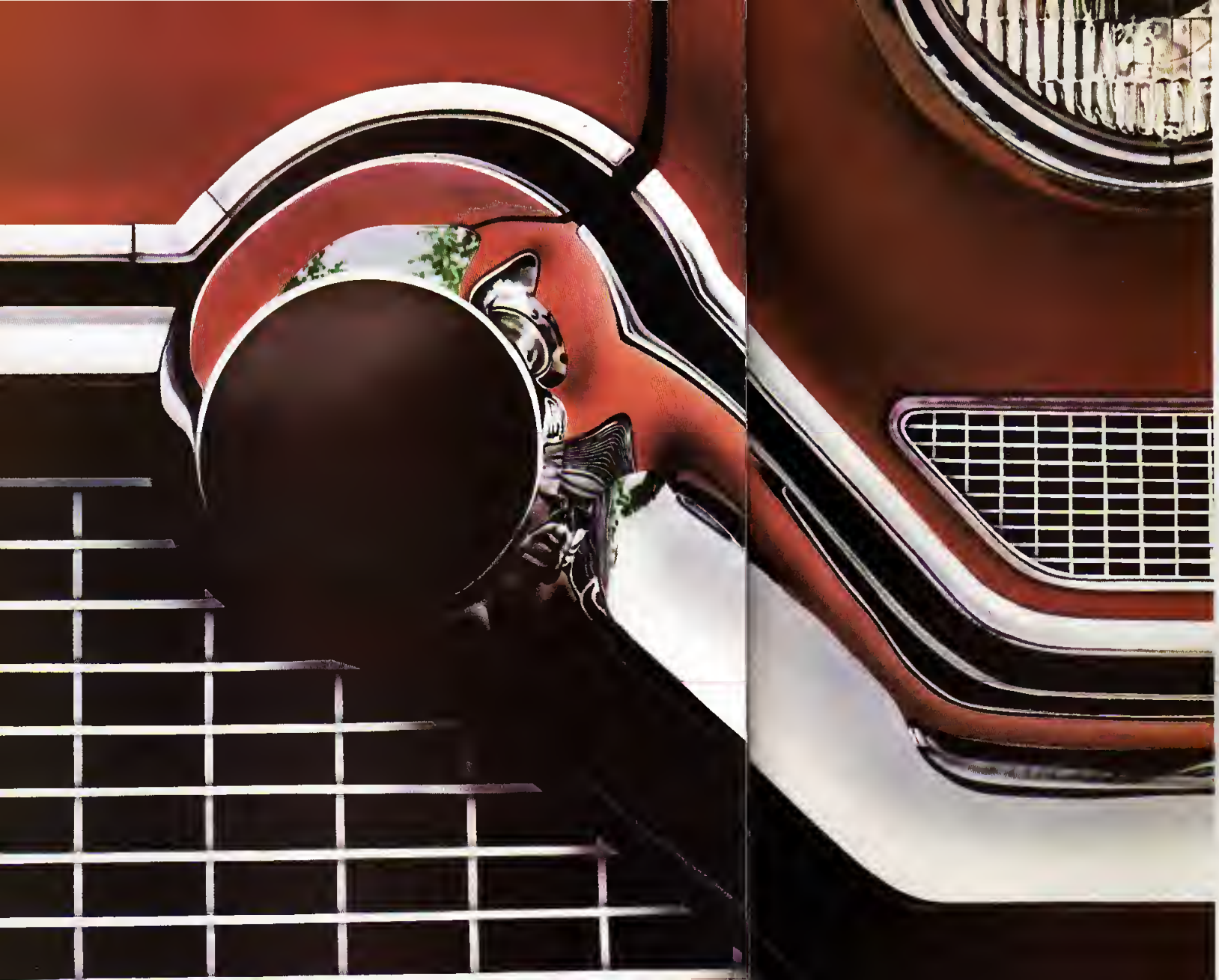
Similarly, the New World monkeys of South America have only the rudimentary beginnings of color vision. They can see the blue coloring on parrots (below right) and can perceive yellow but have difficulty distinguishing reds and greens the way we do (below left). Surprisingly, the green foliage in which they frolic appears to them as shades of white and gray. Squirrels, prairie dogs, and many other simple mammals share the monkey's sensitivity to yellow and blue.

The more highly evolved African primates, however, have color vision similar to our own. The mandrill, a large baboon of western Africa (opposite page), for example, has no trouble distinguishing between green and red tones. It has the same three color receptors as the human eye and probably sees the world in the full spectrum of hues, a distinct advantage in the natural world. As Sinclair puts it, "A creature that can see in color has a better chance of survival."





Facing page, the mandrill. Left, the loris. Top left, parrots as seen by the human eye. Top right, parrots as a New World monkey sees them. Above, a human's-eye view of leaves. To most nocturnal mammals, the green leaf would seem brighter than the yellow one.



FICTION

ROADSIDE RESCUE

Beware of generous little aliens with big cars and helpful chauffeurs

BY PAT CADIGAN

Barely fifteen minutes after he'd called Area Traffic Surveillance, Etan Carrera saw the big limousine transport coming toward him. He watched it with mild interest from his smaller and temporarily disabled vehicle. Some media celebrity or an alien—more likely an alien. All aliens seemed enamored with things like limos and private SSTs, even after all these years. In any case, Etan fully expected to see the transport pass without even slowing, the navigator (not driver—limos drove themselves) hardly glancing his way, leaving him alone again in the rolling green, empty countryside.

But the transport did slow and then stopped, crammming itself into the breakdown lane across the road. The door slid up, and the navigator jumped out, smiling as he came over to Etan. Etan blinked at the dark full-dress uniform. *People who worked for aliens had to do some odd things* he thought, and for some reason put his hand on the window control as though he were going to roll it up.

"Afternoon, sir," said the navigator.

PAINTING BY DON EDDY

bending a little from the waist.

"Hi," Etan said.

"Trouble with your vehicle?"

"Nothing too serious, I hope. I've called Surveillance and they say they'll be out to pick me up in two hours at most."

That's a long time to wait." The navigator's smile widened. He was very attractive, holo-star kind of handsome. *People who work for aliens,* Etan thought. Perhaps you'd care to wait in my employer's transport. For that matter, I can probably repair your vehicle, which will save you time and money. Roadside rescue fees are exorbitant."

"That's very kind," Etan said. "But I *have* called, and I don't want to impose—"

"It was my employer's idea to stop, sir. I agreed, of course. My employer is quite fond of people. In fact, my employer loves people. And I'm sure you would be rewarded in some way."

"Hey, now, I'm not asking for anything—"

"My employer is a most generous entity," said the navigator, looking down briefly. "I'll get my tool kit." He was on his way back across the road before Etan could object.

Ten minutes later the navigator closed the power plant housing of Etan's vehicle and came around to the window again, still looking formal and unruffled. "Try it now, sir."

Etan inserted his key card into the dash console and shifted the control near the steering module. The vehicle hummed to life. "Well, now," he said. "You fixed it."

That smile again. "Occasionally the connections to the motherboard are improperly fitted. Contaminants get in, throw off the fuel mixing, and the whole plant shuts down."

"Oh." Etan said, feeling stupid, incompetent, and worst of all, obligated.

"You won't be needing rescue now, sir."

"Well, I should call and tell them." Etan reached reluctantly for the console phone.

"You could call from the limo, sir. And if you'd care for a little refreshment—" The navigator opened his door for him.

Etan gave up. "Oh, sure, sure. This is all very nice of you and your, uh, employer." *What the hell,* he thought, getting out and following the navigator across the road. *If it meant that much to the alien, he'd give the alien a thrill.*

"We both appreciate this. My employer and I."

Etan smiled, bracing himself as the door to the passenger compartment of the limo slid back. Whatever awkward greeting he might have made died in his throat. There was no one inside, no one and nothing.

"Just go ahead and get in, sir."

"But, uh—"

"My employer is in there." Somewhere. Smile. "You'll find the phone by the refrigerator. Or shall I call Surveillance for you?"

"No, I'll do it. Uh, thanks." Etan climbed in and sat down on the silvery gray cushion. The door slid partially shut, and a moment later Etan heard the navigator moving around up front. Somewhere a blower went on, puffing cool, humid air at his face. He sat back tentatively. Luxury surroundings—refrigerator bar, video, sound system. God knew what use the alien found for any of it. Hospitality. It probably wouldn't help. He and the alien would no doubt end up staring at each other with nothing to say, feeling freakish.

He was on the verge of getting up and leaving when the navigator slipped through the door. It shut silently as he sat down across from Etan and unbuttoned his uniform tunic.

"Cold drink, sir?"

Etan shook his head.

"Hope you don't mind if I do." There was a different quality to the smile now. He took an amber bottle from the refrigerator and flipped the cap off, aiming it at a disposal in the door. Etan could smell alcohol and heavy spicing. "Possibly the best spiced ale in the world, if not the known universe," the navigator said. "Sure you won't have any?"

"Yes. I— Etan sat forward a little. "I really think I ought to say thank you and get on. I don't want to hold you up—"

"My employer chooses where he wants to be when he wants to be there." The navigator took another drink from the bottle. "At least

> *"The small creature at the end of the seat seemed to have coalesced out of the humid semidark, an off-white mound of what seemed to be fur as dense as a seal's."*

I'm calling it a he. Hard to tell with a lot of these species. He ran his fingers through his dark hair; one long strand fell and brushed his temple. Etan caught a glimpse of a shaved spot near his temple. Implant, so the navigator would be mentally attuned to his employer, making speech or translation unnecessary. With some genders irrelevant. Some have more than one gender. Some have more than *two.* Imagine taking *that* trip, if you can." He tilted the bottle up again. "But my present employer here, asking him what gender he is, it's like asking you what flavor you are."

Etan took a breath. One more minute, then he'd ask this goof to let him out. "Not much you can do, I guess, except to arbitrarily assign them sex and—"

"Didn't say *that*."

"Pardon?"

The navigator killed the bottle. "Didn't say anything about sex."

"Oh." Etan paused, wondering exactly how crazy the navigator might be and how he'd managed to hide it well enough to be hired for an alien. "Sorry. I thought you said that some of them lacked sex—"

"Never said anything about sex. Gender. I said. Nothing about sex."

"But the terms can be interchangeable."

"Certainly *not*." The navigator tossed the bottle into the disposal and took another from the refrigerator. "Maybe on this planet, but not out there."

Etan shrugged. "I assumed you'd need gender for sex, so if a species lacked gender, they'd, uh—" he trailed off, making a firm resolution to shut up until he could escape. Suddenly he was very glad he hadn't canceled his rescue after all.

"Our nature isn't universal law," said the navigator. "Out there— he broke off, staring at something to Etan's left. "Ah. My employer has decided to come out at last."

The small creature at the end of the seat seemed to have coalesced out of the humid semidark, an off-white mound of what seemed to be fur as close and dense as a seal's. It might have repelled or disconcerted him except that it smelled so *good,* like a cross between fresh-baked bread and wildflowers. The aroma filled Etan with a sudden, intense feeling of well-being. Without thinking, he reached out to touch it, realized, and pulled his hand back.

"Going to pet it, were you? Stroke it?"

"Sorry." Etan said, half to the navigator and half to the creature.

"I forgive you," said the navigator, amused. "He'd forgive you, too, except he doesn't feel you've done anything wrong. It's the smell. Very compelling." He sniffed. "Go ahead. You won't hurt him."

Etan leaned over and gingerly touched the top of the creature. The contact made him jump. It didn't feel solid. It was like touching gelatin with a fur covering.

"Likes to stuff itself into the cushions and feel the vibrations from the ride," said the navigator. "But what it *really* loves is talk. Conversation. Sound waves created by the human voice are especially pleasing to it. And in *person,* not by holo or phone." The navigator gave a short, mirthless laugh and killed the second bottle. "So. Come on. Talk it up. That's what you're here for."

"Sorry." Etan said defensively. "I don't know exactly what to say."

"Express your goddam *gratitude* for it having me fix your vehicle."

Etan opened his mouth to make an angry response and decided not to. For all he knew, both alien and human were insane and dangerous besides. "Yes. Of course I do appreciate your help. It was so kind of you, and I'm saving a lot of money since I don't need a roadside rescue now—"

"Never called it off, did you?"

"What?"

"The rescue. You never called to tell Surveillance you didn't need help."

Etan swallowed. "Yes. I did."

"Liar."

All right. Etan thought. *Enough was too much.* "I don't know what transport services you work for, but I'll find out. They ought to know about you."

"Yeah? What should they know—that I make tree repairs at the bidding of an alien hairball?" The navigator grinned bitterly.

"No" Etan's voice was quiet "They should know that maybe you've been working too long and too hard for aliens' His eyes swiveled apologetically to the creature "Not that I mean to offend—

'Eorget it It doesn't understand a goddam word"

"Then why did you want me to talk to it?'

"Because *I* understand We're attuned On several frequencies mind you one for every glorious mood it might have Not that it's any of your business

Etan shook his head You need help

'Fuck if I do Now finish your thanks and start thinking up some more things to say"

The bread-and-flowers aroma intensified until Etan's nerves were standing on end His heart pounded ferociously and he wondered if a smell could induce cardiac arrest

"I think I've finished thanking your employer He looked directly at the creature And that's all I have to say Under more pleasant circumstances I might have talked my head off Sorry He started to get up

The navigator moved quickly for someone who was supposed to be drunk Etan found himself pinned against the back of the seat before he realized that the man wasn't jumping up to open the door For a moment he stared into the navigator's flushed face not quite believing

"Talk," the navigator said softly almost gently "Just talk That's all you've got to do"

Etan tried heaving himself upward to throw them both off the seat and onto the floor but the navigator had him too securely "Help! he bellowed "Somebody help me!

'Okay yell for help. That's good too" said the navigator smiling They began to slide down on the seat together with Etan on the bottom "Go ahead Yell all you want

"Let me up and I won't report you

"I'm sure I can believe *that*" The navigator laughed 'Tell us a whole fairy story now

"Let me go or I swear to Christ I'll kill you and that furry shit you work for"

What? the navigator asked leaning on him a little harder What was that *sir?*

"Let me go or I'll *fucking kill you!*"

Something in the air seemed to break as though a circuit had been completed or some sort of energy discharged Etan sniffed The bread-and-flowers aroma had changed more flowers less bread and much weaker, dissipating in the ventilation before he could get more than a whiff

The navigator pushed himself off Etan and plumped down heavily on the seat across from him again Etan held still looking first at the man rubbing his face with both hands and then turning his head so he could see the creature sliding down behind the cushion *We scared it* he thought horrified *Bad enough to make it hide under the seat*

Sir"

Etan jumped The navigator was holding a fistful of currency out to him The denominations made him blink

"It's yours. sir Take it You can go now

Etan pulled himself up What the hell do you mean it's mine?'

"Please sir" The navigator pressed one hand over his left eye 'If you're going to talk anymore, please step outside"

'Step outs— Etan slapped the man's hand away and lunged for the door

'Wait!" called the navigator and in spite of everything Etan obeyed The navigator climbed out of the transport clumsily still covering his eye, the other hand offering the currency Please sir You haven't been hurt You have a repaired vehicle more than a little pocket money here—you've come out ahead if you think about it

Etan laughed weakly "I can't believe this"

Just take the money, sir My employer wants you to have it The navigator winced and massaged his eye some more "Purely psychosomatic he said as though Etan had asked 'The implant is painless and causes no damage no matter how intense the exchange between species But please lower your voice sir My employer can still feel your sound and he's quite done with you"

What is that supposed to mean?"

The money is yours from my employer' the navigator said patiently "My employer loves people We discussed that earlier *Loves* them Especially their voices

So? Etan crossed his arms The navigator leaned over and stuffed the money between Etan's forearms

Perhaps you remember what else we were discussing I really have no wish to remind you sir

"So? What's all that stuff about gender—what's that got to do with Etan's voice died away

"Human voices" the navigator said No speech where they come from And we're so new and different to them This one's been here only a few weeks Its preference happens to be that of a man speaking from fear and anger something you can't fake"

Etan took a step back from the man unfolding his arms and letting the money fall to the ground thinking of the implant the man feeling whatever the creature felt

I don't know if you could call it perversion or not "said the navigator "Maybe there's no such thing He looked down at the bills "Might as well keep it You earned it You even did well He pulled himself erect and made a small formal bow "Good day sir' he said with no mockery at all and climbed into the transport's front seat Etan watched the limo roll out of the breakdown lane and lumber away from him

After a while he looked down The money was still there at his feet so he picked it up

Just as he was getting back into his own vehicle the console phone chimed "We've got an early opening in our patrol pattern Surveillance told him So we can swing by and get you in ten minutes"

Don't bother Etan said

Repeat?

I said you're too late

"Repeat again please"

Etan sighed "There isn't anything to rescue me from anymore'

There was a brief silence on the other end "Did you get your vehicle overhauled?"

'Yeah Etan said 'That too ∞

In animal and human society, leaders rise and fall with the tides of ancient hormones

THE BIOLOGY OF POWER PLAYS

BY KATHLEEN STEIN

For months he lingered at the outskirts of the community, lost in some private meditation. But one day he decided to seize control, and within a week he'd gained ascendancy. He was a superb male in his prime, and his reign was long and peaceful; he ruled not with coercion or violence but effortlessly, through the impalpable aura of power emanating from him. But hatred festered among the deposed, and they plotted against him, each conspirator quaking with terror at the thought of the confrontation. Finally one schemer, gathering every shred of courage, leapt on him from behind, and the rest followed, dislocating his shoulder and breaking his arm. With the dethronement, the coalition disintegrated, and chaos reigned in the community for months.

