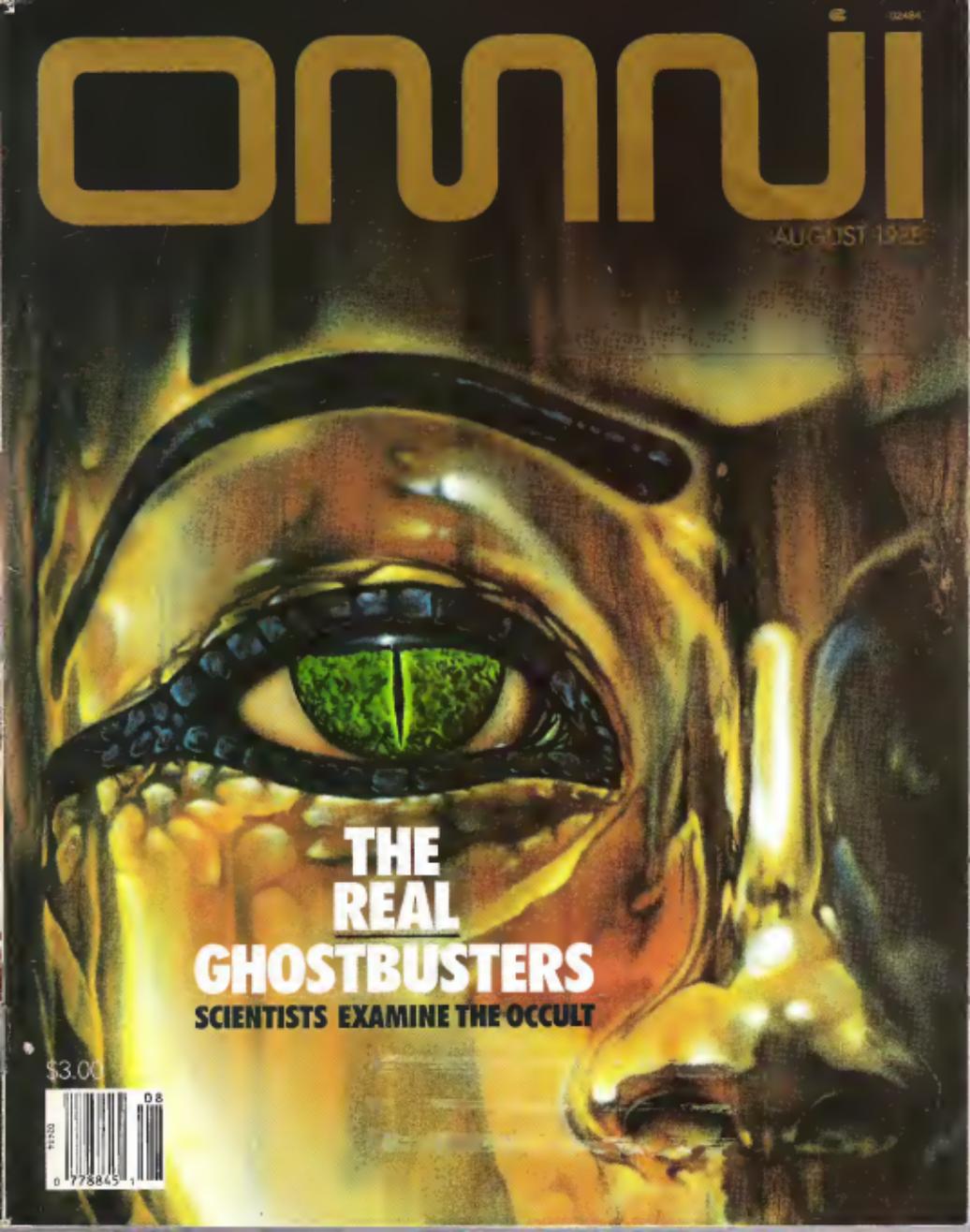


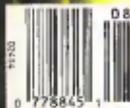
ENTERTAINMENT WEEKLY

AUGUST 1988



**THE
REAL
GHOSTBUSTERS**
SCIENTISTS EXAMINE THE OCCULT

\$3.00



DB

OMNI[®]

VOL. 10 NO. 11

AUGUST 1988

EDITOR IN CHIEF & DESIGN DIRECTOR: BOB GUCCIONE

PRESIDENT: KATHY KEETON
EDITOR: PATRICE ADCROFT
GRAPHICS DIRECTOR: FRANK DEVINO
EDITOR AT LARGE: DICK TERFSI
MANAGING EDITOR: STEVE FOX
ART DIRECTOR: DWAYNE FLINCHUM

CONTENTS			PAGE
FIRST WORD	Saving the Pandas	George B. Schaller	6
OMNIBUS	Data Bank		10
COMMUNICATIONS	Correspondence		12
FORUM	* Preparing Children for Tomorrow's World	Marvin Cetron	14
BODY	Who Owns the Sperm?	Ruth Winter	16
SPACE	Martian Kitchen	Nel McAlister	18
EARTH	Zoo Story: Rehabilitating Endangered Species	Tim Mulligan	20
STARS	Galactic Tug-of-war	Steve Nadis	22
CONTINUUM	Preventing Scientific Fraud, etc.		25
THE REAL GHOSTBUSTERS	Science and Poltergeists: A Haunting Story	Tracy Cochran	34
BRUNO'S SHADOW	Fiction	Marc Ladlaw	40
LETTERS HOME	Correspondence from Scientists in the Wild	Douglas Preston	46
THURSDAY'S CHILD	Potential: The Fantastic Art of Ilse Meyer	Nina Guccione	54
INTERVIEW	Gary Strobel, Maveack Plant Pathologist	Kathleen Stein	62
ANTIMATTER	Controversial UFO Case, etc.		73
STAR TECH	Star-climbing Wheelchairs and Other Tools for the Year 2000		100
GAMES	The Cerebral Sport of Hide and Tie	Scott Morris	102
LAST WORD	Humor: A Fat Tale	Steve Nadis	104



This month's cover is a lacquer and oil painting by illustrator Manuel S. Morales. The image—a reptilian eye set inside the golden mask of King Tutankhamen—was originally created for the cover of the mystery novel *Crocodile on the Sandbank*

OMNI (ISSN 0149-8711) is published monthly in the United States and Canada by Omni Publications International Ltd., 1065 Broadway, New York, NY 10020-9995. Second-class postage paid at New York, NY, and at additional mailing offices. POSTMASTER: Send address changes to Omni Magazine, Post Office Box 3041, Hightstown, NJ 08520-0304. Volume 10 Number 11. Copyright © 1988 by Omni Publications International Ltd. All rights reserved. Tel. (212) 496-6300. OMNI is a registered trademark of Omni Publications International Ltd. Printed in the USA by Meredith/Burda Corp. and distributed in the USA, Canada, United States territorial possessions, and the world (except the UK) by Curtis Circulation Company, 21 Henderson Drive, West Caldwell, NJ 07090. Distributed in the UK by CDMAG, Tavistock Road, West Nynton, 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 nonfiction and real places or persons living or dead is coincidental. Subscriptions: U.S., APO—\$24 one year, Canada and elsewhere—\$28 one year. Single copies \$3.00 in U.S., APO, and Canada. Telephone: 1-800-286-6664. The publisher disclaims all responsibility to return unsolicited material, and all rights in portions published thereon 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 George B. Schaller

● *Ultimately, the responsibility for saving the panda rests with China. If the Chinese fail to make the right choices now, only a few pandas will linger in captivity, mementos of a better past* ●

Pandas are China's ambassadors of friendship. They are symbols of our effort to protect the environment. Decoratively colored and with an innocent, childlike quality, the panda has an extraordinary spiritual resonance. Why else would people endure long waits just to watch pandas sleep? Why else would there be an almost voyeuristic press in their, reluctant, appearances every spring?

Buddhism, this gentle, self-contained animal with symbolism, reverence, and adulation is harmless. But we also have a moral obligation to assure the species a future in its threatened mountain home. In this, we have a lot to learn.

During the past decade pandas have declined in number. This has occurred in spite of legal protection, the existence of 12 reserves, and a vast China-World Wildlife Fund conservation program. Originally, the species thrived over much of eastern China, but now only small, scattered populations totaling perhaps no more than 1,000 animals remain in the forest along the eastern edge of the Tibetan highlands.

Pandas have an evolutionary bond with bamboo depending wholly on the leaves and stems of the grass for food. Usually bamboo is abundant, thickets of it covering entire hillides. But every 15 to 120 years, depending on the species, bamboo mysteriously flowers, seeds, and dies. In 1963 many pandas died when the arrow bamboo flowered in the Dabie Mountains—the location of Wolong, China's largest panda reserve.

I participated in panda research at Wolong before and after the 1983 bamboo die-off and gained insights into how pandas cope. After all, bamboo flowering is a natural event to which pandas adapted long ago. Fortunately, only about 15 percent of the arrow bamboo at Wolong died to flower, and at first these remaining patches sustained the pandas. During the winter of 1986–87, however, some of the pandas changed their routine—unraveling the mystery of how pandas have survived bamboo die-offs over the centuries. The Wolong pandas began spending more time foraging on low-elevation umbrella bamboo.