The rise and fall of olive baboon #257 was witnessed by Rockefeller University neuroendocrinologist Robert Sapolsky, investigating the free-ranging primates in Kenyas Masai Mara Game Reserve. But Sapolsky didn't just record the behavior of this reigning king and his treacherous plenipotentiaries. His primary goal was to examine how power, hormones, and stress interrelated. He tranquilized male animals, drawing blood to measure the level of hormones with each new trauma he imposed on them. Body chemicals, Sapolsky discovered, seem to surge and subside with the flow of political power. He adds that baboons appear to share their chemical *and* political natures with a wide range of animals, including man.

Here's another scene representing a series of complex coalitions: the 1984 retirement dinner for political curmudgeon Meade Esposito, outgoing chairman of the Kings County Democratic Committee of Brooklyn, New York. A consummate power broker, a backroom man, a cutter of deals, Esposito had extended his political reach far beyond his fame. At his farewell dinner, reported the *New York Post* (for once taking good field notes), there was more protocol than at the court of Louis XIV. It was said that in one 12-minute period Esposito shook 27 hands, kissed nine women, and used a certain obscenity 11 times. He stood up for two priests, one rabbi, a monsignor, the new human-rights commissioner, and former Tammany Hall boss Carmine

PAINTING BY CARLOS REVILLA

DeSapio whom he also kissed Another old pol explained how to work the room "First you kiss the wife then drape your arm around the guy's chair so he's gotta lean close Then you drop your little something in his ear"

Can Margaret Mead explain Meade Esposito? There was no Robert Sapolsky at Esposito's banquet no one tranquilizing specimens or measuring hormone levels and stress No one is filming docudramas on dominant hierarchy and coalition patterns in the House of Representatives Not yet

But a number of scientists are beginning to investigate the infant field of *biopolitics* scrutinizing power as a function of biochemistry and evolution Their findings from the molecular to the global level promise to turn our notion of power—indeed our *power* over power—on its head

Already brain scientists are coming to understand not just the thinking cortex but also the ancient reptilian limbic system the primordial navigator of emotions located at the base of the forebrain This new knowledge points the way to drugs that can modulate stress sex drive imagination memory and perception itself And by the year 2000 says Yale geneticist Francis Ruddle man might wield the tools of genetic engineering to create the body politic anew The raw fact of it is those who harness biopolitics might one day rule the world

Scientists are not yet sure how master politicians might use their new theories but the possibilities are vast They include

- Computer programs that use the tenets of evolution to analyze conflicts and coalitions
- Television images that might manipulate brain neurotransmitters—and consequently the voting patterns of populations
- Drugs that could alter behavior in a leader his enemies or the minions being led
- Animal models to help women tap a potent fount of power making their influence equal to or greater than that of men
- Genetic engineering to inhibit or enhance specific hormones inducing the biochemical states most likely to generate success or intelligence

One scientist who popularized the notion of power rooted in biology is Harvard entomologist E O Wilson His seminal book *Sociobiology* asserts that human behavior is guided not only by environment but also by genes The underpinning of political behavior says Wilson is evolution itself

Dutch ethologist Frans De Waal takes that idea further If we define politics as the social manipulations that secure and maintain influential positions he says in *Chimpanzee Politics* his great account of Machiavellian intrigue at the Arnheim Zoo then it's a game we all play The difference between humans and the power gluttons in fur suits resides in the size of the cortex

It seems that the bigger the cortex the more subtle the maneuvers "Chimps are what baboons would like to be comments Sapolsky if they had the brains or the discipline to be that scheming competitive and backstabbing on such a successful scale The trouble for chimps is that their competitors are that much smarter too

Human chimpanzee or ant the most elementary rule of evolution—and biopolitics as well—is reproductive success Reproductively successful individuals are essentially selected by nature to leave the most surviving offspring Lots of healthy fertile progeny signify continuation of gene lines the ultimate in power brokering

It was a seeming contradiction to this reproductive mandate that led British biologist William Hamilton of Oxford University to propose the concept of inclusive fitness His theory grew in part from the observation of a sterile all-female worker class of ants wasps and bees

These creatures seemed to refute the foundations of evolution itself If they were sterile how could they ensure the perpetuation of their own genes? Hamilton provided an answer to the puzzle by contending that females were helping to perpetuate the genes they shared with their close relatives Such altruistic behavior was a powerful evolutionary strategy aimed at perpetuating closely related sets of genes

"Cheating—pretending to cooperate reciprocally while actually skimming off the top—has greater genetic payoffs, provided that you don't get caught"

After analyzing this theory Robert Trivers a sociobiologist at the University of California at Santa Cruz put forth an ingenious expanded version of his own (see the interview beginning on page 76) Altruism he said might characterize not only relationships between kin but also relationships between unrelated individuals and even between species Reciprocal altruism says Trivers today presupposes a built-in expectation that a good turn will be paid back A kind of "I'll scratch your back now and you'll scratch mine next week"

And according to evolutionary biologists it's reciprocal altruism this expectation of the payback that fuels politics Humans have evolved systems of reciprocity so complex in fact, that they require huge brains (and huger computers) to keep score of who owes what to whom As New York's Ed Koch writes in his autobiography *Mayor* "You are dealing with the labyrinthine interrelationships between federal state and city governments and the solutions to problems lie somewhere in the balancing interests between groups Nothing short of an able political craftsman will do"

Reciprocity is the engine of geopolitics says Pierre Van den Berghe a sociologist at the University of Washington The politics of modern states is overwhelmingly that of "manipulating allegiances and the more complex the society the more range of possible allegiances and the more complex the game of manipulating them" And cheating—pretending to cooperate reciprocally while actually skimming off the top for your loved ones—has greater genetic payoffs than altruism provided you don't get caught Governments says Van den Berghe were created to restrain cheaters

Whether it's local government in New York City or international espionage sociobiologists are beginning to use the theory of reciprocal altruism to examine the operation of just about everything And they've recently begun to hone their concepts further with a series of incisive computer games The most expansive of these games called *The Prisoner's Dilemma* models altruism and its shadowy underside cheating

According to Robert Axelrod author of *The Evolution of Cooperation* a book about the game "We all know that people are not angels" And *The Prisoner's Dilemma* is as amoral as politics itself The game played in an indeterminate number of rounds goes something like this Two people have stolen some money—say $20—gotten caught and been put in separate cells in the slammer but not before stashing the money The jailer informs each one privately that if he keeps his mouth shut he'll be freed with a $1 fine If one tells where the money is and the other doesn't however the squealer will get off free while the sucker returns the money and serves ten days or $10 in fines It both sing both forfeit the money and are sentenced to nine days or nine dollars This last possibility has the worst outcome for the two collectively yet it is inevitably what would transpire if both prisoners decided their actions privately on the basis of personal piggy cost-benefit calculations

To find the best strategy to use in the game Axelrod invited experts in game theory to submit computer programs for a tournament of an undetermined number of rounds To my considerable surprise he says "the winner was *TIT FOR TAT* the simplest of all the programs submitted It proposed starting with cooperation and thereafter doing what the other player did on the previous move" Axelrod circulated the result to the participants and called for another round again *TIT FOR TAT* triumphed

Axelrod's advice to the players Don't be envious don't be the first to defect (squeal) reciprocate both cooperation and detection don't be too clever

When a country say makes a sudden move that another country cannot possibly counter notes one expert "it's bound to be a very aggressive stance Reagan's star wars for example is a scenario guaranteed to lead to nuclear war The Russians have to attack They have no choice It's their last chance With the star-wars scenario there's

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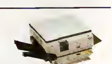

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a fundamental shift in the balance of technical capability." Tit for tat. I'm not willing to pay my taxes if I think I'm the only one paying taxes. And Koch again. I had crossed party lines to endorse him [John Lindsay]. I expected Lindsay to endorse me, but he went ahead and endorsed a Republican. Our relationship began to cool.

The notion of tit for tat is evolution in miniature. It is the human condition. When A and B cooperate, both gain a little. If they both go for the jugular, both go down.

Yet another game that demonstrates the outcome when rampant self-interest triumphs over reciprocity is called *The Tragedy of the Commons*. Developed by Garrett Hardin, human ecologist at the University of California at Santa Barbara, *The Tragedy of the Commons* is played among any number of neighbors on something like a hypothetical Boston Commons, an eighteenth-century field on which everyone grazes his cows. Inevitably, one cow too many begins grazing the common, which will turn into a dust bowl. As Hardin puts it, "Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited." We see the game in action all too vividly in Ethiopia.

Tragedy has only two outcomes, short term and long term. In the short run, everybody will keep adding cows, for to do otherwise would be purely altruistic, incurring loss with no conceivable gain. To keep adding cows looks beneficial. It is only when Killer Cow X saunters onto the commons that losses are encountered, and the mutual harm to all participants is enormous. Not adding cows entails a loss to the single farmer, but the danger that everybody will seek a selfish outcome makes restraint seem beneficial. Under these circumstances it can be rational for self-interested individuals to form a political society, even if it entails self-sacrifice, including payment of taxes, service in the army, or death in a war.

Computer games can now help scientists, and perhaps someday their political protégés, dissect the anatomy of politics. But in the not too distant future, the television itself will help *restructure* that anatomy.

Pioneering research in this arena is political scientist Roger Masters, of Dartmouth University. Small and wiry, with a craggy face and ear-to-ear beard, Masters looks like a living replica of the Abraham Lincoln daguerreotype hanging on his office wall. According to a pilot study by Masters and colleagues, a leader's face on TV sways most viewers regardless of their political beliefs.

To do their experiments, the Dartmouth scientists asked volunteers to view videotapes of President Reagan projecting a number of moods, ranging from happiness to fear to chagrin. As viewers watched the tapes, they were monitored through electrodes that recorded skin resistance, heart rate, and subtle changes in facial muscles. The result: The viewers had an immediate emotional response to Reagan's image on the tube. Those who hated him had similar autonomic responses as those who loved him, leading Masters to conclude that "while the recognition of Ronald Reagan as a Republican is learned, the recognition of a smile is innate. It looks as if a viewer's response to reassuring behavior occurs without strong interference from what they think. One thing is for sure: You'll never be able to choose an important political candidate without consideration of his or her effectiveness on TV."

Emotional responses evoked by a candidate, especially over months or years, might mean the difference between failure and success. Moreover, politicians might one day use such images to literally alter the chemistry of those they hope to sway. According to psychologist R. B. Zajonc of the University of Michigan, facial muscles might play a role in modulating blood flow to the brain. This, in turn, would alter brain temperature, releasing certain neurotransmitters and inhibiting others. It follows from Zajonc's discussion that an audience unconsciously mimicking Reagan's cheery smile on TV might involuntarily reproduce the corresponding cheery neurochemical state.

> *"If you went around, stopping on every corner and shouting, "I command the invasion of the next block!" and nobody paid attention, your serotonin level would go down, too."*

While some scientists see the day we use TV to control body chemistry indirectly, others suggest we may someday exert *direct* control through the use of drugs. Researchers cannot, of course, gain access to the physiological ebbs and flows of Ronald Reagan or Mikhail Gorbachev. But they *have* begun to chart the biochemistry of dominance, the true alchemy of power, in a number of primates.

In an eight-year study at UCLA's Neuropsychiatric Institute, a team headed by Michael McGuire has traced male power to high levels of the neurotransmitter serotonin, linked to general health, mood, and sleep. Studying 40 vervet monkey groups in the lab, McGuire and his team found that male leaders had nearly twice as much serotonin circulating in their bloodstreams as submissive males did. When a leader was dethroned, however, his serotonin level plummeted while that of the new boss surged.

And if power seems to dictate serotonin level, McGuire found, then the concentration of serotonin also affects the ability to lead. When McGuire gave passive male monkeys a drug to jack up the level of serotonin, they began to behave like dominant animals: put through a series of intelligence tests, they performed with the confidence of four-star generals. And when he gave serotonin inhibiting drugs to dominant males, they began to act like subordinates, approaching the same tests with panic and anxiety.

If McGuire discovered a bidirectional feedback loop between hormones and power, moreover, he discovered another loop linking the leaders and those being led. Dominant males retained their ability to dominate McGuire learned, only when they had a group of passive cohorts to push around. Indeed, when McGuire removed all the subordinate males from the group—leaving only females, babies, and the chief—the chief's serotonin level fell. When the chief was isolated behind a one-way mirror to watch his underlings copulating with favored females or sitting on his special perch, he'd go into psychic agony, and his serotonin level would drop.

"The dominant needs the submissive," McGuire says. "If you went around as world leader threatening everybody, stopping on every corner and shouting, 'I command the invasion of the next block!' and nobody paid any attention to you, your serotonin level would decline, too."

The punch line to vervet politics, though, is the power behind the perch. "You can tell when a new male is going to gain dominance," McGuire continues, "by watching the females' behavior. A dominant male can be displaying, winning nine out of ten aggressive bouts, and still the females will be cozying up to a subordinate male. That male will be dominant within two weeks, and his serotonin levels will then rise accordingly." Female vervets have their political organizations, but with much more complex hierarchies. Males are much more straightforward. They just like to slug it out.

Extending this animal work, McGuire has also begun to confirm the relationship among dominance, subordination, and serotonin in man. In a study of fraternity members and athletes at UCLA, he found that officers and team leaders had higher serotonin levels than their team and frat members did.

And serotonin is not alone. Other hormones play a role in the acquisition of power as well. Sapolsky's baboon studies, for instance, show that high-ranking males have significantly *lower* resting levels of the major stress hormone cortisol. These leaders respond to stress with a faster and larger rise of cortisol, but when the stress subsides, they switch off cortisol production more rapidly than their underlings do.

And although the cortisol stimulated by stress normally inhibits the sex hormone testosterone, linked to aggression, the highest ranking baboons are actually better able to maintain testosterone levels in response to stress. High-ranking males seemingly have testes that are less vulnerable to cortisol's suppressive actions, Sapolsky speculates. They simply function more effectively when the going gets tough.

After a revolution, a deposed leader now

CONTINUED ON PAGE 114

Do females choose mates with the fewest parasites? Have we evolved into self-deceivers the better to cheat others? This evolutionary biologist examines the sometimes shocking designs of nature's bold genetic experiments

INTERVIEW

ROBERT TRIVERS

It may have been one of the most ironic labor disputes in the history of science. In one corner, the august dons of Harvard University; in the other, the brilliant, unconventional sociobiologist Robert Trivers. "I was lecturing on reproductive success but was not being paid enough to have any of my own," Trivers now says. Denied his request for early tenure and the accompanying respectable salary, Trivers left the Harvard faculty in 1978. "They were offering me ego gratification," he explains, "but I didn't see how I could feed ego gratification to my children." By the mid-Sixties Trivers, originally a mathematics student, had shifted his focus to the crossroads of biology and behavior. He wondered how animals, including humans, had developed such an exquisitely purposeful repertoire of social skills. How did it all evolve? To answer this question, Trivers turned to a new set of Cambridge mentors. He engaged Harvard anthropologist Irven DeVore in extended, impassioned conversations. He went on bird-watching expeditions with Audubon Society ornithologist William Drury, who revealed to Trivers the world of subtle communication veiled in the deceptively simple melodies of bird song. He devoured Darwin, soon counting himself among the British naturalist's most enthusiastic disciples. Even during these

PHOTOGRAPH BY ALAN LEVENSON

early studies in biology. Trivers dreamed of a unified body of social theory based on natural selection, nature's grand creative process. (The simplest way to describe natural selection, says Trivers, is to say that it favors traits that permit an individual to leave the most surviving offspring.)

In the late Sixties, Trivers's thinking was increasingly shaped by the work of William Hamilton, a British biologist at Oxford University. Hamilton had been intrigued by a puzzling feature of the natural landscape that confounded even Darwin. The existence of all-female, sterile worker classes in insects seemed to refute the very basis of natural selection. How could these wasps, bees, and ants ensure the perpetuation of their own genes? Hamilton argued that these sterile females are actually more related to their fertile sisters than to their own offspring. Therefore they will perpetuate more of their genes by caring for their sisters than they would by raising young of their own. Hamilton's concept of *kin selection*, or *inclusive fitness*, showed that many such examples of seemingly self-sacrificial behavior could have evolved to benefit kin.

Trivers soon took Hamilton's thinking a step further. Altruism might be a feature of relationships entirely outside kin. A vampire bat sharing its bloody meal with a nest mate, or a man helping another man build a house—may be examples of what Trivers called *reciprocal altruism*: the tendency of unrelated individuals to confer favors on one another in the expectation of having such favors returned sometime in the future.

Trivers's first paper on reciprocal altruism, in 1971, was immediately acclaimed and incorporated into mainstream evolutionary theory. Trivers next took a hard look at the ancient question, "What do women—and men—really want?" His answer was couched in terms of mutual sexual exploitation. The female is after a mate with high-quality genes who will also invest heavily in the rearing of her offspring. The male is at least partly interested in spreading his genes. Trivers had provided an exquisitely biological explanation for what the rest of us so nervously call the battle of the sexes.

Biologists and psychologists since Darwin and Freud have pondered the seemingly inevitable series of conflicts between parents and their children. Inspired by his on-the-spot observations of baboons at Jane Goodall's camp in Tanzania, he soon saw among other things that a baby, be it baboon or *Homo sapiens*, will struggle artfully against being weaned, crying or pestering a reluctant mother into continued feedings. Perhaps, speculated Trivers, the Freudian model of parent–offspring conflict—with the parent dispensing care and discipline to an essentially passive child—was wrong. Trivers turned Freud on his head. He argued that parental monopoly of vital resources is offset by the children's ability to coax their parents into providing more care than the mother or father might have intended.

By the mid-Seventies Trivers's reputation as an ingenious, provocative evolutionary theorist was firmly established. Previously he and his fellow "neo-Darwinists" had labored unobtrusively out of the limelight. But in 1975 an unexpected bombshell was dropped. E. O. Wilson, a Harvard entomologist and Trivers's friend, published *Sociobiology: A New Synthesis*. At first glance the book seemed to be a scholarly tome that interprets the behavior of insects, birds, and mammals from an evolutionary point of view. Had it ended there, the book would probably have made only the smallest of splashes.