As in Wolong, most panda habitats once had two or more bamboo species growing at different altitudes. If one died, pandas could amble up or down the hillside to a new food source. In recent decades, however, agriculturists have pushed fields into valleys and up slopes, destroying habitats. Unfortunately, only one species of bamboo caps a ridge. And if it flowers and dies, the pandas no longer have an alternative food source.

During 1983 in areas outside Wolong where no alternative bamboo species existed, many pandas died. The government's rescue teams captured 25 pandas and deposited them in other bamboo areas. About 40 additional pandas were taken into captivity to be nursed back

to health (42 soon died, and 62 others were found dead in the wild).

Currently China holds far too many pandas in captivity—about 100. The breeding record of these captives is dismal: two or three births a year, usually as the result of artificial insemination. Scattered in zoos and other facilities, the pandas are not part of any coordinated breeding program, and most animals don't even get an opportunity to reproduce. Those that have caged mates show unexplained estrus, females being especially frustrated.

Believe it or not, pandas captured during the bamboo die-off should be given their freedom, for in the wild they will surely breed and repopulate the forests. There should also be a moratorium on capturing pandas. The animals reproduce so slowly—a female can raise at most one cub every two years—that every individual still in the wild should remain alive. Instead, China is investing huge sums to build panda-breeding centers. I have a nightmare of more and more pandas being drained from the wild until the species exists only in captivity.

In 1974 there were about 145 pandas in Wolong. Twelve years later there were 72. This startling decline was caused by poaching—villagers who live near the reserve set snares throughout the forest to catch musk deer. The musk gland is a high-priced commodity used in traditional medicines. Pandas are inadvertently strangled by the snares set for the deer. And in recent years they have also been killed for their hides, many apparently smuggled to Japan. When I visited the Jinchagou reserve in 1983 (I saw so many snares that I was surprised to find any pandas left at all).

As of August 1987 the penalty for killing a panda could be as severe as the imprisonment or death. Because forests are seldom protected, however, few poachers are apprehended. China is proud of its efforts to save the panda, but if the government continues to neglect the poaching problem, it may lose the animal it considers a national treasure.

After China loaned two pandas to Los Angeles in connection with the 1984 Olympics, 2005 began an unsuccessful scramble to obtain pandas, and China was eager to provide them. If soon became a giant-a-panda program, with each country collecting huge profits. Instead of being part of a breeding program in China, pandas have taken to the road to entertain an enthusiastic public that sees only a chipmunk face, not the image of a dying species.

Ultimately, the responsibility for saving the panda rests with China. If the Chinese fail to make the correct choices now, only a few will linger in captivity, mementos of a better past. **DD**

George B. Schaller is director emeritus for Wildlife Conservation International.

CONTRIBUTORS

OMNIBUS



COCHRAN



LETTERS HOME



THE REAL GHOST BUSTERS



THURSDAY'S CHILD



BRUNO'S SHADOW



STROBEL

Day 1: Dear Mum, Well, I'm doing fieldwork at Omni, trying to unearth rare, interesting articles. Not a pleasing prospect for a summer month. Actually, we're not to leave the premises this month. I suppose they're afraid we won't get our work in on time. The managing editor, Steve, threatened us with his vacation pictures if we were late, so we opted for the confinement.

It's not bad here: no mosquitoes, ample food (I get to order out a lot), and I'm getting used to sleeping on the floor. I get particularly restless on the weekends—don't see why we can't even go for a walk. They've promised to let us go as soon as the issue closes. And people think publishing is glamorous!

Day 2: Didn't sleep well last night. I kept hearing footsteps in the halls, and the copy machine was running by itself. Maybe I was just overtired. Or maybe my imagination was stimulated by Tracy Cochran's article "The Real Ghost Busters," on page 34. This piece profiles a group of researchers—many of whom boast Ph.D.s—who explore haunted houses and hunt for poltergeists. Of course, there are the skeptics who believe that the apparitions result from a disturbed unconscious mind. That would certainly explain last night's phenomenon here!

Day 5: I'm going a little batty. Surely there are laws about keeping staff imprisoned. We've had our coffee privileges revoked today, as they felt we were getting jittery.

Day 9: This wasn't on my job description! I want to go home. We already had two editors make a break for it—they disguised themselves as members of the art department and sneaked out early! As punishment they're not letting us use the phones. If I didn't have someone to write to, I'd lose my mind. Now I know how people feel who do fieldwork in remote areas. This month's feature "Letters Home" by Douglas Preston (page 46) is a collection of personal letters written by scientists such as Margaret Mead. Stones relayed through the letters—such as one man's battle each night with a vampire bat, and a group that was stranded for a week on top of a South American mountain, desperately waiting for a food drop—never make it into the scientific journals. (Exploration isn't as enchanting as I'd imagined.) Do you think anyone will publish my letters?

Day 13: Almost two weeks have passed, and we're getting even more crazed. Apparently Nina Guccione, who has taken to sleeping with the pictorials, dreamed up a fable for the illustrations found in "Thursday's Child" (page 54). The artwork is a series of beautiful, surreal paintings created by Iane Meyer.

Day 20: The Japanese edition of Omni (there's also a Spanish edition) has a new editor. (I daresay his people get to go home at night.) An impressive individual, Dr. Hideo Iikawa is considered his country's top scientific authority. He designed the airplane that held the

world's record for time in flight, he helped establish the foundation for Japan's space program, and he has written numerous books.

Day 23: They're easing up on us today—we got to look out the window! It's sunny outside, but I guess you know that. The whole ordeal is rather like this month's fiction, "Bruno's Shadow" (page 40) by Marc Laidlaw. The poor character Bruno was branded a heretic and jailed for using a camera, an instrument that is purported to be a Da Vinci creation. Nevertheless, Bruno managed to leave behind a magnificent monument of his passion. No chance of that happening here.

Day 24: It's not fair. They let Kathleen Stein, our staff writer, out—just because she had to interview Gary Strobel, a plant pathologist who set DNA research on the road to liberation. Strobel caused an uproar by testing his genetically engineered Dutch elm disease cure—without permission from the proper authorities. It seemed irrelevant to the bureaucratic agencies that the harmless antidote could wipe out a disease that was ravaging most of America's elms. The interview begins on page 62.

Day 25: I'll write later. They've just rung the bell for our morning exercise.

Later that day. The issue closes! I feel so relieved. God, I love my job! The bad news is that I'm late on the September issue. I'm afraid I won't be able to come home this month either. I promise to write. Hugs and kisses! ☺



BOB GUCCIONE
editor & publisher

KATHY KEETON
president

OMNI PUBLICATIONS INTERNATIONAL, INC.

THE CORPORATION

Bob Guccione, Chairman of the Board
Kathy Keeton, President
David J. Myer, (Chief Operating Officer)
Anthony J. Guccione, Secretary/Treasurer

EDITORIAL

Editor: BOB GUCCIONE, Editor, *Omni*
ADVERTISING: BOB GUCCIONE, Dick Leland, Managing Editor
Diane Fyne, Susan Collins, marketing coordinators
Jane Rosenthal, Murray Cox, Fiction Editor, *Omni*
Dorothy Hanson, Editor, *Omni* Life, *Omni* Writer, *Omni*
1987-1991, Associate Editors Tom Dewinski, Keith
McKinney, Gene Chad, Leslie M. Berlin, Literary
Editor, Margaret Robinson, G. Lushak, Daily Editor
Jack Eppler, Fiction Editor, Nina Guccione, Assistant
Editor to Fiction, Judith Kaplan, Editorial Assistant,
Art, Mary S. Guccione, Glaves, Editor, Book Review
Editor, Editor, Book Division, Roberto C. Galati,
Associate Editor, Peter Egidio, Consulting Editor,
John Flannery, Bill Lawrence, March Long, Staff
Specialist, Offices: 100 Broadway, New York, NY
10022-5476, tel. (212) 496-6100, fax no. 212-217-28

ART

Dr. W. H. Guggenheim, Dr. Harris DeLano, AF 010, Drawing
Photograph, Abstract, Dr. O. W. Guggenheim, Sculpture, book
designer, Rein Levy, Art and Photo Ed., Hologram,
Robert Ruff, Photo Ed., Akshay Ramesh, Art Review
Editor, David Lewis, Norman, Special Art Editor
Guccione, Jane Hartman

ADVERTISING AND MARKETING

Pete, Marketing Dir., William Markin, VP/DC, of
Adm. Long Newman, Sr. VP/COO, Dr. Max Buz-
zard, Executive, Executive, Executive, Executive,
Sales, Nancy Keast, Executive, Executive, Dr. J. J. J.
Sharon Stone, M.D., England, Alex, Jamie Good-
rich, VP/Promotional, Executive, Art, Dr. Peter Gold-
stein, Editorial Mgr., Ralph A. Wertz, Western Art
Dir., Susan K. Scharf, Art, Assoc. Art, Mgr., Southern
Reg. Ad. Sales, Marketing Production, Dr. Eileen
Bronson Garber, Adv. Prod. Dir., Christine Smith,
Adv. Prod. Dir., Mark Williams, Offices: New
York, 1505 Broadway, New York, NY 10019-3185,
Tel. (212) 695-6100, Telex No. 237725, Moscow, 333
N. Michigan Ave., Chicago, IL 60601, Tel. (312) 242-
9833, Fax (312) 242-3018, Detroit, Wisconsin, Ham-
milt, Adams, Inc., 2088 Lapeer Road, Suite 100,
Rochester, NY 14607, Tel. (716) 273-1326, North-
west and Canada, 1001 Post Street East, Houston,
TX 77002, Tel. (281) 224-8900, FAX (281) 224-8900,
N.W. Washington, DC 20006, Tel. (800) 758-0092,
West Coast, 9726 East Ave., Carlsbad, CA 92008,
Tel. (619) 434-5470, (619) 434-5471, Kona, Hawaii
Advertising, Inc., 7777, Kilaheoa, Room 422,
Kona, Hawaii, HI 96741, Tel. (808) 853-8888, Fax
808-853-1011, 119-8506, 8047 9813, Telex 3144
Kayard, Cable "Kayard" Souda, Fax 522-38886

ADMINISTRATION

C. O. O. David J. Myer, Sr. VP/Administrative
Services, Teri Winston, Sr. VP/Promotional Director,
John Evans, Sr. VP/DC, Financial Officer, John
Petrick, Controller, Patrick Baker, VP/Newsstand
Sales, Martin Givner, DC, Editor, Doug, Maggie,
Anderson, DC, Head, Insp. and Sales, Bruce, DC,
Editor, Assistant Editor, Mgr. Lori Raley, VP/DC,
of Public Relations, Maria Polizzi, Editorial, Peter
Photo, Dir. of Sales, Marketing, Beverly Gop-
pen, Research, Dir. of Sales, Mgr. David, Telex, Mgr.,
Asst. Prod. Mgr., Robert, Dir. of Sales, DC, Mar-
ca, Souda, Telex, Mgr., William Hartwig

FOREIGN EDITIONS

VP/Promotional, John, Mgr., Dr. John
Omni, Kuznetsov, Japan, Osamu, Company, Ltd.,
35, Yodokai-cho, Shirogane, Tokyo 102, Japan,
Editorial, Frederic, Souda, 304, Rensselaer, 06615,
AUGUST

LETTERS

COMMUNICATIONS

Zapping Kafka

In the May 1988 issue of *Omni* there is an aphorism attributed to Frank Zappa: "In the light between you and the world, back the world!" This is actually a quote from Franz Kafka's *The Great Wall of China: Stories and Reflections*. Ordinarily, a misattribution would not trouble me greatly, but to the mouth of a philosopher into the path of a rock star is more than I can permit to go unchallenged.

Alfred Evenstky
Winter Park, FL

Editors' note: Frank Zappa has been known to quote Frank Kafka often in his songs and in interviews. He has used the above-mentioned quote, which is in fact Kafka's, on a number of occasions during public appearances.

A Rat's Tale

The report from a Tehran newspaper about alleged 26 pound rats in Iran devouring cats ["Monster Rats," *Antimatter*, May 1988] is an example of misinformation and rumor prevailing over thoughtful research and common sense.

Consider the effects of translating Persian, a poetic but notoriously untechnical language, into English. Our rat is the Farsi "mooch." Our edible cat is the Persian "khorma." To a zoologist such as myself, the small, carnivorous mongoose, known to have a ravenous appetite for any small animal—including a house cat—is far removed from the rodent clan. To an Iranian, however, many small creatures are called mooch, regardless of their zoological relationship. The date palm grows dwelving mongoose is known as mooch-e khorma, or literally "rat of the date palm." The 26-pound rats you mention are surely 12-kilo mongooses.

Robert G. Tuck, Jr.
Melbourne, FL

For Him the Bell Tolls

Your interview with John Bell [May 1988] was interesting and inspiring. The fact that he, too, has questions about nonlocality—a state in which what happens in one location can cause a reaction at a

remote place without a direct connection—is just one more reason why the theoretical physicists community should start incorporating faster-than-light phenomena into their models. If the unification of gravity pays off like electromagnetism, we will have reached a heavenly state. Does anyone really believe he can prove that a graviton coincidentally travels at the same speed as a photon because that's all we know to measure?

Art Ochsmann
Dublin, OH

Chain of Reactions

Allow me to commend you for your superb job on "Nuclear Reactors" [May 1988]. In my "quietly adamant" way and with "emotions restrained," let me say that your tenacity and curiosity on getting the facts represented journalism at its finest.

Carl A. Goldstein
U.S. Council for Energy Awareness
Washington, DC

If you have ever marched in a parade behind 40 Clydesdale stallions, you would not daydream for long about the renaissance of the horse as modern urban transportation without having to sidestep (pardon the pun) the issue of waste disposal. In your article you made no mention of this most important and still-unresolved problem facing the nuclear power industry.

There is only one way to regain the readership's trust in your journalistic integrity. Run an issue dedicated to the problem of nuclear-waste disposal and do it quickly. If you don't, then send us a pair of cowboy boots.

Ed Rincon
Garden Grove, CA

Just Say Om

In a nation of several million addicts and at a time when "escape" is the largest consumable, Lucius Shepard's "Life of Buddha" [May 1988] was a magic tonic and a sobering revelation of the whole reality—and to end

Howard A. Keiser
Houston, TX

TEACH OUR CHILDREN WELL

FORUM

By Marvin Cetron

This country's future lies with today's children, but are they prepared? Among young adults, less than 40 percent can understand a *New York Times* article or figure out their change when paying for lunch! Studies show that one high-school junior in five can write a comprehensive application for a summer job, that among high-school seniors fewer than one third know to within 50 years when the Civil War took place, and one in three do not know Columbus discovered America before 1750. More than 500,000 children drop out of school each year, and an additional 700,000 finish school barely able to read their own diplomas.

When tested, students from our school system have performed atrociously. In 1982 eighth-graders who took a standardized math test answered only 46 percent of the questions correctly, placing them in the bottom half of the 11 nations competing. That same year the top 5 percent of twelfth-graders from nine developed countries took standardized algebra and calculus tests. America's best came in last. These are the politicians, the scientists, and the businessmen of the twenty-first century.

The high-school graduating class of 2000 is with us already; they entered kindergarten last September. Demands on the students go far beyond those of their parents' generation. Citizens must be able to read so they can understand voting issues. They must know history so they can develop political judgment. And today they must also understand basic science so that they can make informed decisions concerning the space program, nuclear power, and genetic engineering. Unless those criteria are met, the United States could be hearing its last days as a world power.

The class of 2000 will need more extensive education simply to get a decent job. Today's fast-growing employment fields are computer programming, health care, and law. They require not only a high-school diploma but advanced schooling or job-specific training. Traditional jobs also call for familiarity with technology, even a department-store clerk

must be "computer literate" to use a computerized inventory system. Nearly 60 percent of jobs today require a high-school diploma, and more than half of new jobs demand some college. By 2010 virtually all jobs will require computer and telecommunication skills.

The influx of new technology will make constant retraining essential. Even today engineers find half of their professional knowledge obsolete within five years. And this need for reeducation will change the role of schools.

Many public schools now offer adult education either as a community service or for much-needed supplemental income. Tomorrow's institutions will initiate adult programs out of necessity for revenues. I foresee 24-hour public schools. Adults could attend retraining sessions from four a.m. to midnight, and businesses could rent the schools' costly computer systems from midnight to dawn.

American schools are capable of quality education when they try. In Fairfax County, Virginia—a community of about 350,000—Mantua Elementary School makes that effort. Special courses are offered for out-of-the-ordinary students in the county. There are programs for the learning disabled, preschool handicapped, and the gifted. Students who are often expected to fail are excelling.

But how can we spread educational success throughout the class of 2000? Certain measures come to mind immediately, most of them simple:

- Lengthen the school day and year. Japan's school year consists of 240 eight-hour days. Ours averages 180 days of six and a half hours. Let's split the difference: 210 seven-hour school days.
- Cut the average class size from 17.6 to 10 students. Teachers would have more time to focus on the average student. Recently schools have begun to recognize the needs of special students with learning disabilities or exceptional talents. But in focusing on the needs of the minority at the extremes, we have neglected the needs of the majority in the middle. American students' dismal performance on standardized tests affirms this:

- **Competenz.** Computer-aided learning programs are already replacing drill books; as software improves, they will begin to replace some textbooks as well. The best programs available now can diagnose a student's learning problems so that instruction can be modified.

By 1990 the United States will have spent \$1 billion on computerized learning. But two thirds of that will have been spent by affluent parents for their own children. If public schools don't develop these programs, the poor will suffer.