But Wilson chose to conclude with a final word on human behavior, which he saw as strongly influenced by genetic factors. This last chapter touched an exposed nerve among the many social scientists who prefer to envision man as a free and potentially perfectable product of his upbringing and his cultural environment. Within days of *Sociobiology*'s publication, the hoary debate over nature versus nurture—one that harkens back to Darwin's era—was revived with a passion that astonished both Wilson and Trivers. In Cambridge a group of leftist academics known as Science for the People unleashed a furious attack on sociobiology and Wilson, saying that in endorsing "genetic determinism" he had provided a pseudoscientific justification for the darkest side of the human spirit. Recalling Hitler, slavery and the capitalist excesses of the Industrial Revolution, these critics branded Wilson sexist, racist, and elitist.

> *"Sexual reproduction is extremely disadvantageous in most species. The female bears the child and does most of the rearing, while the male contributes almost nothing."*

In a series of public debates, Trivers leapt to the defense of his colleague and his discipline. Actually, the role of standard-bearer for a rebel flag was nothing new for Trivers. Growing up in suburban Washington, D.C., Trivers had developed a strong identification with blacks and black causes, an identification that eventually led him to join the Black Panther party. One colleague called Trivers "the blackest white man I know."

In the wake of the sociobiology debates and his tenure debacle with Harvard, Trivers took a teaching post in 1978 at the University of California at Santa Cruz. After a hiatus of several years, the former bad boy returned to work with new vigor. His recent book, *Social Evolution* (Benjamin Cummings, Menlo Park, California), is a sweeping reevaluation of much of sociobiology, pulling together an encyclopedic stack of data on species ranging from bacteria to *Homo sapiens*.

Today Trivers lives with his Jamaican wife, Lorna Staple, and their five children in suburban Santa Cruz. As a family man, Trivers is more than usually aware of the biological forces at work in constructing the pyramid of domestic authority. "We men are only worthwhile when we step out the door," he says with a rueful smile. "At home we're on the bottom of the totem pole. My wife dominates me, and so do my older children. Even my six-year-old twins, when they see everyone else dominating me, dominate me, too."

Frequent *Omni* contributor Bill Lawren interviewed Trivers at his complex of offices on the redwood-shaded University of California, Santa Cruz, campus. Like sociobiology itself, their conversation ranged without boundaries.

Omni: Let's set this ancient question to rest. Which is more critical in shaping behavior—genes or the environment; nature or nurture?

Trivers: Neither. Both are inextricably involved in every behavioral characteristic of every organism. No genetic trait exists without an interaction between the gene and the environment. The gene interacts with the environment to construct an individual, and if you remove either component, you've got nonsense. People who criticize sociobiology in the mistaken belief that it makes genetic factors the only determinants for behavior are simply missing the point.

But surely all of us alive today, being the result of four billion years of evolution, have a set of genes that got here through organizing processes that we now understand—in theory and outline—as natural selection. Filling in the details of natural selection, however, is another matter. I think American culture has some deep antievolutionary biases—I don't think it, I know it. I am faced with undergraduates who have been raised in a school system with elements so hostile to evolution that they may come to college with no knowledge that evolution has happened and with a belief that it is unlikely that it happened. And this hooks up with another bias reflected in our social science: the egalitarian bias and the bias toward the English philosophers and psychologists who stated everything was determined by experience. I am really bored with that error, but I'm saying that it has found an almost natural ally in this other, visceral antievolutionism. So it's a sort of pox on evolution from a couple of different angles.

Since most of us no longer breed our own domestic animals or plants and lack knowledge of heredity in other creatures, we are losing the basis to see hereditary associations in our own culture. And they have become less real to us. I'm struck by the fact that in rural Jamaica older women have a much more sophisticated understanding of human behavioral genetics than you could find almost anywhere in American universities. It comes from the fact that they know

three or four generations. They know of a child say fathered by one male who never had contact with that child, who was raised by the mother and another man. And they see the child at age eighteen showing striking similarities in behavior to the way his father behaved at eighteen. These women have made the kinds of observations that allow heredity to be seen.

Omni: Is free will in human beings an acceptable notion to a sociobiologist?

Trivers: What do you mean by free will? There's no question that human beings have been selected to review our behavior and to alter it in ways that seem desirable. There's no question that we sometimes set ourselves against ourselves, so to speak, and try to mold ourselves differently from the ways we are naturally inclined. Apparently individuals who have reviewed their own behavior and sometimes acted in opposition to it have outreproduced those who haven't bothered. So evidently natural selection has found useful a degree of self-consciousness and ability to redirect our efforts. If that's what you mean by free will, fine with me.

On the other hand, not all self-review is necessarily being directed by the individual. You have to bear in mind that we all have the potential to be parasitized by others, so to speak, and by our parents in particular. I can imagine some cases of intensive self-review that do not originate in an individual and that are far from beneficial. These might be a reflection of past parental pressures. You might find parent–offspring conflicts as conflicts between two kinds of self-review.

Omni: Might parents make a child review himself in a specific way because it makes him a more docile little kin–altruist?

Trivers: Yes, and if one applied this approach, it seems at first blush that one could come up with a truly evolutionary biological approach to human psychology.

Omni: Some critics say sociobiology tends to reduce much of human behavior to the level of sexual gamesmanship. Do you think that's a fair and accurate criticism?

Trivers: No, it's very superficial. In fact, there's an ancient misunderstanding in the way you put it. Sociobiologists aren't really talking about sex per se; we're talking about reproduction. There's a big difference, and reproduction is the much deeper concept. Sex is the bringing together of genes from the male and female and then recombining them in the offspring. But reproduction includes all the work done to construct the offspring—the raising of the young, the parental investment. Sex is just a part of, a prelude to, reproduction.

Omni: You've begun to broadcast the idea that parasites, including bacteria and viruses, are a very important aspect of sexual reproduction. Could you explain?

Trivers: The basic problem comes in trying to explain the evolutionary success of sexual reproduction. In theory, sexual reproduction is tremendously disadvantageous because in most species the female does almost all the work. She bears the child and does most of the rearing, while the male contributes almost nothing. This is so inefficient compared with asexual forms of reproduction that we're not quite sure how the benefits offset the costs. The most promising theory has it that coevolving antagonistic species, primarily parasites, provide the selection pressures that maintain sexual reproduction. As we come to appreciate the incredible complexity and subtlety of our immune systems, we realize that defenses against parasites are a much greater portion of our biology than is sometimes appreciated. In [British biologist William] Hamilton's memorable phrase, sexually reproducing species may be "guilds of individuals committed to free, fair exchange of biotechnology for parasite exclusion." In other words, the reason we reproduce through sex is to exchange and mix genes for defense against parasites.

When you pick a mate, you're trying to get good genes. This argument suggests that good genes are those that provide defense against parasites. If that's true, one might expect females to emphasize traits in males that demonstrate genetic resistance to the locally abundant parasites. What traits? Well, in birds it has been suggested that either brightness of coloration or complexity of song might indicate the degree of resistance the individual has to parasites. The intuitive notion is that it's hard to be brightly colored when you're full of parasites, and it's hard to sing a complex song when you're sick.

Omni: Do we also unconsciously select mates according to the apparent vigor of their immune systems in fending off parasites?

Trivers: I suspect so, but I wouldn't limit it to the immune system because humans have other methods of parasite exclusion. But I do feel that it must certainly be the case. We're a large, multicellular creature, especially slow in reproduction and with a relatively small number of offspring in a lifetime. These are all conditions in which we expect this pressure from parasites to be especially important. We obviously spend a large amount of time in parasite exclusion: washing, cleaning, grooming. This all ultimately relates to parasites. Perhaps the mating system changes as we move from the arctic to the tropics because of the increased frequency and importance of parasites. Is getting the best genes for parasite resistance more important in the tropics? Do males in tropical cultures emphasize bright plumage in the way they paint themselves or in the clothing they wear? In New Guinea, for example, the men actually remove bright feathers from birds and wear them. It's entirely speculative, but I wonder if the drab, gray, monogamous life of the northern climes is replaced by brighter, more sexual social life in the tropics, where parasites are more abundant.

Omni: How can a woman tell if a potential mate really has good genes for parasite defense or just access to antibiotics?

Trivers: Put that way, I don't think she can. I

"He's just been transferred from tobacco research to alcohol research."

think these selection factors may have less impact when antibiotics are available. But if you look at the day-to-day evidence, we seem to find any kind of obvious condition that indicates illness—skin disease or dull, dry hair—to be sexually unattractive.

A really good example of how parasites can influence life-style is this AIDS parasite that has had such a radical influence on the behavior of gay men and may yet have a strong influence on the behavior of society at large. Just the spreading of one little old parasite changes the way a whole sef of people have sex and spend their evenings. So imagine life in earlier times, with the incredible pestilence that happened when civilization, as it is called, began to flourish. Imagine what it was like, say, with syphilis as a factor to inhibit the free expression of sexuality.

Omni: If females are choosing mates for their apparently low parasite counts, what about females who choose mates who seem obviously disadvantageous, such as the philandering man?

Trivers: One intriguing possibility is that there's a conflict in female choice, a conflict between choosing a mate for his parental investment potential—the sort of faithful, dull old sod who comes home every night at six and plays with his children—and choosing for quality of genes. One solution to that dilemma is for her to get her investment from one place and her genes from another. In that model, the dull old sod is good for investment but genetically uninteresting, and the philandering male could be attractive precisely because he's so attractive to other females. So the female therefore wants to hook up her genes with his philandering tendencies, so to speak. What I like about this idea is that it's the female perspective on cuckoldry. We poor males usually discuss cuckoldry only from the standpoint of the grievous damage that it may do to a male's self-interest. But from the female standpoint, getting one's genes from one place and one's investment from another might be a nice solution to the conflicting demand.

Omni: Didn't one woman have herself sterilized after reading your paper on parental investment and sexual reproduction?

Trivers: She came up to me after a meeting and said she had been thinking about sex differences from a woman's perspective, and after she read my paper she saw the magnitude of the problem for the first time. She saw that the whole pattern of female oppression by males ran much deeper than she had thought, and in reaction she had a tubal ligation. My initial reaction was, Oh God, no! But she saw the look on my face and said, 'No, it's not that way at all,' and told me she'd already had two children and was very happy with them. She just didn't want to have any more. After that we became close friends, and she did a very good doctoral thesis on—what else?—female choice in humans.

Omni: What's homosexuality about from the evolutionary point of view? Is it exclusively human, or do we see it in other animals?

Trivers: One of the most exciting developments of research in the past ten years has been the growing discovery of cases of real homosexual behavior in animals. I myself have seen homosexual copulations in a lizard I studied. I didn't believe it at first—I thought I'd written one of the individuals' sexes incorrectly in my notebook. So I went and caught them again and found that the lizard underneath had indeed been a male.

One of the most interesting examples is the discovery of high frequencies of lesbian couples in several species of seagulls. It was first discovered in Western gulls off the California coast, and everybody said, Well, that's California for you. What do you expect? Since then it's turned up in four or five species, including New Zealand gulls, in some populations as many as twelve percent of the nesting couples are actually female–female pairs. Some of them go through all the sexual behaviors of a heterosexual couple, including mounting and coital contact. They even raise offspring together.

This obviously implies that the females are copulating outside the homosexual relationship, which they apparently do often enough to fertilize their eggs—about half as often as heterosexual couples. These homosexual couples are somewhat less successful in raising young than are the heterosexual couples, but they do achieve some reproductive success. So here's a whole little world that's appeared to us in the last ten years that says, in effect, that homosexuality is not so unnatural. I would like to see much more theorizing and empirical work on human homosexuality. If I were gay I'd certainly be interested in pursuing this.

Omni: Where does human homosexuality fit in the scheme of evolution?

Trivers: If I were trying to construct a theory myself, I would look for some way in which a gay orientation improved your ability to do something else. How would a person with gay tendencies in a hunter–gatherer society function? It couldn't be reproduction because homosexuality interferes with that. The only way I can see to get a positive benefit from it is if it gave the person some special insights, for example, if it makes you more likely to assume the role of shaman.

Omni: Do you think that some parents may mold their children into homosexuals as an unconscious evolutionary strategy to keep them close to the nest so that they can help in raising other siblings?

Trivers: There's no clear evidence in support of that possibility. Actually, I think homosexuality may be disturbing to parents precisely because it *threatens* kin-directed altruism. That is, if a man is in love with another man he's going to bestow on that man the objects of his affection. If he's chasing other men in a sort of singles scene, then he's going to waste a lot of resources in male–male competition. So either way you construe homosexuality, it's going to drain the man of resources that he might otherwise be expending on kin. Celibacy seems more likely to be a strategy benefiting kin because

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Something other than bombs may be producing rapidly expanding, mushroom-shaped clouds

ANTI MATTER

UFO UPDATE

It was close to midnight on April 9 1984 when Captain Charles McDade of Japan Air Lines flight 036 saw the mushroom Ac cording to McDade his commercial 747 was cruising some 250 miles northeast of Tokyo when a layer of cloud began to rise In two minutes it had blossomed into an enormous mushroom 60 000 feet high and 200 miles wide McDade radioed a May day alert to Anchorage Alaska and ordered his crew to use oxygen masks as a precaution Later he stated that he had "never seen anything like it except in news reels and films

But McDade was not alone Other pilots from Japan Air Lines, KLM Royal Dutch Airlines and Flying Tigers saw the cloud as well Speculating that the mushroom might have resulted from the explosion of a nuclear-powered submarine the Japanese Air orce sent an F 4 Phantom fighter-bomber to the scene to collect dust but according to offi cials not a trace of radioactivity was found

Soon the Federal Aviation Authority had dismissed the sighting as a lenticular or lens-shaped, cloud (see 'Phantom Mushroom Antimatter, October 1984) And that s when Daniel A Walker a seismologist at the University of Hawaii stepped onto the scene Walker knew that the mushroom had risen too fast to be a lenticular cloud And as director of an array of hydrophones in the western Pacific, he thought he might be able to come up with his own solution

Walker s hydrophones constantly scan the seas and they are sensitive enough to detect and record the blast of a quarter pound of dynamite thousands of miles away So he decided to search his records for traces of the unusual or bizarre Soon he'd uncovered a swarm of sharp sudden pulses peaking in intensity on April 8 and 9 This was the clear signature of an undersea volcano and Walker ultimately traced it to the eruption of Kaitoku Seamount some 900 miles south of the cloud Meteorologists analyzing the data then said that the jet stream could have blown the volcano dust north at high speed accounting for the cloud reported by McDade But when Walker checked satellite records, he discovered that winds recorded on the eighth and ninth were relatively weak and that they hadn t been moving toward the north at all

Walker s results published in the February 8 issue of *Science* magazine soon elicited some other theories The cloud might have resulted from a weather-modification experiment researchers suggested, or it might have been caused by the explosion of a tanker carrying liquefied natural gas

Walker and colleagues have begun building a database to help them study the cloud For as Walker points out 'The explanation is important f these ideas don t work we're back to some really scary possibilities If the cloud was caused by a man-made atmospheric explosion then who did it? And what kind of device have they employed? ir t was caused by some unknown natural phenomenon on the other hand 'it s important for us to know that something other than bombs can produce rapidly expanding mushroom-shaped clouds What if it were to happen again over Washington DC?' —*T A HEPPENHEIMER*

KAMIKAZE BIRDS

Motorists on U S Highway 101 near Mountain View California recently watched hundreds of robins dive-bomb over passing cars into a concrete wall More than 400 birds were killed during a 48-hour period, and some cats pursuing the dead or dying birds were killed as well Although no people were injured a multicar wreck resulted when drivers swerved to avoid the mess

What caused this apparent suicide? Karen Fraad director of public relations at the Santa Clara County Humane Society looked into the mystery and concluded that "the robins were drunk "

The California Department of Transportation plants pyracantha bushes along certain highway exits Fraad explains And this year some unusual weather caused the pyracantha berries to ferment just as thousands of migrating robins were passing through

The birds ate the small red berries and then seemed to become intoxicated says Fraad They didn t know where they were going and began to fly low Some recovered and were later able to fly away but many couldn t

Noting that this is not the first time birds have become drunk from pyracantha berries along California roadsides, Fraad says she would like to see the plants cut back or removed 'Not only did those bushes cause birds stress injury, and death she says they are a potential cause of human death as well '

In a recent development, Fraad adds the California Department of Transportation has agreed to cut back the intoxicating plants

Sherry Baker

' Everything is only a metaphor, there is only poetry '

Norman O Brown

I m lonely and shy Women don't like me Unfortunately, real life is different from movie fiction I've got many girlfriends, but I still can't find my twin soul One day who knows, might find her amidst the thousands of fans who write me or call on me '

—Richard Chamberlain

STRANGE BIRTH IN SWAZILAND

Christina Mazibuko twenty-three of Swaziland Africa allegedly gave birth to a baboon The hairy stillborn male was delivered by midwives just eight months after Christina was raped by a baboon according to widespread reports appearing in the African press superstitious neighbors later threw the lifeless creature into a roaring fire

According to local mythology human/baboon hybrids imbue the matchmaker with great magical power And Mazibuko claims she was drugged and then paired with the baboon by just such an evil entity Of her pregnancy she says The fetus would go mad inside of me and claw at my stomach And of the delivery " screamed in horror I had given birth to a monster "

But monstrous or t says geneticist Kurt Hirschhorn M D of Mount Sinai School of Medicine in New York ity the child must have been human It s simply impossible for a baboon and a woman to conceive an embryo together " he explains The baboon differs too significantly from man in its genetic makeup and the chromosomes just won t line up properly

Perhaps someone will explain the genetic facts to Mazibuko s troubled husband Maphiko twenty seven a sales clerk who grouses 'I just hope she has a normal one the next time around — Eric Mishara

'There are intervals when a life becomes clouded over by a sense of unreality when definition is lost when the rational will or what passed for it before has given up control or the pretense of it At such times there is a sense of drifting if not of drowning in a universe of turbulently rushing fluids or vapors

Tennessee Williams

Specialized sciences of our times are concentrating on the study of the three constants of life sexual instinct the sentiment of death and the anguish of space-time '

Salvador Dali

SIBERIAN SPACESHIP?