- **Tailor courses to the individual student.** Individualized Educational Programs (IEP), already used in some schools, help evaluate students' learning styles and whether they learn best in small groups or large classes, whether they retain more information from reading, lectures, or computer programs; how much supervision they need; and so on.

- **Set new priorities for school systems.** It's time to give teachers the right to do the job they were trained for. Then make them answerable for the students' performances. Those who turn out well-educated students should be paid and promoted accordingly. (In 40 states, a starting garbage collector makes more money than a starting teacher.) If students don't advance, neither should their would-be educators.

- **Recruit teachers from business and industry, not just university educational programs.** Get chemists to teach chemistry, accountants to teach arithmetic, and so on. With the required education courses, these professionals could meet teaching standards and then fill scarce teaching positions.

Today's education system cannot begin to prepare high-school students for the world they will enter on graduation. By the time today's kindergartners finish their 12 years of schooling, they will have to assimilate more information than has appeared in the last 150 years.

Time is running out. The class of 2000 is already with us. On the door of a Mantua classroom in Virginia is a gentle reminder to us all: THIS ROOM IS A MAGIC PLACE . . . WE'RE MAKING TOMORROW 

SPERM UND DRANG

BODY

By Ruth Winter

Row upon row of polished chrome containers fill the shelves of the cold, quiet room. Although there is no outward sign of life, the neatly labeled flasks contain the essential stuff of life itself. This is where frozen sperm is stored until individual samples are chosen for use in an artificial insemination attempt. For the one American couple in 15 unable to conceive a child due to the husband's infertility, the sperm bank may represent their last hope for a family.

Over the past two decades an increasing number of couples—joined in recent years by ranks of single women—have turned to artificial insemination. By one estimate, 15,000 to 20,000 babies are conceived through artificial insemination each year in the United States, 10 percent of them by single women.

There are now more than 30 sperm banks in the United States alone, and some of them, along with individual donors, are finding themselves embroiled in lawsuits over sperm ownership. Current controversies include whether sperm donors may visit or should support children born of their donations. The nature of these disputes is so new that appropriate legislation is usually not in place.

E. Donald Shapiro, professor of law at New York Law School, points out that as far as we know, frozen sperm remains potent almost indefinitely. He warns that even married couples who agree to store the husband's sperm for future pregnancies may not realize the legal ramifications. "Federal law states that a child born ten months after a man's death cannot be considered a legitimate offspring of his marriage," Shapiro says. Imagine, for example, that a married couple decides to bank the husband's sperm in case he dies unexpectedly. Suppose then that the man dies three months later and his wife has the insemination. According to the law, the infant born of that union could never be recognized as his dead father's legal child.

Shapiro describes a recent French case he says set a precedent for determining sperm ownership in a legal forum. Alain Parpallax, a twenty-four-year-old

man with testicular cancer, deposited sperm in the Centre d'Étude et de Conservation du Spermé (CECOS), a research center outside Paris, before undergoing chemotherapy that would render him sterile. He died two years later without leaving written instructions as to the future use of his sperm.

Two days before he died in 1983, Parpallax had married Corinne Richard, with whom he'd lived since sometime before arranging to store his sperm. Shortly after Parpallax's death, his young widow contacted CECOS to obtain his sperm so her doctor could artificially inseminate her. The Parpallax family supported her desire to bear her dead husband's child. CECOS, however, claimed that it retained ownership of the sperm and that its only legal obligation was to the donor. CECOS officials also pointed out that under French law, both husband and wife must consent to artificial insemination. The husband's death, they said, precluded his giving his consent. After a long battle, the court ruled in the widow's favor. Many doctors won't even consider

artificially inseminating single women. Those determined to get pregnant without having sex sometimes resort to doing the procedure themselves. A friend or relative is on hand to provide the sperm (fresh semen actually affords a better chance of conception), and a meat baster is used to introduce the semen into the vagina. This unorthodox method has raised several legal diemmas.

One recent case arising from a do-it-yourself insemination involved a California woman who applied for welfare for herself and her child, whom she had conceived with a friend's sperm. When he learned of her hardship, he sought to have himself declared the child's father under the state's welfare code.

The woman had previously allowed the donor father to see the child, but she argued in court that he had waived paternal rights prior to her insemination. The First District Court of Appeals of California ruled that the donor was the legal father under state law because the sperm donation was not made through a licensed physician. (Six states currently have laws stipulating that a donor's parental rights are waived if a physician performs the artificial insemination.)

As for men who want to donate their sperm and retain ownership of it while it is safely stored in a bank facility, Shapiro offers a novel solution. He suggests that healthy young men make deposits in sperm banks and have them held in escrow accounts as a futuristic sort of fertility insurance. "With more and more couples waiting until their later reproductive years to have kids, it's an excellent safeguard," says Jeanie Schneider, operations manager of the Repository for Germinal Choice, a California sperm bank. Men who take advantage of such safe-deposit facilities with the express intention of using the deposit themselves in the future do own their donations. Moreover, they're required to pay for maintenance and later withdrawal.

"If there are written instructions as to what to do with the sperm in case of death, there should be no legal question about its ownership," Shapiro says. **DD**



Is a man's sperm his own? Don't bank on it.

DINING OUT

SPACE

By Neil McAleer

The crew of the first Mars expedition sit down at the table and dig into their heavenly first course, home-cooked borscht and freshly tossed salad. The aroma of whole-wheat bread wafts through the cabin.

They then turn to plates heaped with space-made Monterey Jack and Swiss cheeses, spicy soybean dip, crackers, cherry tomatoes, and radishes. The entrée that follows is a luxury, microwaved frozen salmon from mother Earth, with captive juices flowing.

Someone has piled a bowl with handpicked strawberries. One of the crew members takes a bite and sighs. There's no place like home.

A manned flight to Mars will be the longest and hungriest journey in human history—almost 1.5 billion miles and more than a thousand meals from home. During the three-year mission, there will be no ports of call in which to restock the larder. The crew must bring along all the provisions it will need.

The current estimate of the groceries needed to feed a crew of seven for the

round trip is 27,000 pounds of food (including water content) and another 37,000 pounds of water. But what will the cuisine en route to Mars actually be like?

There could be dishes of fresh vegetables, fruits, home-baked bread, cheeses, and pastas—if the next stop after NASA's Controlled Ecology Life Support System (CELSS) project is successful (see *Space*, "Astrocrops," July 1987).

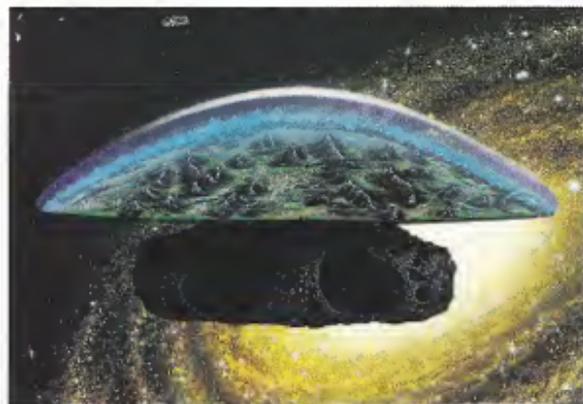
One likely design would consist of a series of drawers set in large racks like those in a Spacelab module. Each type of vegetable could grow in four or five drawers, and automated pumping and machinery would take care of the garden. Astronauts could continually harvest leafy crops such as spinach and lettuce by pruning. Other likely in-space vegetables include Brussels sprouts, cucumbers, sweet and white potatoes, radishes, small onions, patio tomatoes, and legumes such as soybeans. The bulk of the food consumed on the voyage, however, will probably be space stew—a combination of freeze-dried, reduced-moisture, and thermostabilized foods.

Not all of the raw harvest would be for eating, either. Astronauts could also turn some of it into other foodstuffs—like bread, pasta, and cheese. One recipe for space-made cheese requires ground soy, yeast, and algae.

NASA is studying ways of enhancing the food value of plants. One involves altering inedible plant parts—such as the stems and cellulose—with microorganisms to produce edible by-products. Microorganisms could also produce consumable calories directly by ingesting carbon dioxide and water derived from inedible plant material. They can make glycerol, a component of fats and oils. Microorganisms altered by genetic engineering techniques can produce specific proteins—of a bean, for example—and other essential food ingredients. "It's possible," says MIT's Mark Karel, "that fermentation, using engineered microorganisms, will be a major component of a space-based food system in twenty to thirty years."

A truly successful life-support recycling system will also have to contain a human- and nonhuman-waste processing device. NASA scientists are already working on one promising approach, called supercritical wet oxidation. Waste materials enter a small chamber (about one hundredth of a liter). The chamber heats the waste to 375°C at a pressure of 3,000 pounds per square inch for two seconds. That is enough to destroy the organic materials and turn what is left into sterile water, with some mineral salts and gases. If the astrofarmers then add magnesium, iron, and calcium to the fresh water and salts, they can create a balanced nutrient stream for their crops.

Travelers to the red planet will be mighty grateful for fresh food during their 36 months on the road. Although raising rations will be pretty complicated, eating them will be much easier. Because the ship will be spinning—to create at least one-third g, which experts believe will be essential to protect passengers from severe bone loss—there will be no need for magnetic plates and the like, and no floating food on a voyage to Mars. **DO**



Growing your own: Food raised on the flight to Mars will break the freeze-dried monotony.

ZOO STORY

EARTH

By Tim Mulligan

Problem: Several months after giving birth, the mothers of captive tree kangaroos abandon their babies, or joys, when they are still incapable of caring for themselves.

Solution: Generally, kangaroos are group oriented. The tree kangaroo, it turns out, is not similarly sociable. In fact, extended observation reveals that the mother, when herded with others in captivity, abandons her joy after being harassed by other females to do so. Therefore isolate the mother from the other females; remove even the male who sired the joy. Left alone, the mother raises her baby until it can take care of itself.

I am at the Conservation and Research Center, an adjunct to the National Zoo in Washington, DC. The 3,150-acre animal preserve is set on rolling land in the Blue Ridge Mountains of western Virginia.

In one of the buildings used by the Small Animal Facility there, I observe the Matschie's tree kangaroo, the southern Asian clouded leopard, a Brazilian golden-headed lion tamarin, a Micronesian kingfisher, and a Guam rail. All have been bred in settings as close to their natural habitats as possible.

Unlike most animal preserves, the center is not open to the public. Half the preserve is wooded with oak, maple, hickory, and other trees, and half is open pasture. Forty miles of fencing crisscrosses the landscape, enclosing pens averaging 30 acres with feeding facilities and barns for such exotic animals as scimitar-horned oryx from Africa, Père David's deer from China, married wolves from South America, toylike Eld's deer from Burma, Darwin rheas, and several species of cranes.

The center is one of the new breed of zoos. Historically, zoos have taken from the wild, caring little about preserving species. They existed primarily as places for the public to get a closer look at exotic animals and birds. Now, says Chris Wemmer, assistant director for conservation and director of the center, "with the radical loss of natural habitats, the great outdoors is becoming more like the traditional zoo."

Today the center is home to 20 species of hoofed and small mammals and 21 species of birds. According to Wemmer, the center serves three purposes: to breed endangered wildlife in captivity, to explore all aspects of an animal's biology using the latest scientific discoveries; and to teach other conservationists about research techniques for the preservation of natural habitats and about the management of wildlife in captivity.

Problem: Initial attempts by the center to breed the tiny golden-headed lion tamarin, a nearly extinct monkey colored a brilliant yellowish orange, were disastrous. Captive tamarins make terrible parents: They ignore, abuse, and sometimes inadvertently kill their offspring.

Solution: After extended observation, researchers at the center theorized that if female and male tamarins could gain parenting experience by helping to care for younger siblings, they could rear their own young. The researchers also found that the animals needed a high-protein diet to breed, not the carbohydrate-rich fruit diet they were customarily fed.

As a result, the breeding program has become so successful that tamarins have been reintroduced into the wild.

Problem: The maned wolf, a graceful, long-legged canine from South America, could be bred in captivity only with great difficulty. Even when females did have pups, they often would not care for them. The pups had to be raised by humans.

Solution: Because the wolves are solitary and very shy, human and other animal contact was greatly reduced particularly after birth. The wolves soon proved to be excellent mothers.

One of the center's more intriguing future experimental projects may be a surrogate mother program for the small, nearly extinct Eld's deer. To quickly breed more of the species, the center is exploring the idea of embryo transfer. The plan would be to give a female Eld's deer hormones to stimulate her ovaries, then artificially inseminate her. The embryo will be removed and implanted in a surrogate mother, a role that will be played by the far more common white-tailed deer. Meanwhile the Eld's deer would be free to produce more eggs.

Of all the center's programs, Wemmer is most proud of the Wildlife Conservation and Management Training Program, designed to train people from countries in Asia, Africa, and South America to preserve natural habitats. There are almost two dozen participating countries and training sites. In Sri Lanka, for example, the program focuses on conservation of the leopard and the elephant, the two most endangered animals.

As Wemmer sees it, the center represents a source of hope, a promise that man will repay a part of his enormous debt to his fellow creatures through preservation and conservation rather than pursue his more traditional role as an annihilator of nature. Through programs like those at the center, our children will be able to see, enjoy, and learn from such animals as the sable antelope, darkly colored like a dream. Without the antelope and the other mammals and birds at the center, human experience would be tragically diminished. □



Lion tamarin: Recalled to the wild

FATED ATTRACTIONS

STARS

By Steve Nadis

For nearly 50 years, astronomers have painted a remarkably simple picture of the cosmos. Since the Big Bang, they say, the universe has been expanding in a uniform way, with galaxies, energy, and matter of all kinds flying outward in all directions.

Recently, however, astronomers have learned that galaxies have motions of their own, so-called peculiar velocities that deviate from the general speed at which the universe is expanding. These motions arise because matter is unevenly distributed in space, gathering in large clumps that exert considerable gravitational pull. Galaxies—our own Milky Way included—are tugged by gravity toward these high-density regions.

Last year a group of astronomers known as the seven samurai announced that our galaxy, the local supercluster (or large group of galaxies) that contains it, and the neighboring Hydra-Centaurus supercluster are all being drawn toward one special high-density region 200 million light-years away, which they call the Great Attractor.

Although the Great Attractor's gravitational force is not strong enough to keep the galaxies from continuing their outward movement, it appears to slow the expanding tide. Scientists estimate that it takes a massive cosmic structure to exert this much pull. They figure that the Great Attractor is several hundred light-years long and that it would have to contain tens of thousands of galaxies and the equivalent of more than 10,000 trillion solar masses. It would be roughly 20 times heavier than our local supercluster.

Meanwhile a second group of researchers independently identified other mass-filled regions with similar high-density properties. "The Great Attractor is not the only show in town," says Amos Yahil, an astrophysicist at the State University of New York at Stony Brook. "The gravitational field is not dominated by any one attractor."

The seven samurai agree. "We never claimed the Great Attractor was unique," explains Alan Dressler of the Mount Wilson and Las Campanas observatories.

"If it appeared to be unique, it would bother me. Every time astronomers have argued that we're in a special place in the universe, they have turned out to be wrong. It's much more believable to find that we orbit an average star, in an average galaxy."

Astronomers met in Rome last November to thrash over the attractor controversy at a conference on "Large-scale Motions in the Universe." It soon became apparent that despite different approaches, their research had yielded surprisingly consistent results. The samurai had begun their work by mapping the peculiar velocities of specified galaxies at different points in space. From these data the group calculated the distribution of mass necessary to cause such motions. Thus they inferred the existence of the Great Attractor from the distinctive pattern of motion they had observed.

The other group, which includes Yahil and colleagues Marc Davis, John Huchra, Michael Strauss, and John Tonry, took the opposite tack. Using data on 2,500 representative galaxies from the IRAS

(Infrared Astronomical Satellite) catalog, they estimated the mass distribution in the local universe (the region surrounding our own galaxy) and then computed the gravitational forces exerted on each galaxy, as well as its peculiar velocity. The velocities predicted by these calculations closely matched those actually measured by the samurai.

Both groups agree that galaxies are moving toward high-density regions, like the Great Attractor, and away from other sparser areas. But disagreement remains over many details. Astronomers need to gather more data by surveying a bigger chunk of the universe before they will know for certain whether they're on the right track. To this end, a team headed by astrophysicist Jeremy Mould of the California Institute of Technology will attempt to find another "attractor," predicted by Yahil's model to reside in the Perseus supercluster.

Davis and Yahil, in turn, will broaden their survey to cover 80 percent of the sky out to a distance of almost 300 million light-years, the most extensive mapping to date. IRAS data, they explain, provide a uniform sampling of the universe because the dust lying in the plane of our galaxy does not obscure the view.

Should the velocity fields predicted by Davis and Yahil agree with those measured by the samurai and other observers, then astronomers could draw several conclusions. First, such a convergence of findings would support the basic underpinning of the Davis-Yahil model—that gravity alone is responsible for the large-scale motions in the universe, apart from the dominant outward flow left over from the Big Bang. Second, it would offer confirmation of their assumption that the total mass of the universe—90 percent of which is thought to be invisible—is primarily distributed around galaxies.