On June 30 1908 a huge explosion rocked Tunguska in central Siberia ravaging 1 500 square miles of land with the force of a 35 megaton bomb Witnesses reported a bright object traversing the sky just before the blast leading some to speculate that it had been caused by an alien spaceship crashing to Earth

Now a Soviet scientist says he has evidence that lends credence to this theory N Vassiliev a professor at the University of Tomsk who recently headed an expedition into Tunguska announced that lead collected from the blast site has proved to be 1 billion years old—three times older than Earth itself Vassiliev speculates the mysterious metal may have come from an alien space machine

But space expert James E Oberg disagrees "There is no evidence of this so called discovery outside of Vassiliev s word Oberg says Moreover, since lead doesn't decay its half-life is infinity making it impossible to date

Most scientists agree that the Tunguska blast was caused by a comet or an asteroid and that Oberg says is what we should be concerned about We don t want this kind of thing to ever happen again, he contends If an asteroid or comet crashed into Moscow or New York tomorrow it could be the equivalent of a good-size hydrogen bomb If any are headed our way we want to push them aside —Sherry Baker

I heard a chilling, thoroughly unearthly roar something like a shrill metallic gasp, and the tentacle that had me caught unraveled and I fell into that cavernous mouth
—Carlos Castaneda

"Put all your eggs in the one basket and—WATCH THAT BASKET
—Mark Twain

"Events aren t in serial form but collect here and there like quanta "
—Lawrence Durrell

BARNEY CLARK'S OBE

Barney Clark the world s first artificial-heart recipient, claimed he had several out-of-body experiences (OBEs) following his historic operation

Clark died 112 days after receiving the Jarvik 7 heart, and his OBEs were made public by his widow, Una Loy Clark (shown with Barney, below) just recently She says About two months after the heart operation when he was completely lucid and his seizures had passed he told me Honey I have died three times I floated above everyone saw my own body on the hospital bed and could hear everything perfectly it was as if I were a separate being and no longer occupied my own body After each time I awakened surprised to find myself still here

Clark also described his OBEs to Claudia Berenson his psychiatrist at the University of Utah Medical Center During one experience he told her he even floated out over the hospital lawn

Dr Clark was on a whole variety of drugs including antibiotics and anticoagulants," Berenson notes but he was on no specific medication that clearly alters behavior

Clark was very much a private person who preferred to keep things in a normal climate Una Loy Clark says 'So he must have sincerely felt that something special had happened '

But according to UCLA psychologist Ronald K Siegel not one iota of evidence suggests that such experiences are anything more than the mind s misperception of reality I have no reason to doubt that Barney Clark had the experience of floating outside his body, Siegel says 'But don t think he actually did so
Eric Mishara

If painting is partly war then one of my chief weapons s a sense of the blackness of black And in certain desperate situations it s the weapon I pull out
Robert Motherwell

"Man is the only animal that laughs and weeps for he is the only animal that is struck with the difference between what things are and what they ought to be
—William Hazlitt

BENIS TO THE RESCUE

One night not long ago Los Angeles allergist Max Benis dreamed about a pickup truck crashing into a telephone pole. The very next day, Dr. Benis claims, my dream became real. An overwhelming urge caused me to change my usual route, and as I drove I saw the pickup truck right in front of me plow into a pole. The driver wasn't breathing, so I resuscitated him."

According to Benis' clinical professor of medicine at UCLA, this is just one of numerous rescues facilitated by extrasensory perception. "I usually don't get a mental image of the accident," he says. "I just feel a heightened awareness and excitement that is followed by a strange decision to drive along a certain street or visit a certain place."

For instance, Benis says, he once made a snap decision to enter a Los Angeles deli. "As I walked in, an employee had a seizure and stopped breathing, but I revived him. And then there was the morning that Benis, feeling strangely jangled, decided to leave for work earlier than usual. I came across a station wagon that had crashed off the highway just seconds before," Benis says. "As the car burst into flames, I pulled the four unconscious men sitting inside it to safety."

The allergist's uncanny ability moreover, is confirmed by paramedic Carl Moscovitz, who has seen Benis arrive at accident scenes on two separate occasions. "Most doctors carry a little black bag," Moscovitz says, "but Benis travels with this really big first-aid kit that contains every drug paramedics carry, plus more."

Benis may be prepared, but one skeptic says the latter probability, not ESP, explains his luck. "There must be a hell of a lot of traffic accidents in Los Angeles," says Marcello Truzzi, a sociologist at Eastern Michigan University and director of the Center for Scientific Anomalies Research in Ann Arbor, and there are probably hundreds of doctors running around Los Angeles daily; we would expect some of those doctors to have a high record of running into people they could help. —Eric Mishara

It is true that we are weak and sick and ugly and quarrelsome, but if that is all we ever were, we would millenniums ago have disappeared from the face of the earth, and a few remnants of fossilized jaw bones, a few teeth in strata of limestone would be the only mark our species would have left on the earth.

—John Steinbeck

BO DEREK HAIR

A bizarre type of monster supposedly inhabiting two lakes in western Canada is said to have a hairdo something like the one Bo Derek popularized in the movie *10*.

This past summer, Ray Makowecki, regional director of the fish and wildlife department in Alberta, received reports from Indians and a sportfisherman who claimed to have sighted fast swimming, fifteen- to thirty-foot-long creatures in Saddle Lake and Christina Lake, 400 miles apart. The animals allegedly had horselike heads and eyes the size of saucers. But the most astonishing feature was the cornrow-style hair.

Intrigued by the reports, Makowecki called in cryptozoologist James Butler, professor of parks and wildlife management at the University of Alberta in Edmonton. Butler, who interviewed 14 witnesses, says he is skeptical. "We have not been able to dismiss this as an otter or a moose, animals normally mistaken for lake monsters," he notes. "But the possibility of a giant sturgeon has not been discounted."

—Eric Mishara

2001 QUIZ

CONTINUED FROM PAGE 40

14) Which of the following planets will man have walked on by the year 2050? (Check as many as seem realistic.)
a. Mars
b. Venus
c. Jupiter
d. Saturn
e. none

15) When will a universally accepted grand unification theory—one that unites the electromagnetic, gravitational, strong, and weak nuclear forces of energy under one principle—finally be developed?
a. before 1990
b. 1990 to 2000
c. 2001 to 2010
d. 2011 to 2020
e. beyond 2020
f. never

16) Which of these diseases will be eradicated before the year 2000? (More than one answer is acceptable.)
a. lung cancer
b. herpes
c. leprosy
d. AIDS
e. Alzheimer's disease
f. hepatitis
g. none of the above

17) Name the most common global energy source in the next century.
a. oil
b. coal
c. fusion
d. fission (nuclear power)
e. solar power
f. geothermal power

18) Which group will first have a member elected president of the United States?
a. women
b. blacks
c. Jews
d. Hispanics

19) Which one of the following scenarios will best characterize the state of Soviet–American relations in 2000?
a. widespread cooperation, including joint ventures in space and scientific collaborations on Earth
b. a wary detente with arms limitation treaties working somewhat successfully
c. a continued buildup of weapons both on Earth and in space, but no aggression (in essence, a status quo situation)
d. continued arms buildup with limited military operations in progress on Earth
e. wide-scale nuclear war pursued only in space
f. nuclear war pursued both on Earth and in space

20) What do you think the American minimum wage will be in the year 2000?
a. under $5
b. $5 to $6
c. $6.01 to $8
d. $8.01 to $10
e. over $10

21) Which one of the following alternative living environments will be used by the greatest number of people in the year 2050?
a. underground communities
b. underwater communities
c. space colonies
d. orbiting spacecraft

22) By the year 2000, which one of the following will the space shuttle be most used for?
a. as today, for scientific experiments and satellite repair
b. for routine passenger transportation to a space station or for pleasure (honeymoons, excursion trips, and so on)
c. for industrial cargo transportation to a space station or moon colony
d. all of the above
e. the shuttle will no longer be used

23) Which of the following events will have occurred by 2010? (More than one answer is acceptable.)
a. a computer will defeat a grand master at chess
b. a major earthquake will ravage the California coastline
c. terraforming will have begun on Mars
d. genetically engineered foodstuffs will virtually eliminate hunger in Africa and the Third World

24) Which of the following macroengineering projects will be completed before the middle of the next century?
a. Planetran, a levitated tunnel subway transporting passengers from New York to Los Angeles in 20 to 60 minutes
b. an English Channel tunnel
c. a pipeline exporting Rhone river water under the Mediterranean to and Libya or Algeria
d. a friendship bridge across the Bering Strait connecting Siberia and Alaska
e. all of the above
f. none of the above

25) August 6, 2045, marks the hundredth anniversary of the nuclear devastation of Hiroshima. Will we have done away with nuclear arms by that time?
a. yes
b. no

26) Can we expect a vaccine for the common cold (interferon, perhaps) within one generation (30 years)?
a. yes
b. no

27) Which will come first?
a. a cloned man
b. a bionic man
c. a one-hundred-and-fifty-year-old man

(with help from life-extension drugs)
d a self-replicating robot

28) What will be the most polluted city on Earth in the year 2000?
a New York
b Los Angeles
c Tokyo
d Bangkok
e Mexico City
f Cairo
g Sao Paulo

29) Which city will boast the biggest population at the turn of the century?
a New York
b Los Angeles
c Tokyo
d Rio de Janeiro
e Mexico City
f Shanghai
g Sao Paulo
h Calcutta

30) Which of the following types of fuel will most likely power our spaceships in the next century?
a fusion
b fission
c solar power
d antimatter, such as boron fuel
e conventional rocket fuel
f other

31) Will the existence of a flying object whose crew is from another world be verified in the next century?
a yes
b no

32) What will be the primary use of orbiting satellites in the coming century?
a telecommunications
b solar-energy receivers/transmitters
c space weapons
d cargo holds and fueling stations for shuttles

33) Keeping in mind the ravages of inflation and the rising costs of paper, what will you pay in the year 2000 for a magazine that costs $2.50 today?
a $3
b $5
c $7
d $10
e $15
f more than $15

34) Which of these drugs is likely to be commonly used in 2000? (More than one answer is acceptable.)
a memory-enhancing medicine
b proven aphrodisiacs
c intelligence-boosting medicine
d life-extension drugs
e none of the above

35) The first permanently manned space colony will be established by which of the following groups or nations?
a United States
b Soviet Union
c European consortium
d China
e there will never be a viable manned space colony

36) Who will be the world's technological leader at the turn of the century?
a the Americans
b the Russians
c the Japanese
d the Germans
e the Chinese

37) Robots and computers will make which of the following jobs obsolete in the year 2010? (Check more than one, if desired.)
a bank clerks
b newspaper deliverers
c telephone operators
d short-order cooks

38) What will be the average life expectancy of an American in the year 2000?
a 66 to 69
b 70 to 73
c 74 to 77
d 78 to 81
e 82 or over

"How many people will be living in space on New Year's Eve of 1999? When will personal robots be widely used in American homes?"

39) It's New Year's Eve, December 31, 1999. How many people will be popping champagne corks in space?
a none
b 1 to 9
c 10 to 20
d 21 to 50
e 51 to 100
f 101 to 1,000
g more than 1,000

40) A so-called greenhouse effect long predicted by scientists will cause extensive damage to coastal areas within the next 40 years.
a true
b false

41) By 2000, how many nations will possess workable nuclear weapons?
a 8 to 10
b 11 to 13
c 14 to 18
d 19 to 24
e more than 25

42) Which of these animals will be extinct by 2000? (More than one answer is acceptable.)
a grizzly bear
b sperm whale
c bald eagle
d giant panda
e whooping crane
f Indus dolphin
g snow leopard
h none of the above

43) How will most cars be powered in the year 2010?
a gasoline
b gasohol
c electricity
d steam

44) There are approximately 4.5 billion people alive today. How many will there be in the year 2000?
a 5 to 6 billion
b 6 to 7 billion
c 7 to 8 billion
d 8 to 9 billion
e 9 to 10 billion
f more than 10 billion

45) What will the typical classroom of the twenty-first century be like?
a group of students listening in school to a human teacher (traditional)
b group of students listening in school to a robot or computer teacher
c each student at home with a computer terminal

46) Will Venice be underwater (uninhabitable to the city's population) by the end of the next century?
a yes
b no

47) "That's one small step for a man, one giant leap for mankind," remarked Neil Armstrong as he began his historic lunar stroll on July 20, 1969. Will man be living on the moon 50 years later (2019)?
a yes
b no

48) What would a twenty-first-century man say is the single greatest invention or discovery of the twentieth century?
a computer
b theory of relativity
c polio vaccine
d splitting the atom
e television
f satellite

49) Given that painting is the most ubiquitous manifestation of fine art today, what format will most artists favor in the twenty-first century?
a painting
b sculpture

c photography
d computer and holographic art
e a new art form as yet unexploited or uninvented

50) What is the most *difficult*, perhaps impossible, challenge facing man in the twenty-first century?
a alleviating world hunger
b reducing or eliminating nuclear weapons
c finding alternative energy sources to replenish depleted reserves
d stabilizing world population
e colonizing outer space

PROPHECY QUIZ SCORECARD

Here are Arthur C. Clarke's answers. Count the number of your own answers that match his, then look up the futuristic profile that fits your score.

1) a
2) b
3) b
4) a
5) a
6) a
7) c
8) b
9) b
10) b
11) b
12) d
13) a
14) a (If you answered *c* or *d*, not only are you at odds with Clarke, but you're completely wrong. Jupiter and Saturn do not have solid surfaces!)
15) e
16) g
17) a
18) a
19) a
20) e
21) a
22) b
23) a,b (Give yourself half a point for each correct response.)
24) b
25) a
26) a
27) d
28) f
29) c
30) a
31) b
32) a
33) d
34) a,b,c,d (Give yourself a quarter of a point for each correct response.)
35) a
36) a
37) b,c (Give yourself half a point for each correct response.)
38) e
39) e
40) b
41) b
42) h
43) a
44) b
45) b
46) b
47) a
48) a
49) d
50) b

Crack open your fortune cookie and find out what kind of seer you are.

0 to 9. **Dust Off Your Crystal Ball**
The future is still a foreign, somewhat forbidding place. You prefer buying an antique chair to shopping for a compact-disk player. Your pessimism about the fate of our planet is unjustified. You need to come to terms with your fears about the future and learn to appreciate the achievements of science and technology.

10 to 16. **Armchair Futurist**
The future may seem somewhat tempting, but you're more of a spectator than a participant. Don't put off for another month what should have been done yesterday. If you've been delaying that purchase of a home computer, you need to take some immediate action. If you prefer soap operas to science fiction, expand your viewing and reading habits to prepare for the world of the twenty-first century. And think of a career change that could dramatically improve your own life and that of your family.

17 to 24. **Reluctant Visionary**
It's obvious that your eyes are open to the positive changes yet to come. You possess a great deal of curiosity about the future but need to refine much of your knowledge. Because space represents the next great frontier for our civilization, you will need to improve your knowledge of space opportunities in order to benefit—whether spiritually or financially—from the coming space boom. You show considerable promise as a futurist, but you need to be a great deal more daring in your outlook to create a better world of tomorrow for yourself and for those who will share your future.

25 to 33. **May All Your Children Be Astronauts, Your Grandchildren, Spacebabies**
You are enthusiastic and knowledgeable about our future world. You're a trendsetter, someone who is unwilling to be mired in the traditions of the past. You will not be reluctant to put a robot to work in the home or to learn the art of holography. As a role model for the next generation and for generations to come, you are excellent because you're good at communicating your daring and excitement to others.

34 to 42. **Make Your Reservations for the Space Shuttle Now**
You have already accepted a future world that those around you have yet to recognize. You're the kind of person who dreams of experiencing the ultimate frontier, be it a space station or a life-extension clinic. Remember to share your visions with the less farsighted. Your path to 2000 and beyond will be both rewarding and enlightening. Your life in the next century will be a dream fulfilled.

43 to 50. **Arthur C. Clarke Clone**
Either you're a replicant of Arthur C. Clarke or you've peeked at the answers. You've hit the jackpot of the future with a score fewer than 1 in 100 could attain. You are a peace-loving person who believes that scientific discoveries and technological accomplishments will lead to a world without war. Not only are you familiar with the philosophy of Clarke and his visions of the future, but you possess a gentle, clear-sighted vision of your own. You hope that genetic engineers will learn to feed the hungry and that space will be used to bridge the hostility between the United States and the Soviet Union. More of a philosopher than a businessman, you dream of the twenty-first century as a technological Eden unlike any past era in the history of civilization. ∞

"We're looking for a home for some toxic waste."

DOGFIGHT

CONTINUED FROM PAGE 46

baby fine hair) Choppy Japanese haircut Money 'That sucker was gonna be my dinner he said ruefully He took hold of the towel and let her pull him up

She smiled but skittishly backed away from him Let me make it up to you ' she said You want some food? It was only a projection okay?'

He followed her in wary as an animal entering a trap

Holy shit ' Deke said, 'this is *real cheese* He was sitting on a gutsprung sofa wedged between a four foot teddy bear and a loose stack of floppies The room was ankle deep in books and clothes and papers But the food she magicked up Gouda cheese and tinned beef and honest to God greenhouse wheat wafers was straight out of the Arabian Nights

Hey she said We know how to treat a proleboy right huh? Her name was Nance Bettendorf She was seventeen Both her parents had jobs—greedy buggers—and she was an engineering major at William and Mary She got top marks except in English I guess you must really have a thing about rats You got some kind of phobia about rats?