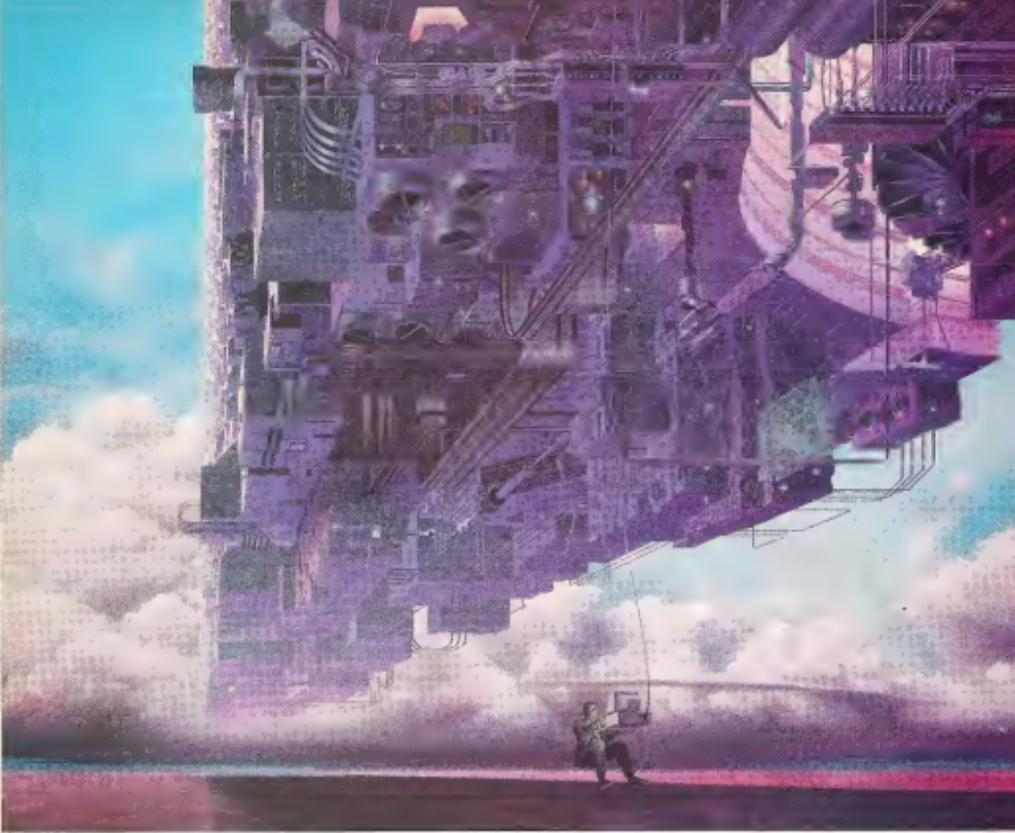
"If mass is found only around stars, that leads to a relatively simple picture. Mould says, 'But matter may be distributed in a pattern we can't even imagine.'"

In time, further study of these large-scale motions may resolve the big question in cosmology: Is the universe "open" or



A star-studded spot has pull with our galaxy.

CONTINUED ON PAGE 99



CONNECT YOUR COMPUTER TO A HIGHER INTELLIGENCE.

CompuServe's reference databases make you more productive, competitive, and better informed.

Remember the last time you tried to get your hands on hard-to-find facts? In a magazine article you read a year ago. In a news report you never saw. Or in a table of data you didn't know existed.

Imagine those facts just a few keystrokes away on your personal computer. Through CompuServe.

Your personal research center.

Save hours of research by going

straight to the reference information you need in seconds.

Access thousands of sources of information in the areas of business, finance, medicine, education, demographics, science, law, news, popular entertainment, and sports.

What you know can help you.

Research an industry or company through articles, financial statements, and other sources. Analyze an investment. Assist in a job search. Follow market competition. Investigate a business opportunity.

Check characteristics such as age,

income, and occupation in any U.S. community. For a geography report, a business plan, or a family move.

All you need to access CompuServe's unlimited world of information is a modem and just about any personal computer. Visit your computer dealer today. To order direct, or for more information, call or write:

CompuServe®

Information Services, P.O. Box 20212
5000 Arlington Centre Blvd., Columbus, OH 43220
800-848-8199
In Ohio and Canada, call 614-457-0802
An IBM® Book Company



CONTINUUM

DIRTY DATA

We expect it from politicians—some manipulation of facts, maybe even some blatant lying. But like from the people we're supposed to trust—like religious leaders and scientists—take us by surprise. Among the cases to have made the news recently are several involving charges of scientific fraud. Although most scientists believe the amount of outright fraud—in which a researcher deliberately publishes fabricated results—is fairly small, they worry that there may be a significant amount of inaccuracy in the scientific literature for other reasons. Some is due to honest error, some to sloppiness, and some to plain old fudging. Selective use of data—smoothing of curves, cleaning up rough edges to make findings appear more precise—these are practices that most scientists will acknowledge having witnessed among colleagues, though they themselves, of course, would never

The latest case to hit the headlines came out of the world-class MIT laboratory run by Nobel laureate David Baltimore. Not all the facts are clear yet, but what seems to have happened is this: In 1986 Thereza Imanishi-Kan, then an immunologist at MIT, published a study in the prestigious journal *Cell* on immune cell function in genetically altered mice. The paper's conclusions were unexpected, showing that when foreign genes came in contact with the mouse's own genes, they altered the indigenous genes' production of proteins. When junior MIT researcher Margot O'Toole attempted to repeat the study, reproducibility being the essence of good science, she failed. After several attempts, she suspected that the methodology simply didn't work as advertised. But when she tried to raise the issue, O'Toole says she was squashed, vilified, and eventually hounded out of science altogether. (At this writing she is unemployed.)

O'Toole and Imanishi-Kan are each backed up by a number of scientific experts. But the real issue here is not who's right, it's how to sort out who's right. If science is to work, it must be self-correcting. In other words, scientists must be able to repeat one another's experiments, correcting wrong assumptions and inaccurate information, modifying the research when necessary in a continual movement toward truth and knowledge. Yet in this case, the process backfired. The whistle-blower, rather than being seen as carrying out the necessary corrective steps of scientific investigation, wound up being the heavy. And that's a fate that

discourages all but the most self-confident and stubborn researchers from raising legitimate questions about their colleagues' experiments.

Professional associations along with academic institutions across the country have begun to grapple with the problem, devising procedures for dealing internally with accusations. The best example of a successfully implemented program is the one at the University of California at San Diego's (UCSD) School of Medicine. There, once a charge of fraud or misconduct has been made, it is reviewed by a series of researchers who decide whether to investigate the matter further. At any step along the way, the charge may be dropped, but if the researcher who brought the charge feels it was dropped by a reviewer for the wrong reasons, he or she may take it to another reviewer. With this tiered structure, the school tries to protect the integrity of laboratory studies without alienating either the whistle-blower or the researcher called into question.

But Dr. Paul J. Friedman, associate dean for academic affairs at the UCSD School of Medicine, believes other steps need to be taken to ensure the continued growth of good science. He would like to see seminars and classes in research ethics and the adoption of guidelines that would, for one thing, require researchers to hold on to their laboratory data for a specified number of years. (Presently, most institutions allow researchers to decide how long to keep the data. Some file them away, others toss them out, making it impossible to check for inaccuracies.)

Scientists, being by and large a practical and realistic lot, are quite clear about the dangers of fraud not only on scientific integrity but also on public opinion. If taxpayers, who generally believe that science improves their lives, get the idea that the enterprise is bogus, they may balk at shelling out for it. Scientists too need to believe that the work they do is honorable, decent, and useful. Their working lives are founded on the belief that the scientific method is a rational approach to making sense of the world. But the scientific method succeeds only if the scientists who practice it do so honestly. That's why many researchers have had such a hard time facing up to the dishonesty of colleagues. But it's also why some of them are now trying very hard to find ways of ensuring that scientists go on being the "good guys."

—TABITHA M. POWLEDGE AND JANE BOSVELD



CONTINUUM

CHICKEN-BONE CHEESE

Although the idea could make gourmards gag, cheese may soon be processed with a new ingredient—chicken bones.

Currently, most cheese is manufactured using a liquid enzyme called rennin that curdles milk. But according to food scientist Rick Yada of the University of Guelph in Ontario, Canada, the problem with making cheese the traditional way is that rennin is becoming increasingly expensive. "The best enzyme comes from the lining of calves' stomachs," he explains. "Fewer calves are being slaughtered, yet more cheese is being consumed, so the price of rennin, and cheese, keeps going up."

Rennin normally becomes soluble and mixes with milk as cheese is made. But, Yada says, by attaching it to chicken bones, rennin can be immobilized so that the same batch of enzyme can be reused repeatedly. "The bones are porous and trap the enzyme," he notes. "And they are cheap, machines that mechanically debone chickens produce mounds of chicken bones."

Yada's new cheese-making process involves a 45-gallon drum, which holds rennin-coated bones. Milk passes through the drum, undergoing a chemical reaction when it contacts the rennin. Then the milk is funneled into a vat where it curdles. "The milk is filtered so no chicken bones are left in the cheese," Yada emphasizes.

Does the stuff taste the



Cost of cheese got you down? Manufacturers think they can lower the price by using chicken bones—and less rennin—in processing.

same as cheese manufactured the old-fashioned way? "We've just produced our first curd," Yada answers. "We're aging it, hoping to produce a cheddar cheese people will like. If they do, the process could be used commercially in a couple of years. And that should lower cheese prices."

—Sherry Baker

"An idealist is one who, on noticing that a rose smells better than a cabbage, concludes that it will also make better soup."

—H. L. Mencken

OPTICAL NEURAL NETS

Today's digital electronic computers are far better than the human brain at things like arithmetic. Yet the brain beats computers hands down at other jobs, like recognizing patterns. Computer theorists think a big reason for the difference is how computers and brains are wired. Computers contain processors more powerful than neurons but have far fewer interconnections.

John J. Hopfield of the California Institute of Technology has proposed making

"neural networks," which, like the brain, would have many connections. Electronic signals interfere with each other, however, so no more than a few hundred connections can be made to any one chip. Optics can do a much better job, says John Caufield of the University of Alabama, because light signals don't affect one another. Thus optical neural networks should have denser interconnections.

Caufield has designed a way to make a trillion optical interconnections between a 1,000-by-1,000 matrix of small holograms and a liquid crystal display. He hasn't built the device yet, but he says, "No optical breakthroughs are required."

Caufield is elated with what he calls "the first proof that optics has a major role that electronics cannot serve." Don't throw away your electronic computer yet, though, it will probably take many years to perfect optical neural networks. —Jeff Hecht



Is light the key to making computers think like humans?



An electronically aged Sam Miller (left) looked enough like the real boy (right) to be identified and returned to his father.

SOFTWARE FINDS MISSING KIDS

Several years ago New York conceptual artist Nancy Burson and computer scientist David Kramlich devised a software system called *ImAger* that could artificially but accurately "age" photographs of human faces. *Omni* reported on their promising system in the April 1985 Continuum. Since then, the system has helped to locate two children who had been missing for a total of almost six years.

Debra Denise Halporn was charged with kidnapping her son, Christopher Fuimer of Atlanta, in September 1982. He was one and a half years old at the time. More than three years later Burson used *ImAger* software to computer-age a photo of Chris taken when he was only six months old, "updating" the boy's face to the age of five. The photo was broadcast nationwide on an NBC special devoted to missing

children. Chris's mother consulted a lawyer and her options and decided to return the child to his father.

Several months later Burson and Kramlich electronically aged a photo of Sam Miller, a Seattle boy who had disappeared with his mother two years earlier, at the age of eighteen months. Once again the software-aged photo was broadcast on NBC. This time the photograph was seen by neighbors of the child's mother, who was living in Kentucky. The police were notified, and within days the boy, then three and a half, was returned to his father.

Is *ImAger* the system of the future for locating the long-term missing? Apparently the FBI thinks so. It has just bought the software from Burson and Kramlich for a reputed \$25,000.

—Bill Lawren

"Life is not a spectacle or a feast; it is a predicament."
—George Santayana

WORLD'S LARGEST DINOSAUR

In 1979 amateur paleontologists exploring an area in the Jemez Mountains about 56 miles northwest of Albuquerque, New Mexico, stumbled across a sandstone slab that, thanks to erosion, revealed four ancient bones. The group kept mum about their find until 1985, when they revealed its location to David Gillette, curator of paleontology at the New Mexico Museum of Natural History. Not only did Gillette excavate more bones at the site, but he thinks the remains are those of the largest dinosaur yet discovered—a gigantic reptile he has dubbed *Sesmosaurus*, or earthshaker.

So far, Gillette (whose work is supported by the National Geographic Society) has uncovered eight connected vertebrae, part of a leg, and other bones. He plans to use remote sensing techniques, including radar,

to locate the exact position of more bones that lie 10 to 16 feet deep within the earth.

Just how big was *Sesmosaurus*? "It is the longest dinosaur ever found, and I think it will turn out to be the largest—until someone finds a bigger one. It could have stood five stories high and been more than one hundred and thirty feet long," says Gillette. He estimates that the creature, which lived during the Jurassic Period about 135 million years ago, weighed at least 80 tons.

—Sherry Baker

"The dignity of man lies in his ability to face reality in all its meaninglessness."

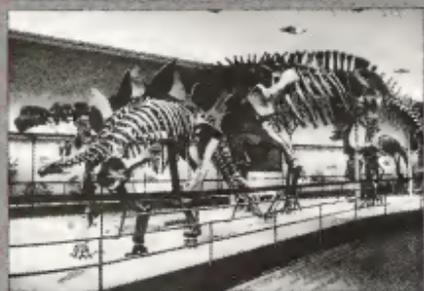
—Martin Esslin

"If love makes the world go round, why are we going to outer space?"

—Margaret Gilman

"Anyone who has begun to think places some portion of the world in jeopardy."

—John Dewey



As tall as a five-story building and more than 130 feet long, the *Sesmosaurus* makes other dinosaurs look like house pets.



CONTINUUM



Back from the dead: Drug overdose and suicide victims may be saved with an experimental drug designed to reverse the life-threatening effects of some "downers."

TRANQUILIZER ANTIDOTE

An experimental drug dubbed Flumazenil can reverse the effects of such common tranquilizers as Valium, Halcion, Versed, Restonil, and Ativan a mere 60 seconds after it is injected, according to Dr. George R. Gay, principal investigator of the drug at the University of California at Davis.

The Flumazenil compound, now undergoing double-blind tests at 15 major medical centers around the country, represents a potentially dramatic therapeutic ad-

vance," says Gay. "It appears quite capable of reversing the central nervous system depressant effect of the benzodiazepines," frequently prescribed anti-anxiety sedatives widely used in surgical procedures and often given to calm outpatients as well. The drug works by locking onto benzodiazepine receptor sites in the brain, locking out the sedatives. FDA approval for surgical use could come within a year.

Gay says the compound would be of immense value in treating drug-overdose victims and attempted suicide cases involving tranquilizers.

It could also permit outpatients to go home the same day after a minor operation instead of having to spend a night in the hospital recovering from the grogginess associated with the benzodiazepines. In addition, Gay says, it would allow doctors greater freedom in their use of medication in major surgical procedures during which many patients are now undersedated because of concerns about depression—George Nobbe

"Criticism is prejudice made plausible."

—H. L. Mencken

TOKYO'S AQUAPOLIS

With land in central Tokyo going for \$30,000 a square foot—assuming you can find an empty patch—it seems inevitable that the innovative Japanese would plan a floating city built on 10,000 piers in the middle of Tokyo Bay. It would solve a lot of local problems: a growing housing crunch, skyrocketing land prices, and transit woes among them.

The idea of a floating city has been kicked around since 1970, but this time the Japanese are really serious about what they call Ocean Communications City, says John Craven, director of the Law of the Sea Institute at the University of Hawaii.

"It's the obviously superior way to build the cities of the future," says Craven, adding, "The highway of the sea is free of traffic congestion. Japan doesn't care that it's going to take five, ten, or fifteen years to do. They



Plans are in the works to make Tokyo the first floating city.

just know that twenty years down the pike, they'll be in business, and the rest of the world won't."

The Japanese anticipate no problem recruiting 1 million settlers for their aquapole, given the problems ashore. The word from Japan's prestigious Science Council is that Ocean Communications City will be built in four layers, the uppermost being a landscaped recreation area with an airport. Below that, in descending order, would be a high-tech-industry layer, a residential level, and utilities. All of this is technically feasible right now, according to Craven, Jiro Kondo of the Science Council, and Kyohide Terai of Tokyo University, long an advocate of sea cities. Yet Kuzuo Moro of the Japanese Technology Transfer Institute in Los Angeles says, "A floating city is probably many, many years away."

—George Nobbe

GALACTIC BIRTH CONTROL

Many primitive peoples worshipped the sun as the ultimate giver of life on Earth. But if aerospace engineer Jerome Pearson is right, sun worshiping may be nothing more than misplaced gratitude. The red sine qua non of life on Earth, he argues, is not the sun but the moon.

Pearson, a former NASA engineer who now works for the Air Force in Dayton, thinks that the moon was "captured" by the earth soon after the formation of the solar system, a series of

events that generated so much tidal friction and subsequent heat in the earth's core that it melted. That melting, in turn, set in motion the strong swirling of molten material that produces the earth's magnetic field.

This process, Pearson explains, is the key to life. Because the moon is so big—Pearson calls the earth-moon a double planet—our magnetic field is almost 100 times as strong as it should be for a planet of this size and rotation rate. This ultrapotential field shields the earth from radiation from space. Without sufficient shielding, radiation would have killed early life forms before they could get a foothold.

If Pearson's theory is correct, the chances of life having emerged elsewhere in the galaxy may be much slimmer than expected. "The probability of the existence of double planets," Pearson explains, "is very low. If it weren't, you'd see more of



Without the moon, you might not be living on this planet.



What do you get when you cross an American elm with a Chinese elm? A crossbreed that won't succumb to disease, says one botanist.

them in our own solar system." If double planets are necessary for life, he concludes, "we may be one of the very few civilizations or perhaps the only civilization in this galaxy." —Bill Lawren

ELM MYSTERY

One afternoon in 1972 George Ware, a botanist, forest scientist, and research director of the Morton Arboretum in suburban Chicago, sat gazing at an old elm tree outside his office, musing on its seeming immunity to Dutch elm disease.