He glanced sidelong at her bed You couldn't see it, really it was just a swell in the ground cover It's not like that It just reminded me of something else is all

Like what? She squatted in front of him, the big shirt riding high up one smooth thigh

Well did you ever see the— his voice involuntarily rose and rushed past the words—'*Washington Monument*? Like at night? It's got these two little red lights on top aviation markers or something and I and I He started to shake

'You're afraid of the Washington Monument? Nance whooped and rolled over with laughter long tanned legs kicking She was wearing crimson bikini panties

I would die rather than look at it again he said levelly

She stopped laughing then sat up studied his face White even teeth worried at her lower lip like she was dragging up something she didn't want to think about At last she ventured 'Brainlock?'

Yeah he said bitterly They told me I'd never go back to DC And then the fuckers laughed "

What did they get you for?

I'm a thief ' He wasn't about to tell her that the actual charge was career shoplifting

"Lotta old *computer* hacks spent their lives programming machines And you know what? The human brain is not a goddamn bit like a machine no way They just don't program the same ' Deke knew this shrill desperate rap this long circular jive that the lonely string out to the rare listener knew it from a hundred cold and empty nights spent in the company of strangers Nance was lost in it and Deke nodding and yawning wondered if he'd even be able to stay awake when they finally hit that bed of hers

'I built that projection I hit you with myself she said hugging her knees up beneath her chin It's for muggers, you know? I just happened to have it on me and I threw it at you cause I thought it was so funny you trying to sell me that shit little Indojavanese programmer She hunched forward and held out her hand again Look here Deke cringed No no it's okay I swear it, this is different She opened her hand

A single blue flame danced there perfect and everchanging 'Look at that she marveled Just look I programmed that It's not some diddly little seven-image job either It's a continuous two hour loop, seven thousand two hundred seconds never the same twice, each instant as individual as a fucking snowflake!"

The flame's core was glacial crystal shards and facets flashing up twisting and gone leaving behind near subliminal images so bright and sharp that they cut the eye Deke winced People mostly Pretty little naked people fucking How the hell did you do that?"

She rose bare feet slipping on slick magazines and melodramatically swept folds of loose printout from a raw plywood shelf He saw a neat row of small consoles austere and expensive looking Custom work 'This is the real stuff I got here Image facilitator Here's my fast-wipe module This is a brain-map one-to one function analyzer She sang off the names like a litany 'Quantum flicker stabilizer Program splicer An image assembler

You need all that to make one little flame?

You betcha This is all state of the art professional projective wetware gear It's years ahead of anything you've seen

Hey he said you know anything about SPADS&FOKKERS?

She laughed And then because he sensed the time was right he reached out to take her hand

'Don't you touch me motherfuck don't you *ever touch me*! Nance screamed and her head slammed against the wall as she recoiled white and shaking with terror

Okay! ' He threw up his hands Okay! I'm nowhere near you Okay?

She cowered from him Her eyes were round and unblinking tears built up at the corners rolled down ashen cheeks Finally she shook her head Hey Deke Sorry I should've told you

Told me what? But he had a creepy feeling already knew The way she clutched her head The weakly spasmodic way her hands opened and closed You got a brainlock too '

Yeah ' She closed her eyes It's a chastity lock My asshole parents paid for it So I can't stand to have anybody touch me or even stand too close Eyes opened in blind hate I didn't even *do* anything Not a fucking thing But they've both got jobs and

they're so horny for me to have a career that they can't piss straight. They're afraid I'd neglect my studies if I got, you know, involved in sex and stuff. The day the brainlock comes off I am going to fuck the vilest, greasiest, hairiest—"

She was clutching her head again. Deke jumped up and rummaged through the medicine cabinet. He found a jar of B-complex vitamins, pocketed a few against need, and brought two to Nance, with a glass of water. "Here." He was careful to keep his distance. "This'll take the edge off."

"Yeah, yeah," she said. Then, almost to herself: "You must really think I'm a jerk."

The games room in the Greyhound station was almost empty. A lone, long-jawed fourteen-year-old was bent over a console, maneuvering rainbow fleets of submarines in the murky grid of the North Atlantic.

Deke sauntered in, wearing his new kicker drag, and leaned against a cinder-block wall made smooth by countless coats of green enamel. He'd washed the dye from his proleboy butch, boosted jeans and T-shirt from the Goodwill, and found a pair of stompers in the sauna locker of a highstack with cut-rate security.

"Seen Tiny around, friend?"

The subs darted like neon guppies. "Depends on who's asking."

Deke touched the remote behind his left ear. The Spad snap-rolled over the console, swift and delicate as a dragonfly. It was beautiful, so perfect, so *true* it made the room seem an illusion. He buzzed the grid, millimeters from the glass, taking advantage of the programmed ground effect.

The kid didn't ever bother to look up. "Jackman's," he said. "Down Richmond road, over by the surplus."

Deke let the Spad fade in mid-climb.

Jackman's took up most of the third floor of an old brick building. Deke found Best Buy War Surplus first, then a broken neon sign over an unlit lobby. The sidewalk out front was littered with another kind of surplus—damaged vets, some of them dating back to Indochina. Old men who'd left their eyes under Asian suns squatted beside twitching boys who'd inhaled mycotoxins in Chile. Deke was glad to have the battered elevator doors sigh shut behind him.

A dusty Dr. Pepper clock at the far side of the long, spectral room told him it was a quarter to eight. Jackman's had been embalmed twenty years before he was born, sealed away behind a yellowish film of nicotine, of polish and hair oil. Directly beneath the clock, the flat eyes of somebody's grandpappy's prize buck regarded Deke from a framed, blown-up snapshot gone the slick sepia of cockroach wings. There was the click and whisper of pool, the squeak of a workboot twisting on linoleum as a player leaned in for a shot. Somewhere high above the green-shaded lamps hung a string of crepe-paper Christmas bells faded to dead rose. Deke looked from one cluttered wall to the next. No facilitator.

"Bring one in, should we need it," someone said. He turned, meeting the mild eyes of a bald man with steel-rimmed glasses. "My name's Cline. Bobby Earl. You don't look like you shoot pool, mister." But there was nothing threatening in Bobby Earl's voice or stance. He pinched the steel frames from his nose and polished the thick lenses with a fold of tissue. He reminded Deke of a shop instructor who'd patiently tried to teach him retrograde biochip installation. "I'm a gambler," he said, smiling. His teeth were white plastic. "I know I don't much look it."

"I'm looking for Tiny," Deke said.

"Well," replacing the glasses, "you're not going to find him. He's gone up to Bethesda to let the VA clean his plumbing for him. He wouldn't fly against you anyhow."

"Why not?"

"Well, because you're not on the circuit or I'd know your face. You any good?" When Deke nodded, Bobby Earl called down the length of Jackman's, "Yo, Clarence! You bring out that facilitator. We got us a flyboy."

Twenty minutes later, having lost his remote and what cash he had left, Deke was striding past the broken soldiers of Best Buy.

"Now you let me tell you, boy," Bobby Earl had said in a fatherly tone as, hand on shoulder, he led Deke back to the elevator. "You're not going to win against a combat vet—you listening to me? I'm not even especially good, just an old grunt who was on hype fifteen, maybe twenty times. Of Tiny, he was a *pilot*. Spent his entire enlistment hyped to the gills. He's got membrane attenuation real bad, you ain't never going to beat him."

It was a cool night. But Deke burned with anger and humiliation.

"Jesus, that's crude." Nance said as the Spad strafed mounds of pink underwear. Deke hunched up on the couch, yanked her flashy little Braun remote from behind his ear.

"Now don't you get on my case, too, Miss rich bitch gonna-have-a-job—"

"Hey, lighten up! It's nothing to do with you—it's just *tech*. That's a really primitive wafer you got there. I mean, on the street maybe it's fine. But compared to the work I do at school, it's—hey. You ought to let me rewrite it for you."

"Say what?"

"Lemme beef it up. These suckers are all written in hexadecimal, see, 'cause the industry programmers are all washed-out computer hacks. That's how they think. But let me take it to the reader-analyzer at the department, run a few changes on it, translate it into a modern wetlanguage. Edit out all the redundant intermediaries. That'll goose up your reaction time, cut the feedback loop in half. So you'll fly faster and better. Turn you into a real pro. Ace!" She took a hit off her bong, then doubled over laughing and choking.

"Is that legit?" Deke asked dubiously.

"Hey, why do you think people buy gold-wire remotes? For the prestige? Shit. Conductivity's better, cuts a few nanoseconds off the reaction time. And reaction time is the

"I may not agree with what either of you have to say, but I'm ready to nuke anybody to defend your right to say it!"

name of the game, kiddo."

"No," Deke said, "if it were that easy, people'd already have it. Tiny Montgomery would have it. He'd have the best."

"Don't you ever *listen*?" Nance set down the bong, brown water slopped onto the floor. "The stuff I'm working with is three years ahead of anything you'll find on the street."

"No shit," Deke said after a long pause. "I mean, you can do that?"

It was like graduating from a Model T to a ninety-three Lotus. The Spad handled like a dream, responsive to Deke's slightest thought. For weeks he played the arcades with not a nibble. He flew against the local teens and by ones and threes shot down their planes. He took chances, played flash. And the planes tumbled.

Until one day Deke was tucking his seed money away, and a lanky black straightened up from the wall. He eyed the laminateds in Deke's hand and grinned. A ruby tooth gleamed. "You know," the man said, "I *heard* there was a casper who could fly, going up against the kiddies."

"Jesus," Deke said, spreading Danish butter on a kelp stick. "I wiped the *floor* with those spades. They were good, too."

"That's nice, honey," Nance mumbled. She was working on her finals project, sweating data into a machine.

"You know, I think what's happening is I got real talent for this kind of shit. You know? I mean, the program gives me an edge, but I got the stuff to take advantage of it. I'm really getting a rep out there, you know? Impulsively, he snapped on the radio. Scratchy Dixieland brass blared.

"Hey," Nance said. "Do you *mind*?"

"No, I'm just—" He fiddled with the knobs, came up with some slow, romantic bullshit. "There. Come on, stand up. Let's dance."

"Hey, you know I can't—"

"Sure you can, sugarcakes." He threw her the huge teddy bear and snatched up a patchwork cotton dress from the floor. He held it by the waist and sleeve, tucking the collar under his chin. It smelled of patchouli, more faintly of sweat. "See, I stand over here, you stand over there. We dance. Get it?"

Blinking softly, Nance stood and clutched the bear tightly. They danced then, slowly, staring into each other's eyes. After a while she began to cry. But still, she was smiling.

Deke was daydreaming, imagining he was Tiny Montgomery, wired into his jumpjet. Imagined the machine responding to his slightest neural twitch, reflexes cranked way up, hype flowing steadily into his veins.

Nance's floor became jungle, her bed a plateau in the Andean foothills, and Deke flew his Spad at forced speed, as if it were a full-wired interactive combat machine. Computerized hypos fed a slow trickle of high-performance enhancement melange into his bloodstream. Sensors were wired directly into his skull—pulling a supersonic snapturn in the green-blue bowl of sky over Bolivian rain forest. Tiny would have *felt* the airflow over control surfaces.

Below, grunts hacked through the jungle with hype-pumps strapped above elbows to give them that little extra death-dance fury in combat: a shot of liquid hell in a blue plastic vial. Maybe they got ten minutes' worth in a week. But coming in at treetop level, reflexes cranked to the max, flying so low the ground troops never spotted you until you were on them, phosgene agents released, away and gone before they could draw a bead . . . it took a constant trickle of hype just to maintain. And the direct neuron interface with the jumpjet was a two-way street. The onboard computers monitored biochemistry and decided when to open the sluice gates and give the human component a killer jolt of combat edge.

Dosages like that ate you up. Ate you good and slow and constant, etching the brain surfaces, eroding away the brain-cell membranes. If you weren't yanked from the air promptly enough, you ended up with brain-cell attenuation—with reflexes too fast for your body to handle and your tight-or-flight reflexes fucked real good.

"Tracers tore past his face, and he saw the Spad zoom by the Fokker, both untouched, the kickers were going ape, acting like God's own fools."

"I aced it, proleboy!"

"Hah?" Deke looked up, startled, as Nance slammed in, tossing books and bag onto the nearest heap.

"My finals project—I got exempted from exams. The prof said he'd never seen anything like it. Uh, hey, dim the lights, wouldja? The colors are weird on my eyes."

He obliged. "So show me. Show me this wunnertul thing."

Yeah, okay. She snatched up his remote, kicked clear standing space atop the bed, and struck a pose. A spark flared into flame in her hand. It spread in a quicksilver line up her arm, around her neck, and it was a snake with triangular head and flickering tongue. Molten colors: oranges and reds. It slithered between her breasts. "I call it a firesnake," she said proudly.

Deke leaned close, and she jerked back. "Sorry. It's like your flame, huh? I mean, I can see these tiny little fuckers in it."

"Sort of." The firesnake flowed down her stomach. "Next month I'm going to splice two hundred separate flame programs together with meld justification in between to get the visuals. Then I'll tap the mind's body image to make it self-orienting. So it can crawl all over your body without your having to mind it. You could wear it dancing."

"Maybe I'm dumb. But if you haven't done the work yet, how come I can see it?"

Nance giggled. "That's the best part—half the work isn't done yet. Didn't have the time to assemble the pieces into a unified program. Turn on that radio, huh? I want to dance." She kicked off her shoes. Deke tuned in something gutsy. Then, at Nance's urging, turned it down, almost to a whisper.

"I scored two hits of hype, see." She was bouncing on the bed, weaving her hands like a Balinese dancer. "Ever try the stuff? Incredible. Gives you like absolute concentration. Look here." She stood, *en pointe*. "Never done that before."

"Hype," Deke said. "Last person I heard of got caught with that shit got three years in the infantry. How'd you score it?"

"Cut a deal with a vet who was in grad school. She bombed out last month. Stuff gives me perfect visualization. I can hold the projection with my eyes shut. It was a snap assembling the program in my head."

"On just two hits, huh?"

"One hit. I'm saving the other. Teach was so impressed he's sponsoring me for a job interview. A recruiter from I. G. Feuchtwaren hits campus in two weeks. That cap is gonna sell him the program *and* me. I'm gonna cut out of school two years early, straight into industry, do not pass jail, do not pay two hundred dollars."

The snake curled into a flaming tiara. It gave Deke a funny-creepy feeling to think of Nance walking out of his life.

"I'm a witch," Nance sang, "a wetware witch." She shucked her shirt over her head and sent it flying. Her fine, high breasts moved freely, gracefully as she danced. "I'm gonna make it—now she was singing a current pop hit—"to the . . . top!" Her nipples were small and pink and aroused. The firesnake licked at them and whipped away.

"Hey, Nance," Deke said uncomfortably. "Calm down a little, huh?"

"I'm celebrating!" She hooked a thumb into her shiny gold panties. Fire swirled around hand and crotch. "I'm the virgin goddess, baby, and I have the pow-er!" Singing again.

Deke looked away. "Gotta go now," he mumbled. "Gotta go home and jerk off." He wondered where she'd hidden that second hit. Could be anywhere.

There was a protocol to the circuit, a tacit order of deference and precedence as elaborate as that of a Mandarin court. It didn't matter that Deke was hot, that his rep was spreading like wildfire. Even a name flyboy couldn't just challenge who he wished. He had to climb the ranks. But if you flew every night, if you were always available to anybody's challenge. And if you were good, well, it was possible to climb fast.

Deke was one plane up. It was tournament fighting, three planes against three. Not many spectators, a dozen maybe, but it was a good fight, and they were noisy. Deke was

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immersed in the manic calm of combat when he realized suddenly that they had fallen silent Saw the kickers stir and exchange glances Eyes flicked past him He heard the elevator doors close Coolly he disposed of the second of his opponent's planes then risked a quick glance over his shoulder

Tiny Montgomery had just entered Jackman's The wheelchair whispered across browning linoleum guided by tiny twitches of one imperfectly paralyzed hand His expression was stern blank calm

In that instant Deke lost two planes One to deresolution—gone to blur and canceled out by the facilitator—and the other because his opponent was a real fighter Guy did a barrel roll killing speed and slipping to the side and strafed Deke's biplane as it shot past It went down in flames Their last two planes shared altitude and speed and as they turned trying for position they naturally fell into a circling pattern

The kicker made room as Tiny wheeled up against the table Bobby Earl Cline trailed after him lanky and casual Deke and his opponent traded glances and pulled their machines back from the pool table so they could hear the man out Tiny smiled His features were small clustered in the center of his pale doughy face One finger twitched slightly on the chrome handrest "I heard about you" He looked straight at Deke His voice was soft and shockingly sweet a baby-girl little voice "I heard you're good"

Deke nodded slowly The smile left Tiny's face His soft, fleshy lips relaxed into a natural pout as if he were waiting for a kiss His small bright eyes studied Deke without malice "Let's see what you can do, then"

Deke lost himself in the cool game of war And when the enemy went down in smoke and flame to explode and vanish against the table Tiny wordlessly turned his chair, wheeled it into the elevator and was gone

As Deke was gathering up his winnings Bobby Earl eased up to him and said "The man wants to play you"

"Yeah? Deke was nowhere near high enough on the circuit to challenge Tiny "What's the scam?"

"Man who was coming up from Atlanta tomorrow canceled Ol' Tiny he was spoiling to go up against somebody new So it looks like you get your shot at the Max"

"Tomorrow? Wednesday? Doesn't give me much prep time"

Bobby Earl smiled gently "I don't think that makes no nevermind"

"How's that, Mr. Cline?"

"Boy you just ain't got the *moves* you follow me? Ain't got no surprises You fly just like some kinda beginner only faster and slicker You follow what I'm trying to say?"

"I'm not sure I do You want to put a little action on that?"

"Tell you truthful" Cline said "I been hoping on that" He drew a small black notebook from his pocket and licked a pencil stub "Give you five to one They's nobody gonna give no fairer odds than that"

He looked at Deke almost sadly But Tiny he's just naturally better n you and that's all she wrote boy He lives for that goddamned game ain't *got* nothing else Can't get out of that goddamned chair You think you can best a man who's fighting for his life you are just lying to yourself"

Norman Rockwell's portrait of the colonel regarded Deke dispassionately from the Kentucky Fried across Richmond Road from the coffee bar Deke held his cup with hands that were cold and trembling His skull hummed with fatigue Cline was right he told the colonel I can go up against Tiny but I can't win The colonel stared back gaze calm and level and not particularly kindly, taking in the coffee bar and Best Buy and all his drag ass kingdom of Richmond Road Waiting for Deke to admit to the terrible thing he had to do

The bitch is planning to leave me *anyway*" Deke said aloud Which made the black countergirl look at him funny then quickly away

"Daddy called! Nance danced into the apartment slamming the door behind her "And you know what? He says if I can get this job and hold it for six months he'll have the brainlock reversed Can you *believe* it? Deke? She hesitated "You okay?"

Deke stood Now that the moment was on him he felt unreal like he was in a movie or something "How come you never came home last night? Nance asked

The skin on his face was unnaturally taut, a parchment mask "Where'd you stash the hype Nance? I need it"

Deke she said trying a tentative smile that instantly vanished "Deke that's mine My hit I need it For my interview"

He smiled scornfully "You got money You can always score another cap"

"Not by Friday! Listen, Deke this is really important My whole life is riding on this interview I need that cap It's all I got!"

"Baby you got the fucking world! Take a look around you—six ounces of blond Lebanese hash! Little anchovy fish in tins Unlimited medical coverage if you need it" She was backing away from him stumbling against the static waves of unwashed bedding and wrinkled glossy magazines that crested at the foot of her bed "Me I never had a glimmer of any of this Never had the kind of edge it takes to get along Well this one time I am gonna There is a match in two hours that I am going to fucking well win Do you hear me?" He was working himself into a rage and that was good He needed it for what he had to do

Nance flung up an arm palm open but he was ready for that and slapped her hand aside never even catching a glimpse of the dark tunnel let alone those little red eyes Then they were both falling and he was on top of her her breath hot and rapid in his face "Deke! Deke! I *need* that shit Deke my *interview* it's the only I gotta gotta"

She twisted her face away crying into the wall Please God please don't

"Where did you stash it?"

Pinned against the bed under his body

Nance began to spasm, her entire body convulsing in pain and fear.

"Where is it?"

Her face was bloodless gray corpse flesh, and horror burned in her eyes. Her lips squirmed. It was too late to stop now—he'd crossed over the line. Deke felt revolted and nauseated—all the more so because on some unexpected and unwelcome level he was *enjoying* this.

"Where is it, Nance?" And slowly, very gently, he began to stroke her face.

Deke summoned Jackman's elevator with a finger that moved as fast and straight as a hornet and landed daintily as a butterfly on the call button. He was full of bouncy energy and it was all under control. On the way up, he whipped off his shades and chuckled at his reflection in the finger-smudged chrome. The blacks of his eyes were like pinpricks, all but invisible, and still the world was neon bright.

Tiny was waiting. The cripple's mouth turned up at the corners into a sweet smile as he took in Deke's irises, the exaggerated calm of his motions, the unsuccessful attempt to mime an undrugged clumsiness. "Well," he said, in that girlish voice, "looks like I have a treat in store for me."

The Max was draped over one tube of the wheelchair. Deke took up position and bowed, not quite mockingly. "Let's fly." As challenger, he flew defense. He materialized his planes at a conservative altitude, high enough to dive, low enough to have warning when Tiny attacked. He waited.

The crowd tipped him. A fatboy with brilliantined hair looked startled, a hollow-eyed cracker started to smile. Murmurs rose. Eyes shifted, slow motion in heads frozen by hyped-up reaction time. Took maybe three nanoseconds to pinpoint the source of attack. Deke whipped his head up and—

Sonofabitch, he was *blind*! The Fokkers were diving straight from the two-hundred-watt bulb, and Tiny had suckered him into staring right at it. His vision whited out. Deke squeezed lids tight over welling tears and frantically held visualization. He split his flight, curving two biplanes right, one left. Immediately twisting each a half-turn, then back again. He had to dodge randomly—he couldn't tell where the hostile warbirds were.

Tiny chuckled. Deke could hear him through the sounds of the crowd, the cheering and cursing and slapping down of coins that seemed to syncopate independent of the ebb and flow of the duel.

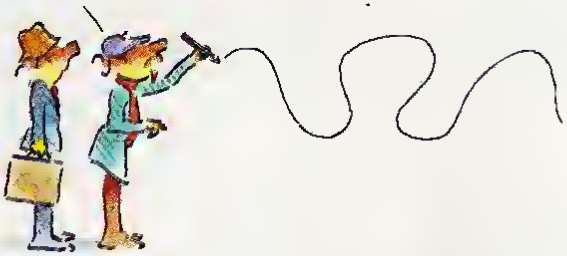
When his vision returned an instant later, a Spad was in flames and falling. Fokkers tailed his surviving planes, one on one and two on the other. Three seconds into the game, and he was down one.

Dodging to keep Tiny from pinning tracers on him, he looped the single-pursued plane about and drove the other toward the blind spot between Tiny and the light bulb.

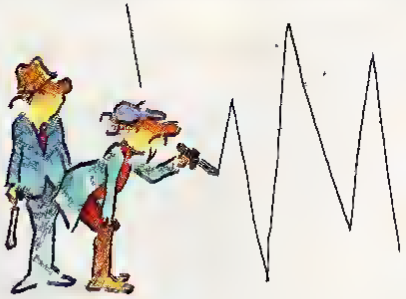
Tiny's expression went very calm. The faintest shadow of disappointment—of contempt, even—was swallowed up by tranquillity. He tracked the planes blandly, wait-

The Artist

The more I draw lines
the more I realize --



the kind of lines
you draw is as important



as where you draw them.

I hate it when he moralizes

ing for Deke to make his turn.

Then, just short of the blind spot, Deke shoved his Spad into a dive, the Fokkers overshooting and banking wildly to either side, twisting around to regain position.

The Spad swooped down on the third Fokker, pulled into position by Deke's other plane. Fire strafed wings and crimson fuselage. For an instant nothing happened, and Deke thought he had a fluke miss. Then the little red mother veered left and went down, trailing black, oily smoke.

Tiny frowned, small lines of displeasure marring the perfection of his mouth. Deke smiled. One even, and Tiny held position.

Both Spads were tailed closely. Deke swung them wide, and then pulled them together from opposite sides of the table. He drove them straight for each other, neutralizing Tiny's advantage . . . neither could fire without endangering his own planes. Deke cranked his machines up to top speed, slamming them at each other's noses.

An instant before they crashed, Deke sent the planes over and under one another, opening fire on the Fokkers and twisting away. Tiny was ready. Fire filled the air. Then one blue and one red plane soared free, heading in opposite directions. Behind them, two biplanes tangled in midair. Wings touched, slewed about, and the planes crumpled. They fell together, almost straight down, to the green felt below.

Ten seconds in and four planes down. A black vet pursed his lips and blew softly. Someone else shook his head in disbelief.

Tiny was sitting straight and a little forward in his wheelchair, eyes intense and unblinking, soft hands plucking feebly at the grips. None of that amused and detached bullshit now; his attention was riveted on the game. The kickers, the table, Jackman's itself might not exist at all for him. Bobby Earl Cline laid a hand on his shoulder. Tiny didn't notice. The planes were at opposite ends of the room, laboriously gaining altitude. Deke jammed his against the ceiling, dim through the smoky haze. He spared Tiny a quick glance, and their eyes locked. Cold against cold. "Let's see your best," Deke muttered through clenched teeth.

They drove their planes together.

The hype was peaking now, and Deke could see Tiny's tracers crawling through the air between the planes. He had to put his Spad into the line of fire to get off a fair burst, then twist and bank so the Fokker's bullets would slip by his undercarriage. Tiny was every bit as hot, dodging Deke's fire and passing so close to the Spad their landing gears almost tangled as they passed.

Deke was looping his Spad in a punishingly tight turn when the hallucinations hit. The felt writhed and twisted—became the green hell of Bolivian rain forest that Tiny had flown combat over. The walls receded to gray infinity, and he felt the metal confinement of a cybernetic jumpjet close in around him.

But Deke had done his homework. He was expecting the hallucinations and knew he could deal with them. The military would never pass on a drug that couldn't be fought

through Spad and Fokker looped into another pass. He could read the tensions in Tiny Montgomery's face, the echoes of combat in deep jungle sky. They drove their planes together, feeling the torqued tensions that fed straight from instrumentation to hindbrain, the adrenaline pumps kicking in behind the armpits, the cold fast freedom of airflow over jet-skin mingling with the smells of hot metal and fear sweat. Tracers tore past his face and he pulled back, seeing the Spad zoom by the Fokker again, both untouched. The kickers were just going ape, waving hats and stomping feet, acting like God's own fools. Deke locked glances with Tiny again.

Malice rose up in him, and though his every nerve was taut as the carbon crystal whiskers that kept the jumpjets from falling apart in superman turns over the Andes, he counterfeited a casual smile and winked. Jerking his head slightly to one side, as if to say, 'Lookahere.'

Tiny glanced to the side.

It was only for a fraction of a second, but that was enough. Deke pulled as fast and tight an Immelmann—right on the edge of theoretical tolerance—as had ever been seen on the circuit, and he was hanging on Tiny's tail.

Let's see you get out of this one, sucker.

Tiny rammed his plane straight down at the green, and Deke followed after. He held his fire. He had Tiny where he wanted him.

Running. Just like he'd been on his every combat mission. High on exhilaration and hype, maybe, but running scared. They were down to the felt now, flying treetop level. Break, Deke thought, and jacked up the speed. Peripherally, he could see Bobby Earl Cline, and there was a funny look on the man's face. A pleading kind of look. Tiny's composure was shot; his face was twisted and tormented.

Now Tiny panicked and dove his plane in among the crowd. The biplanes looped and twisted between the kickers. Some jerked back involuntarily, and others laughingly swatted at them with their hands. But there was a hot glint of terror in Tiny's eyes that spoke of an eternity of fear and confinement, two edges sawing away at each other endlessly.

The fear was death in the air, the confinement a locking away in metal, first of the aircraft, then of the chair. Deke could read it all in his face. Combat was the only out Tiny had had, and he'd taken it every chance he got. Until some anonymous *nationalista* with an antique SAM tore him out of that blue/green Bolivian sky and slammed him straight down to Richmond Road and Jackman's and the smiling killer boy he faced this one last time across the faded cloth.

Deke rocked up on his toes, face burning with that million-dollar smile that was the trademark of the drug that had already fried Tiny before anyone ever bothered to blow him out of the sky in a hot tangle of metal and mangled flesh. It all came together then. He saw that flying was all that held Tiny together. That daily brush of fingertips against death and then rising up from the metal coffin, alive again. He'd been holding back collapse by sheer force of will. Break that willpower, and mortality would come pouring out and drown him. Tiny would lean over and throw up in his own lap.

And Deke drove it home.

There was a moment of stunned silence as Tiny's last plane vanished in a flash of light. "I did it," Deke whispered. Then louder. "Son of a bitch. I did it!"

Across the table from him, Tiny twisted in his chair, arms jerking spastically, his head lolled over on one shoulder. Behind him, Bobby Earl Cline stared straight at Deke, his eyes hot coals.

The gambler snatched up the Max and wrapped its ribbon around a stack of laminateds. Without warning, he flung the bundle at Deke's face. Effortlessly, casually, Deke plucked it from the air.

For an instant, then, it looked like the gambler would come at him, right across the pool table. He was stopped by a tug on his sleeve. "Bobby Earl," Tiny whispered, his voice choking with humiliation, "you gotta get me out of here."

Stiffly, angrily, Cline wheeled his friend around, and then away, into shadow.

Deke threw back his head and laughed. By God, he felt good! He stuffed the Max into a shirt pocket, where it hung cold and heavy. The money he crammed into his jeans. Man, he had to jump with it, his triumph leaping up through him like a wild thing, fine and strong as the flanks of a buck in the deep woods he'd seen from a Greyhound once, and for this one moment it seemed that everything was worth it somehow, all the pain and misery he'd gone through to finally win.

But Jackman's was silent. Nobody cheered. Nobody crowded around to congratulate him. He sobered, and silent, hostile faces swam into focus. Not one of these kickers was on his side. They radiated contempt, even hatred. For an interminably drawn-out moment the air trembled with potential violence, and then someone turned to the side, hawked up phlegm, and spat on the floor. The crowd broke up, muttering, one by one drifting into the darkness.

Deke didn't move. A muscle in one leg began to twitch, harbinger of the coming hype crash. The top of his head felt numb, and there was an awful taste in his mouth. For a second he had to hang onto the table with both hands to keep from falling down forever, into the living shadow beneath him, as he hung impaled by the prize buck's dead eyes in the photo under the Dr. Pepper clock.

A little adrenaline would pull him out of this. He needed to celebrate. To get drunk or stoned and talk it up, going over the victory time and again, contradicting himself, making up details, laughing and bragging. A starry old night like this called for big talk.

But standing there with all of Jackman's silent and vast and empty around him, he realized suddenly that he had nobody left to tell it to.

Nobody at all. ∞

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KNAT	Albuquerque
KVII	Amarillo
WAGA	Atlanta
WBFF	Baltimore
WMGC	Binghamton
KTVB	Boise
WBZ	Boston
KWWL	Cedar Rapids
WVAH	Charleston/Huntington
WBTV	Charlotte
WMAQ	Chicago
WCPO	Cincinnati
WKYC	Cleveland
KLBY	Colby, KS
KRDO	Colorado Springs
WIS	Columbia, SC
WLTZ	Columbus, GA
WTTE	Columbus, OH
WNHT	Concord/Manchester
WRLD	Dallas/Ft. Worth
WHBF	Davenport, RI
KNGH	Denver
KCBR	Des Moines
WDIV	Detroit
WDIO	Duluth
KDBC	El Paso
WICU	Erie
KEZI	Eugene
WTVW	Evansville
KTHI	Fargo
WNEM	Flint
WBBH	Fort Meyers
WKJG	Fort Wayne
KSEE	Fresno
KJCT	Grand Junction
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WLUK	Green Bay
WGGT	Greensboro
WAXA	Greenville
KVEO	Harlingen
WTIC	Hartford/New Haven
KHON	Honolulu
KRIV	Houston
WFAT	Johnstown
KCTV	Kansas City
WTVK	Knoxville
WEAU	La Crosse
WFSL	Lansing
KVVU	Las Vegas
KOLN	Lincoln
KNBC	Los Angeles
KJAA	Lubbock
WISC	Madison
WMC	Memphis
WPLG	Miami/Ft. Lauderdale
WTMJ	Milwaukee
KSTP	Minneapolis/St. Paul
WJCT	Mobile/Pensacola
WCEE	Mt. Vernon
WCAY	Nashville
WDSU	New Orleans
WNEW	New York
KOKH	Oklahoma City
KETV	Omaha
WOFL	Orlando
WEEK	Peoria
KYW	Philadelphia
KPHO	Phoenix
WPGH	Pittsburgh
KOIN	Portland
WCSH	Portland, ME
KCRL	Reno
WOKR	Rochester
WQRF	Rockford
KRBK	Sacramento
KUTV	Salt Lake City
KFMB	San Diego
KRON	San Francisco
KCOY	Santa Barbara
KING	Seattle/Tacoma
KSLA	Shreveport
KSKN	Spokane
WTVH	Syracuse
WTWC	Tallahassee
WGTU	Traverse
KJRH	Tulsa
KDTU	Tucson
WPTV	W. Palm Beach
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INTERVIEW

CONTINUED FROM PAGE 82

the celibate is both nonreproductive *and* nonsexual. In celibacy, you're often redirecting those sexual forces outward in such a way that might be beneficial to kin.

Gregor Mendel is a famous case. [Mendel was a nineteenth-century Austrian botanist whose work with pea plants laid the foundation for genetics.] He was a brilliant lad from a very poor family, pushed to go to the university. He had a breakdown when he was about twenty-one and then he went into the priesthood in order to pursue intellectual work without pressure. So this was a troubled man who found sanctuary and, indeed, greatness. And from within the church there are records of him benefiting kin directly—looking after cousins and so forth. Furthermore, just to round out the complexity of this sort of thing, I have heard from a famous and trustworthy evolutionist that Mendel had a child by the lady who cleaned the abbot's quarters. In that part of the world, I am told, staying over with the priest was called comforting the father. So apparently, in one of these comforting sessions a child was conceived. Oh, I even hear there was a grandchild, and the grandchild, like a true Mendelian, of course resembled Gregor. But it all may be fiction. His records were burned by the abbot who succeeded him. And there was probably suspicion in the church as to what he was up to in that pea garden.

Omni: By maintaining that sex outside marriage is a sin, the Catholic Church is, in effect, limiting reproductive opportunities. Yet reproduction within the family is encouraged to such an extent that married couples are not allowed to limit their own reproduction by means of birth control. How does an evolutionary biologist look at these policies?

Trivers: Cynically. They look like a strategy for maximizing reproductive success within the group. I'm extremely skeptical about the ability of an all-male neuter caste to speak for the larger society. Why all male? Isn't it dangerous to have ideology and social policy determined by a biologically separate Y-chromosomal enclave? As a biologist, I have to be very skeptical.

Omni: What does abortion look like from an evolutionary point of view?

Trivers: Well, that's interesting because people who get apoplectic about abortion often act ignorant of the fact that miscarriages are occurring constantly as a sort of natural form of abortion. The fact that these natural mechanisms of abortion have spread until they appear in organism after organism suggests that they do indeed confer an evolutionary benefit on the individuals who have them. Abortion is even widespread in the plant kingdom. Exciting work on mate choice in plants suggests that since the avenues for the plant to choose on the basis of genetic quality are not as great as in animals, they make many more discriminations *after* fertilization. So abortion is used by many creatures to advance their interests.

I personally think it's the mother's business to do what she wants with her own investment during pregnancy. I don't have any deep horror of abortion, and I certainly don't agree with the Church that it sets the stage for the rest of human misery.

Omni: You've said that human emotions like sympathy, gratitude, and guilt have evolved as part of the mechanics of reciprocal altruism. Could you explain?

Trivers: I suggest that some emotions have evolved in order to drive us to establish reciprocal relationships. A feeling of sympathy would allow you to respond to the actual need of the intended recipient of your altruism. Your gratitude for a past favor will tend to motivate reciprocity on your part. My thinking on guilt is still a little primitive, but perhaps guilt exists, at least partly, as a mechanism to help repair reciprocal relationships that the guilty party has ruptured through cheating. If I do you harm and you find out about it, I may take the opportunity to make an altruistic gesture toward you just so our relationship will be reestablished.

If we are concerned with the problem of being found out as cheaters, it might be better in some circumstances for us to accuse ourselves, so to speak, and even show reparative behavior, which would tend to be correlated with not repeating the cheating behavior. To what degree parents instruct children in guilt, for what benefit, and how it relates to parent–offspring haven't been thought about. We have to ask: Who is promulgating the guilt, who is feeling it, and what are the interests in conflict? I may have an interest in making you feel guilty when you don't have an interest in feeling guilty.

Omni: What are some other examples of reciprocal altruism?

Trivers: Any relationship mediated by friendship will tend to be one in which you are willing to extend yourself but maintain at least an unconscious expectation of similar behavior when the shoe is on the other foot. And even our economic interactions have been built on the system of reciprocal altruism. The invention of money is a means by which a system of stable reciprocity emerges. You can work for me and get enough money to buy someone else's pig. That's really a three-part system because each of us interacts only once.

Omni: Can you explain your concepts of gross and subtle cheating?

Trivers: I wanted to emphasize the fact that when you detect a cheater, it may not be in your best interests to cut off all future aid. Gross cheating is cheating in which you are not getting enough back to pay your cost and therefore you simply stop the relationship as soon as you discover what it is. Subtle cheating, though, is when you're still getting benefits greater than the cost of the cheating but not as many benefits as if the relationship were equitable. Whether you decided to rupture the relationship depends on whether you can replace it with one that's more equitable. If you can't, you're better off suffering the substandard cheating than rupturing the relationship entirely.

Omni: Is a subtle cheater better equipped to survive than an altruist?

Trivers: Put in the starkest form and using the purest sense of those words, probably yes.

Omni: You've done a great deal of thinking about self-deception. What do you see as its evolutionary value?

Trivers: Self-deception is really an effort to deceive others better by first deceiving yourself. If you're lying to me now, you may have a quavery voice or shifty eyes or some other giveaway that accompanies the stress of trying to move the lie forward. But if you've successfully deceived yourself into believing that you're not lying, then the evidence of stress is going to disappear and you may be less likely to get caught in your lie. That means that your interests will be promoted, maybe at the expense of the interests of the person you're lying to.

If deception has been important in evolution, then detecting deception has been important, and it's been a coevolutionary race between the two. And in that race it has been easy to imagine that individuals become sophisticated at paying attention to certain conscious manifestations of knowledge, then to short-circuit those manifestations they invented self-deception. It's something that doesn't require language. If you're a male displaying to another male—a gazelle, antelope, or whatnot—you may be selected to appear more self-confident than you really are or have any right to be.

Omni: Where do we get this consciousness or lack thereof?

Trivers: Which do you mean, consciousness or self-consciousness? I think an insect is conscious in the sense that light is on inside its brain, but not self-conscious or aware of self. Consciousness is a means of apprehending reality at a quicker, deeper level, but it's costly to be awake and conscious with a light on. And all this information coming in through the eyes is energetically expensive. Therefore, individuals were selected early on to have a whole series of activities that went on unconsciously as an energy-saving device. The split between conscious and unconscious predates self-deception. But once consciousness is restricted to just a portion of reality, then it is important to ask if this sample of reality is unbiased. And with self-deception, the notion is that the sample of reality is very biased, that one is continually depriving the consciousness of true information and sticking false information in to fool others.

Omni: What do you think of the idea that human warfare is a reproductive strategy foisted on the young by the old? The young men go off to war and the old men try to gather up the women who are left behind.

Trivers: Any time you look at what human males are up to in a society, you'd better pay attention to age structure and ask what the old are getting out of it. Some legal research by Martin Daly and Margo Wilson at McMasters University in Hamilton, Ontario

shows that it's likely a young man killing an old man will get a much worse penalty than an old man killing a young man. The freeing of [Motown star] Marvin Gaye's father for example. The father said his shooting of his son was a tragic accident, but the son provoked it. I don't care if Marvin Gaye was beating the living shit out of his father, it's still not in the rule book that the old man is allowed to get a gun and drill him.

Omni: Is human warfare unusual behavior compared with the way other animals settle conflicts?

Trivers: It's not nearly the rarity that people used to think. Research on chimpanzees shows that males sometimes organize themselves to hunt other chimps, especially males of other groups. Not only do they hunt them, they actually kill them. So I think human warfare has deep roots in primate behavior. It isn't something we invented the other day.

Omni: In your forward to Richard Dawkins's *The Selfish Gene*, you say there is no objective basis on which to elevate one species over another. Does this mean you're in sympathy with the people who want to end all scientific experimentation on animals?

Trivers: I am in sympathy with the animal-rights movement, with their plea not to cause suffering to another creature so thoughtlessly. I can barely go to a zoo without getting depressed in the same way one would get depressed visiting a prison. I've even found it difficult to collect specimens in the field, and this is a routine event in evolutionary biology.

Omni: If you were to gather data on humans, what kind of data would you gather?

Trivers: I would repeat Nancy Burley's work on zebra finches at the University of Illinois. Nancy showed in zebra finches, a monogamous species like ours, with a high degree of male parental investment, that physical attractiveness has a strong effect on the relations between the sexes. She found that the colored legbands used by ornithologists to identify birds in the field actually influenced the attractiveness of those birds to members of the opposite sex. In other words, some colors made the birds more attractive than others. Because she could manipulate attractiveness by changing the color of the band on the leg, she had a perfect experimental tool to study the effects of physical attractiveness. Incidentally, this was not a popular discovery among ornithologists, who now had to face the fact that the color of these bands they'd been using for so long could actually have major effects on the reproductive success of the birds who are wearing them. Nancy found one thing I think we all can appreciate. Whoever is the worse looking member of the relationship does relatively more of the work in raising the young. As a female varies from unattractive to attractive, her mate goes from doing twenty percent to fifty percent of the work.

Omni: Our dull-old sod again.

Trivers: Absolutely.

Omni: So how would you study this phenomenon in humans?

Trivers: I would get a high school yearbook and rank the males and females according to looks. Then I'd find them twenty years later and get retrospective data. I think it would be fun to design a questionnaire that would measure the relative work going on around them at home without the person knowing it. That way we could see if humans are doing the same things that zebra finches are.

Omni: Do you have any desire to be sociobiology's spokesman to the public?

Trivers: No. In fact, being at Harvard during the great public debate over sociobiology was wasteful and debilitating. It stretched my ego in various ways that were hard to contain. Harvard is a very ego-conscious university where being the best of the best is constantly on people's minds. I was getting so much attention that some days I didn't know if I was Charles Darwin or Julian Huxley. As a result I got very casual about the things I did best. I was a good public speaker in my day, but I gave some memorably awful talks—unprepared, hung over, embarrassing—at about the time I left Harvard. I forgot that hard work was the secret of my earlier success.

I'm skeptical about the ability of an all-male, neuter priest caste to speak for society. Isn't it dangerous to have ideology determined by a separate Y-chromosome enclave?

Omni: It's been said that in putting your tenure on hold, Harvard was bowing to pressure from leftist groups who were upset about the Social Darwinist implications of sociobiology.

Trivers: I don't think that myself, but at Harvard they arrange the whole process so that you're the last one to know anything about it. So in a way I'm a poor person to ask. I think their chief concern was not that I was too right wing for their taste—looking at the rest of Harvard's faculty that would have been a hard act for me to achieve—but because I was mentally unstable.

Omni: Let's go into that. You had a series of emotional breakdowns at Harvard. In fact, weren't you diagnosed as schizophrenic when you were twenty-one? What precipitated that breakdown?

Trivers: I fell in love for the first time, very deeply. I think that's what brought it on: the conflict of trying to establish a love relationship for the first time in my life.

Omni: Did you, as the psychiatrists say, internalize the diagnosis? Did you feel as if you were becoming schizophrenic?

Trivers: I was horrified. I was locked up in a state hospital, and I heard the diagnosis by accident. I wept for three days. I had a roommate who had been diagnosed schizophrenic, and he had been locked up for three years straight. So I was scared to death.

Omni: What was the experience of a breakdown like?

Trivers: It was like a gigantic high followed by a gigantic low. On the takeoff it was sort of intellectually exciting but at the same time emotionally calming. It was as if I were getting a whole new perspective on things intellectually, while emotionally I was very much at peace. Then gradually I found myself sleeping less and less and becoming more and more agitated in my thinking. Then I started breaking into crazy episodes. I walked around Harvard crazy for about five days before I finally got locked up.

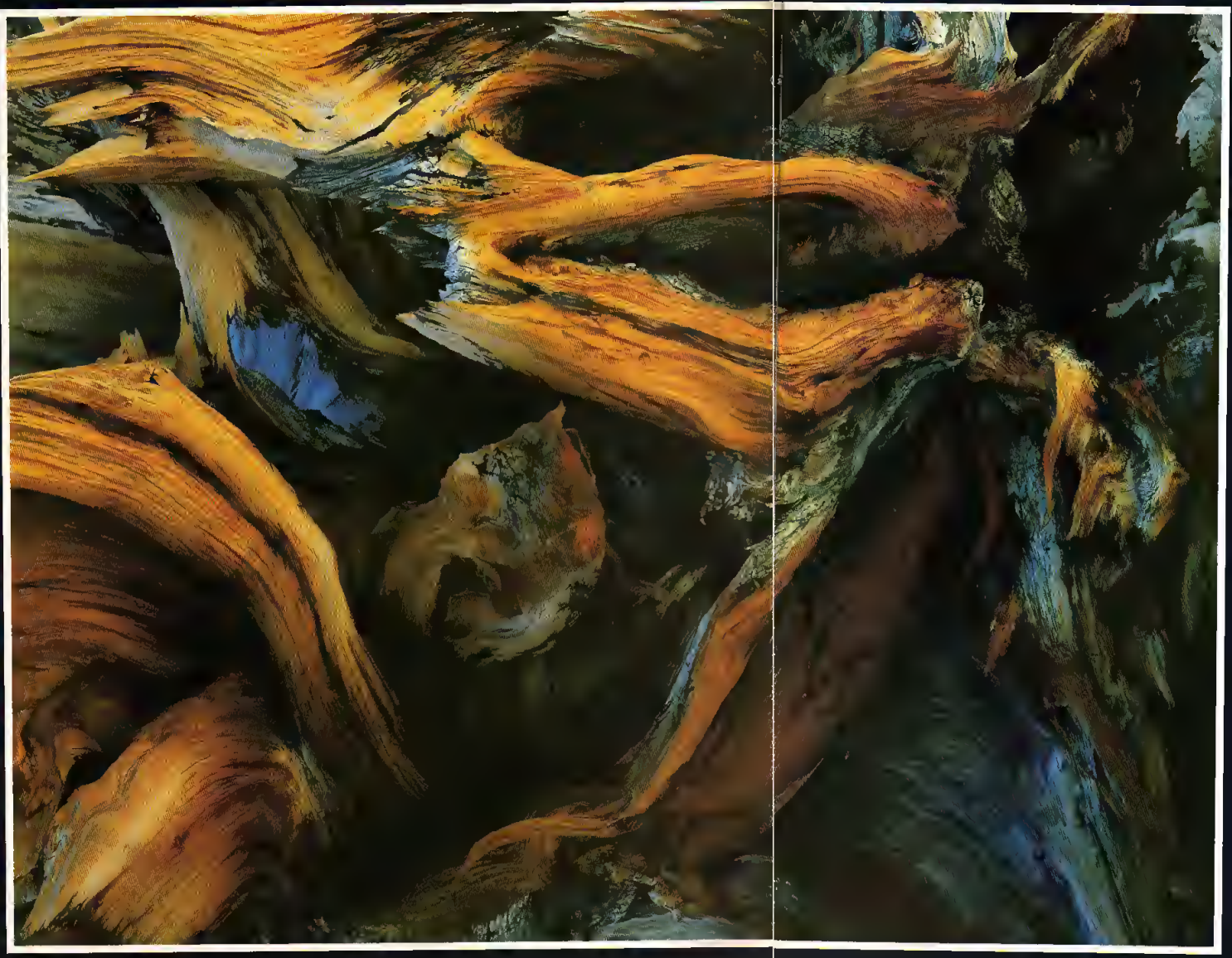
I don't think this sort of experience is either essential or desirable, and the older I've gotten, the more disenchanted I've become with it. I've heard tentative lines of evidence suggesting that the relatives of individuals with certain kinds of schizophrenia may be more creative, may score higher on certain kinds of tests. So there may be an association between schizophrenia and creativity. But the experience itself just isn't worth it.

Omni: What do you see happening in evolutionary biology in the next twenty years?

Trivers: I think we may be in for some surprises regarding the evolution of sex, fundamental surprises that touch on genetic variability, recombination and more. Allied to that, the subject of mate choice is exciting. Within evolutionary biology now are theorists who believe that there is no mate choice made in nature with respect to genes; they don't believe females can benefit from choice for genes. And there are people like me at the opposite extreme who believe it's a strong force for female benefit.

Omni: What are your goals for the future?

Trivers: My humblest goal is to stay alive and stay young intellectually, to keep current with my field. A bit more ambitiously, I want to do more work on mate selection. I have a theory that females may choose mates according to the perceived benefit to their daughters, whereas most theories are biased toward sons. Recent mathematical work with Jon Seger at Princeton, seems to support my theory. I also want to continue working on deceit and self-deception. I feel it's a topic of tremendous importance to our own psychology, and I feel it's ripe for an evolutionary synthesis. But probably the most ambitious thing I want to do is to send Sigmund Freud to his grave once and for all. I think Freud failed to establish a scientific methodology and tradition that would generate useful information for subsequent generations of psychologists. It's one of the scandals of modern psychoanalysis that more than seventy years have gone by and we still have so little usable scientific information on key assumptions of the psychoanalytic system. I'd like to help lay the foundation that Freud failed to lay.



PHENOMENA

Sculpted by centuries of wind, fire, and ice and bleached by the timeless sun, these bristlecone-pine-tree roots have endured the hardships of mountain life for thousands of years. The bristlecone pine, a short, squatty conifer that rarely reaches more than 25 feet in height, is thought to be one of the oldest living things on Earth. While climbing the slopes of California's White Mountains, photographer James Randklev found the exposed roots, situated at an elevation of about 11,000 feet. The tree, succumbing to fierce storms of winters past, had bared its life-support system to the elements. Despite the ravages of nature, the pine managed to cling to life. "There were still several branches of green needles," says Randklev, a professional nature photographer based in Los Angeles. To capture this image of the roots, Randklev used a 4 × 5 Linhof camera outfitted with a 135mm lens and Ektachrome film.

BIOLOGY

CONTINUED FROM PAGE 112

had an endocrine profile similar to that of a low-ranking male. And during times of civil strife in the troop, boss males also had high cortisol levels even when resting, and these barely rose in response to stress. So which came first, being king of the mountain or the efficient stress response? That chicken or the egg thing drives endocrinologists wild." Sapolsky responds: "It seems to work in both directions. What I'm probably a decade away from is spotting changes in cortisol levels six months before the change in rank occurs."

Sitting in his wood-paneled lab, the afternoon sun diligently trying to stream through the dusty old windows, Sapolsky is far from Kenya's Masai Mara. The smell of vintage swamp gas from heating burners hangs in the air, and in the distance a clanking computer processes data from his latest trip. Those data, chronicling the surges of testosterone and the laws of evolution, lend understanding to the biology of power. But Sapolsky admits they go only so far.

They do *not* explain the role of females, whose complex neurochemistry and behavior may alter politics as we know it today. Just a decade ago, biologists studying power in species from *Homo sapiens* down through the water flea Daphnia focused almost exclusively on the male. *He* sought out the female, courted or copulated at the time of *his* choosing, and then, having satisfied *his* desire, *he* crept, swam, or flew away.

But according to biologists Evelyn Shaw and Joan Darling, authors of *Female Strategies*, recent experiments reveal a potent *female* power base as well. For instance, one group of studies shows that in an assortment of species, including rabbits, baleen whales, and bats, the female is larger than the male, a female spider can weigh as much as 1,000 times more than her mate. Other research indicates that in 90 percent of all birds, both sexes *share* the task of foraging for food and caring for the young.

How does all this apply to the *human* female, mummified in layers of culturally fabricated taboos, rites, and superstitions? According to Shaw and Darling, the new studies detailing female power in the animal world reveal the options implicit in female biology. With the advent of birth-control technology, moreover, human females can adopt some of those options as their own. No longer bound by the biological imperative of pregnancy and childbirth, women can pursue a wide range of goals.

And according to Patricia Schroeder, a young Democratic congresswoman from Colorado, when women claim their proper place in the human power base, it will be all for the good. "Women are more issues oriented, still believe in good government, and are here to do the right thing. Maybe that's a sexist statement," she adds. "Not all men are merely power hungry, perhaps. But sometimes I wonder if they're in it for different reasons than I am. I say that I'm against the MX [the proposed intercontinental ballistic missile] because it's a lousy weapons system, and they look at me and say, 'It's built in your district. It's thousands of jobs. Have you lost your mind? Do you know Martin Marietta [main assembler of the MX] will never give you any money?' I say, 'Yes, but it's a lousy system,' and I think they've all lost their minds. So we're hanging from different skyhooks. Politicians have got a lot of growing to do."

Will we ever do that growing? Can we at last become untied from our genetic moorings? To use Joseph Conrad's words in *Nostromo*, can we now afford to ignore the voice of the original Adam, the one that never ceases to speak"?

Masters doesn't think so. We still have a primal animal brain beneath the frontal lobes, he says. "The limbic system doesn't get abolished just because you've got a big cortex and go running around with computers and think you're emancipated from nature. If we were that simple we would be less likely to annihilate ourselves and the planet's other life forms. Evolutionary biology teaches humility. We can't assume that our generation created something better than anything that went before, that all the other generations back to time immemorial were fundamentally less intelligent. Sometimes I think it's the other way around—we're the most foolish generation in history."

Indeed, sociologist Van den Berghe has mixed feelings about gathering more politically volatile information on genes, neurotransmitters, and behavior. "There are all kinds of pressures to apply human sociobiology to politics and even ethics," he says. "I personally am resistant to such questions. This is an ideological, not an intellectual, position. I'm not saying we can't apply biology to politics. I'm saying I'm scared stiff of how it will be applied. As an anarchist, I feel that anything that helps organized governments rule is noxious, and I want to avoid contributing to it."

But Van den Berghe may have no choice. According to Harvard molecular biologist Matthew Meselson, when humans have the power to redesign their genes and modify their natures, they certainly will do so. Which way will we go? Will we follow our power impulses, designing modified Genghis Khans to rage across the solar system? Will we sire a species of pastoral communists tailored to the Garden of Eden before the fall? Or will we create a creature we can't yet fathom?

The answers are unknown. But according to E. O. Wilson, we must find them—and soon. It is imperative, he says, that we take our genetic destiny into our own hands, redesigning human nature in a "way that would touch the deepest levels of human motivation. Even if we try to ignore the genetic 'pilots' that guide our behavior, he warns, we will nonetheless continue "to navigate by them. And if political societies continue to act and react blindly, without challenging the ancient hereditary oracle of the limbic system, there will be no chance of creating a stable and benevolent world."

MIND

CONTINUED FROM PAGE 22

event made it unusual. The children all had something normal to go back to," observes University of Cincinnati psychiatrist Janet Newman. "There was no loss of a family member, no bereavement, no real dislocation. That makes the psychological trauma Terr found very interesting."

Newman herself is an expert in childhood traumas. She studied the children who survived a disastrous 1972 flood in Buffalo Creek, West Virginia, that killed 118 people and virtually wiped out the town. Like the Chowchilla victims, her subjects had a foreshortened sense of the future and invented omens similar to those found by Terr. But none of the Buffalo Creek children described any kind of embarrassment. None had any death dreams, and none performed any reenactments of the flood.

Most startling is Terr's conclusion that the trauma the children suffered is permanent. Even in the few instances in which the families encouraged the children to talk about the kidnapping, the effects were not diminished. And after Terr gave all the children crisis-intervention therapy to help them deal with the trauma, she says they still continued to suffer just as deeply. The conclusion she was forced to reach was that in spite of the popular notion that children outgrow sudden, intense, frightening events, the evidence from Chowchilla is to the contrary."

Still she says, "I have trouble seeing these kids as psychologically abnormal. They certainly think of themselves as normal, and I think that my study shows essentially normal response to an abnormal situation. In fact," she adds—and one hears a note of admiration in her voice—"their belief that they are okay, even after a traumatic experience like this, is self-sustaining."

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The Homonym Wheel
and the fantastic flying ring

GAMES

By Scot Morris

What is a *homonym*? If you think a definition is easy, don't be so sure. Even the dictionary writers can't get together. All agree that homonyms have different meanings, but three distinct variations can be found.

1. Same spelling and pronunciation (bear = carry, bear = animal) *Webster's Third International Dictionary*
2. Different spelling, same pronunciation (bare = naked, bear = carry, animal) *Webster's Second International Dictionary* and *Oxford English Dictionary* (OED)
3. Same spelling, different pronunciation (lead = conduct, lead = metal) *OED* and *Encyclopaedia Britannica*

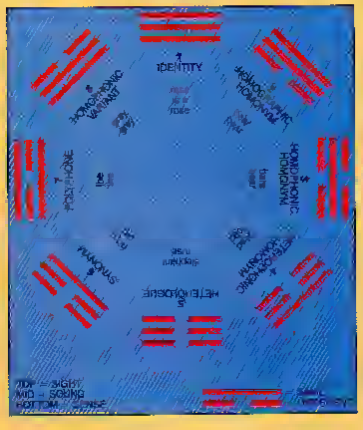
In addition, the sources aren't consistent in labeling certain subcategories of homonyms. *Lead* might be used as an example of a *homograph* in one source and a *heterophone* in another.

PLOTTING PERMUTATIONS

William S. Huff, professor of architecture at the State University of New York at Buffalo, has recently tried to bring some order to the chaos. He categorized all the word groups he could find by the three ways they could be "same" or "different" in spelling, pronunciation, or meaning. He called these *sight*, *sound*, and *sense*.

Huff came up with a remarkable graphic representation (above right). If a solid bar is used to mean "same" and a broken bar to mean "different," and bars are arranged in vertical groups of three (the top tier representing "sight," the middle tier "sound," and the bottom tier "sense"), there are eight permutations of the two types of lines. These can be arranged around a circle to form the familiar symbol from the *I Ching (Book of Change)*, an ancient Chinese construction of the cosmos. The symbol, representing dualities of yin and yang, has been used for 2,000 years in Taoist metaphysics. It appears as an emblem on good-luck charms in the Orient and in abbreviated form on the South Korean flag.

Huff attributes no mystical significance to the parallel, but his Homonym Wheel is certainly a lucky charm for language lovers. It identifies three distinct types of homonyms (groups 2, 3, and 4) and five other word groups with interesting properties. The following is adapted from Huff's research and is published here for the first time. (Huff will send photocopies of his complete 50-page paper, with word lists, for $6.50, including postage. Write him at the Department of Architecture, SUNY Buffalo, 302 Hayes Hall, Buffalo, NY 14214.)



RINGING THE CHANGES

1. IDENTITY. Two words with the same sight, sound, and sense are identical. No word is a better synonym than itself.

2. HOMOGRAPHIC HOMONYM. Same spelling and pronunciation but different meaning. To qualify for inclusion in this group (as with any of "different sense") the two words should have different derivations, Huff says. Alternate meanings of *drop* (lozenge, fall) aren't interesting because both come from the same root. Derivation differences make words like *bear*, *fair*, *hide*, *rear*, and *burn* more interesting. Huff has collected almost 1,000 examples of this type.

QUIZ. For each pair of meanings, find one word that corresponds with both.

1. greet, frozen rain
2. water barrier, mammal mother
3. endure, shoemaker's form
4. fork-tailed bird, ingest by mouth
5. crested bird, marijuana cigarette
6. servant's uniform, resembling liver
7. myrtle flower, edible sea snail
8. secular, of the side of the head
9. of the mind, of the chin
10. smoked salmon, rocket fuel

3. HOMOPHONIC HOMONYM. Different spelling, same pronunciation. These words are the basis for many puns. Huff has collected over 1,050 examples of this type, from *brows/browse* to *nit/knit* and *yoke/yolk*. Especially interesting are words we might never have heard of except for their soundalikes: *sycosis*, *pyknic*, *onerary*, and *lickerish*.

QUIZ. Identify the ten companion words: awful, cereal, colonel, marshal, mind, nice, oriole, slew, soared, swayed.

4. HETEROPHONIC HOMONYM. Same spelling, different pronunciation. This is the rarest and most curious homonym type. English may be the only Western language in which this anomaly occurs—a particular combination of letters that gets two different soundings. Huff has found only 302 examples of this, of which only 151 are pairs in which both words are relatively common—such as *lead*, *coop*, *mow*, *shower*, *wound*, *denier*, *severer*, *lower*, *rugged*, and *tarry*. (Proper nouns, obsolete, dialectical, Scottish, foreign, hyphenated, and common-root words are disallowed.) *Lather* seems to be the only word in English with three separate pronunciations for (1) foam ['lath ər], (2) lathe operator ['lath-ər], and (3) one who places laths (wood strips) in building construction ['lath ər].

QUIZ. Identify the ten spellings implied by the pairs of word meanings below.

1. female horse, dark area on the moon
2. verb form of *do*, female deers
3. fish, choral voice
4. ship front, archer's tool
5. breeze, wrap around
6. more anesthetized, quantity
7. having lungs, thrusted forward
8. front door, captivate
9. type of pigeon, performed a dive
10. workers organized, lacking an electrical charge

☰☰ 5 HETEROLOGUE This includes all words that are wholly unlike one another—such as *elephant* and *rose*—and a multitude of other possible word groups

☰☰ 6 SYNONYM AND HETEROPHONIC VARIANT Do any two words have precisely the same meaning or does each word have its own special shading? True synonyms, if they do indeed exist, fall into this category *hog/pig* or *car/automobile* Other relatively uninteresting members of this trigram are words with identical meanings that may take variant spellings and soundings *scarfs/scarves, leafs/leaves catsup/ketchup polyhedra/polyhedrons*

☰☰ 7 POLYPHONE Same spelling and meaning, different pronunciation This is the rarest of all eight categories implying two correct pronunciations for the exact same word Huff discounts variations on *either, neither potato* and *tomato*, since these are regional or dialectical differences and no one person would use both pronunciations in ordinary speech Many common words vary their pronunciations by context—in *has to*, the usual *z* sound of *has* often changes to an *s* sound There are other examples that often occur but Huff has found only one word that is recognized in all dictionaries as having different pronunciations under specific conditions It is extremely common What is *the* word, of all the words in the English language that is regularly sounded in variant ways?

☰☰ 8 HOMOPHONIC VARIANT This unusual category includes words that differ by spelling only Regional or American/British differences aren't considered interesting (*colour, honour civilise* and so on) More notable are pairs like *ax/axe, gray/grey, disc/disk draft/draught, chute/shoot drier/dryer hiccup/hiccough nicbe/nitch, troop/troupe, vise/vice, and whisky/whiskey* One word pair on this list is unique—the only case Huff has found of words derived from different roots that have come to have the same meaning

Which pair is it?

Some words get 'modernized' spellings—as *socks* becomes *sox, through thru, night nite* and *highway hiway* We might think of these cases as too novel or frivolous to consider but sometimes the new, streamlined spelling becomes the standard Consider *puisne* What is its much preferred 'new' spelling?

QUIZ Give the more common spelling variants for the following eight words aline donjon gaol, gunwale lagune queue quire and phrensy

Answers are at right

FLING THING

Meet the Aerobie (above) Last January, Frisbee champion Scott Zimmerman threw one of these 1 046 feet 11 inches—almost one fifth of a mile!—farther than anyone has ever thrown anything Then for TV news coverage he threw several out of the Rose Bowl in Pasadena California—from the center of the playing field up 70 feet, over the walls and out into the parking lot

The previous distance record—857 feet—was held by another flying ring, the Skyro Both objects were invented by Alan Adler forty six an aerodynamics expert at Stanford University Adler wasn't satisfied with his Skyro—it had tremendous range but its flights tended to be unstable unless thrown at exactly the right speed He spent several years trying to improve it The result is now at hand, and it is incredible

The Aerobie is a compromise between the Skyro—with its minuscule drag and low stability—and the Frisbee, which has very stable flight at the cost of high aerodynamic drag The innovation was a "spoiler lip" on the outer rim of the ring which keeps the leading edge from rising and causing gyroscopic precession

We can't yet manage throws of more than three football fields as Zimmerman can, but 100 yarders are routine Use Aerobies in wide open fields until you learn their ways They fly so far you can easily lose them to the tree gods or the traffic demons Play with care on beaches—the Aerobie is denser than water and (like the Moonlighter Frisbee) it won't float the way a regular flying disc does To order one send $7 95 to Box 2025 Dallas TX 75221

An obvious Aerobie frontier is the first flight across a famous gap the Sheep Meadow in New York's Central Park Niagara Gorge the reflecting pool at the Lincoln Memorial the Potomac River

The milestones beckon Who will be the first intrepid pioneer to send one of Adler's amazing rings across?

I CHING RING ANSWERS

Quizzes are numbered by categories
2 HOMOGRAPHIC HOMONYM 1 hail 2 dam, 3 last 4 swallow 5 jay 6 livery 7 periwinkle 8 temporal 9 mental 10 lox
3 HOMOPHONIC HOMONYM Offal serial, kernel martial mined gneiss aureole slough sword suede
4 HETEROPHONIC HOMONYM 1 mare 2 does 3 bass 4 bow 5 wind 6 number 7 lunged, 8 entrance 9 dove 10 unionized
7 POLYPHONE *The* one word, of all *the* words in *the* English language to be sounded in variant ways is *the* It is *thē* when stressed (not *thē* David Letterman) *thə* before a consonant (the bottle) and *thē* before a vowel (the apple)
8 HOMOPHONIC VARIANT *Chute* and *shoot* can both mean 'trough' *Puisne* is now *puny* The others align dungeon jail gunnel lagoon, cue, choir, frenzy

LAST WORD

By Tom Weller

"Put most simply, science is a way of dealing with the world around us. It is a way of baffling the uninitiated with incomprehensible jargon."

Since the dawn of time, man has looked to the heavens and wondered. Where do the stars come from? He looked at the great diversity of plants and animals around him and wondered. Where does life come from? He looked at himself and wondered. Where do I come from?

Later he asked more complicated questions. Am I on the right bus? Who do you like in the series? He looked in his wallet and asked. Where did my paycheck go?

To the former questions, at least, science has provided answers. Put most simply, science is a way of dealing with the world around us. It is also a way of baffling the uninitiated with incomprehensible jargon, obtaining fat government grants, and achieving mastery over the physical world by threatening it with chaos and destruction. Science represents humanity's deepest aspirations to power, wealth, and the satisfaction of sheer animal lust.

THE SCIENTIFIC METHOD

The cornerstone of modern science is the scientific method. Scientists first formulate hypotheses, or predictions, about nature. Then they perform experiments to test their hypotheses. There are two forms of scientific method.

The first is the inductive method, which includes the following steps:

1. Formulate hypothesis
2. Apply for grant
3. Perform experiments or gather data to test hypothesis
4. Alter data to fit hypothesis
5. Publish

The second is the deductive method, in which scientists:

1. Formulate hypothesis
2. Apply for grant
3. Perform experiments or gather data to test hypothesis
4. Revise hypothesis to fit data
5. Back date revised hypothesis
6. Publish

Sound simple? It is.

Science as we know it today owes a great debt to a man named Francis Bacon or perhaps Roger Bacon or both. It is a debt seldom acknowledged, since few scholars wish to risk the embarrassment of confusing the two. Such concern is unnecessary, since the important facts are nearly identical.

Francis (or Roger) Bacon was born sometime between 1212 and 1561. Of humble or noble birth, he rose quickly but slowly through the ranks of the Franciscan order, becoming Lord Chancellor under James I of England.

Bacon's contribution lay in his criticism of the scholastic philosophy, which held sway in the Middle Ages (or Renaissance). In its place he advocated the direct observation of nature, or the "inductive method." This radical departure from scholarly tradition was to bear fruit with the triumph of modern experimental science sometime between 1 and 500 years later.

Roger (or Francis) Bacon wrote a large body of work with indistinguishable Latin titles, which for that reason are no longer read. He died circa 1292 to 1626 while attempting to invent frozen food, gunpowder, or the submarine. (Many believe that Bacon is the true author of the works of William Shakespeare, or perhaps Bob Shakespeare.)

Because of Francis (or Roger) Bacon's contributions, we now know the answers to such scientific mysteries as:

THE SOLAR SYSTEM

Many theories had to be tried and discarded before we attained our present understanding of the solar system. Some primitive peoples, for example, believed that the world was supported on the back of a tortoise, which rode on the back of an elephant, which in turn rode on the back of a '56 Chevy Bel Aire.

Today we recognize that there are nine planets, each revolving around the sun. To understand the relative scale of the solar system, imagine the earth as a tennis ball located in the middle of Times Square. Venus, on the same scale, would be a golf ball in Buffalo. Likewise, Mercury would be a badminton bird in Pontiac, Michigan, and Mars, a hockey puck in Calumet City, Illinois.

The sun would be the size of the Hyatt–Regency Hotel in Fort Lauderdale, Florida. Jupiter would be the same size and location as the average Central American right-wing dictator, and Saturn would be a rabid Doberman in Anaheim, California.

Uranus would be a Crenshaw melon imported at great expense to Moosejaw, Saskatchewan. Neptune, a typical serving of french fries in Pocatello, Idaho; and Pluto, an excellent Pont-L'Eveque cheese in a charming little bistro in Paris.

WHERE TO FIND MORE INFORMATION

Once, when the secrets of science were the jealously guarded property of a small priesthood, the common man had no hope of mastering their arcane complexities. Years of study were prerequisite for obtaining even dim, incoherent knowledge.

Now all that has changed. Today anyone can obtain a dim, incoherent knowledge of science. Popular science books—with their simple, fatuous, misleading prose, their garish four-color illustrations, and their flimsy binding—have brought science within the reach of anyone who can afford inflated prices or who can wait a couple of weeks for the remainders. ∞

Excerpted from Science Made Stupid: How to Misunderstand the World Around Us. *Published by Houghton Mifflin Company.*