He knew that elms in China develop natural resistance to the fungus that kills American elms by the millions, mounting in six hours a chemical defense that blocks off their afflicted limbs. American elms do the same thing, but it takes them weeks, which is too long.

Ware solved a botanical mystery by determining the parentage of his elm, correctly suspecting it was a

natural crossbreed. "It was just plain sleuthing," he says, recalling how he traced the tree's seeds to the Arnold Arboretum in Boston. Sure enough, his tree came from a Japanese mother planted next to an exceedingly rare Wilson elm from the Chinese province of Szechwan.

"I began making cuttings and crossings," he says, developing 25 promising new strains resistant to the disease. Some now grow in Chicago suburbs, as well as Minneapolis and Williamsburg, Virginia. Last spring seedlings went to Memphis, Martha's Vineyard, Massachusetts, and New Haven, Connecticut. All have stronger chemical defenses.

"We're aiming for diversity in the long run so some of them will survive similar disasters in the future," says Ware, adding that the new strains will probably fall short of the tremendous arching heights of American elms. It's the price they'll pay for survival. —George Nobbe



CONTINUUM



Paris without the Arc de Triomphe or the Eiffel Tower? A proposed underground highway will let drivers choose speed over aesthetics.

DOWN AND UNDER IN PARIS

What to do when you have a paralyzing traffic problem in a historic city where no new roadways can be cut? Former mayor of Paris Jacques Chirac thinks he has a solution: Bury it.

Chirac has engineers studying the creation of an immense rotary traffic circle some 210 feet, or 20 stories, below Paris. Access and egress would be by inclined tunnels leading from freeways at the city's edge and from four strategic points in the inner city. A motorist would plunge underground at 30 CMH

the east end of the city, for example, whirl around the rotary to the west exit, and swoop up and away without halting for one stoplight or traffic jam.

Georges Sarre, head of the city council's opposition Socialist group, denounces the tunnel scheme as "a gigantic vacuum cleaner that will attract still more cars into Paris and worsen the clogging of streets we have now." Other critics point out the difficulty of removing exhaust gases and of dealing with accidents or fires deep underground.

The project will be financed with tolls, probably costing

around \$4 billion. That's not cheap, but one experience with normal Paris traffic would make it seem like a bargain to most drivers.

—Judson Gooding

"Everybody contemplates the infinite instead of fixing the drains, many of us will die of cholera."

—John Rich

"Civilization is a limitless multiplication of unnecessary necessities."

—Mark Twain

PLASTIC VEINS

Strong, flexible bionic blood vessels could one day be used to replace damaged and diseased veins, if current research at the Los Alamos National Laboratory is successful. Scientists there are attempting to make polyurethane-type plastic compatible with the human circulatory system.

According to Los Alamos chemist Debra Wrobleksi, rejection problems currently restrict how plastics can be used to treat vascular disorders. "Some large synthetic grafts have been successful, but when you try anything smaller than one-quarter inch in diameter, the body coats it with a thick layer of cells, causing constriction and blood clots."

To get around this problem, Los Alamos researchers are trying to modify plastic so that it won't register with the body as a foreign material. First the polymeric material is softened, and then powdered, a polymer used as a plasma substitute in

World War II, is infused into the plastic's surface. "Since powdered povidone has some blood compatibility, it may disguise the plastic from the body," Wrobleksi explains.

So far in the test tube the process does keep white blood cells from adhering to the plastic. In about a year's time, the modified plastic will be tested on animals.

If bionic blood vessels become a reality, Wrobleksi thinks they will be a boon for heart bypass patients. "Presently, leg veins are used in that surgery, and if someone needs multiple bypasses, he could run out of available veins. With the plastic grafts, you wouldn't have that problem. And you wouldn't need that additional leg surgery in the first place."

—Sherry Baker

"A paranoid is someone who has all the facts at his disposal."

—William Burroughs



Bionic bypasses may one day help save your life.



Computer aid for the battlefield: An electronic dog tag will let medics check a GI's medical record before administering treatment.

COMPUTER DOG TAGS

Aluminum dog tags, the GI's identification throughout this century, may soon go the way of the dinosaurs. Scientists at Battelle Memorial Institute in Columbus, Ohio, have designed a new plastic-coated electronic computer-chip tag called ICR (for individually carried record) that can hold the equivalent of about five typewritten pages of information. In addition to containing the traditional name, rank, and serial number of the standard dog tags, the new ones can serve as tiny electronic filing systems for all sorts of informa-

tion—everything from the soldier's current assignment to a comprehensive medical record. If a soldier were wounded in battle, for instance, a medic could simply insert the GI's card into a portable hand-held "reader" that would display the information on a small screen.

Battelle product manager Richard Rosen says that the tag itself, which in large part is an outgrowth of research on "smart credit cards," is ready for field-testing. The company is waiting for specifications from the Army before developing the electronic reader.

—Bill Lawren

FIDO'S NEW EARS

If your pooch no longer perks his ears when you call his name, if you're having trouble getting the old dog to pay attention when you're trying to teach him new tricks, he could be suffering from hearing loss. In that case, veterinary neurologist Patricia Lutgen of Texas A&M University has a remedy: a high-tech, custom-fitted canine hearing aid.

The device is electronically similar to the human version but at \$300 costs roughly half as much. This, Lutgen explains, is because the molds in which the hearing aids are made have to be custom shaped to fit the ear canals of each individual dog. To keep the device in place, Lutgen has devised a training program for dog and owner. "If you just put the hearing aid in his ear," she says, "Fido's going to scratch it right out. But if you train

him gradually, putting the hearing aid in for ten minutes a day while you hold him and stroke him, after a while the dog just forgets it's there."

So far Lutgen has fitted more than a dozen dogs with the hearing aids, and reports that in every case hearing seems to have improved. But she offers two caveats: If hearing loss is caused principally by nerve deterioration, hearing aids won't help. And even in cases where the problem is caused by bone damage, she can't guarantee that the dog will recover the full range of hearing. Even so, she says, the calls have been pouring in, and no one with a treatable dog has balked at plunking down the \$300. "In fact," she says, "some people have tried to buy two."

—Bill Lawren

"Man is a dog's idea of what God should be."

—Holbrook Jackson



Fido! ... Come, Fido! Food, Fido! ... FIDO, FODD!!! Is your dog deaf? Help may be here in a high-tech, custom-made canine hearing aid.

CONTINUUM



If you're one of those drivers who can't resist target shooting at road signs, beware: Your rear bumper may be your last. An infrared detection system can now photograph your license plate.

ROAD SIGNS AND BULLET HOLES

Wary of the time and expense involved in replacing bullet-riddled road signs routinely used by some Alaskan motorists for target practice, John C. A. Bierman of Anchorage has invented an infrared detection system that can identify the miscreant gunman.

The retired state highway department employee, who's quick to point out that the problem is by no means unique to Alaska, says his system is triggered when a bullet hits the sign. A one-frequency radio transmitter

then signals a hidden camera, which photographs the front of the offender's car, its license plate, and, he hopes, the driver.

The system can be operated day or night without the knowledge of passing motorists. And it was designed to be easily transportable from place to place and mounted near signs most favored as targets. Bierman also envisions its use in remote surveillance situations — George Nobbie

"Not a shred of evidence exists in favor of the idea that life is serious."

—Brandon Gill

ANTIMATTER FACTORIES

In 1979 theoretical physicist Edison Liang made a startling prediction: Under certain conditions, he said, temperatures in the regions surrounding black holes might become so searingly hot that they would act like cosmic forges, creating clouds of matter and high-energy antimatter. Recently analyzed evidence from a relatively nearby black hole (a collapsed star whose gravity is so intense that incoming matter can never escape) indicates that Liang was probably right.

Shortly after Liang published his theory, an orbiting satellite recorded an extremely intense burst of gamma radiation emanating from a black hole located in the constellation Cygnus, about 7,500 light-years from Earth. It was just the sort of radiation that would be produced if large numbers of electrons were colliding with their antimatter counter parts, known as positrons. Several years of number crunching by James Ling of the Jet Propulsion Laboratory in Pasadena, California, and analysis by Liang and his Lawrence Livermore Laboratory colleague Chuck Dermier clinched the case: "The data agree almost exactly with my theory," Liang says.

Perhaps equally remarkable are the facts themselves: The gamma-ray energy produced by the matter-antimatter reaction was 3,000 times greater than the entire power output of our sun. And the temperatures generated during the creation of the antimatter clouds reached as high as 5 billion degrees—more than a million times hotter than the surface of the sun.

Episodic creation of antimatter, Liang thinks, should be part of the profile of all black holes, including the one thought to be at the center of our own galaxy. "We can now look at other black holes," he says, "and understand them better."

—Bill Lawren

"A man gazing at the stars is proverbially at the mercy of the puddles in the road."

—Alexander Smith



ARTICLE

THE REAL GHOST BUSTERS

BY TRACY COCHRAN



On October night in 1973 Kathleen, a talented young photographer, heard the front door slam. She envisioned her sister ambushing down the hall, imagined the dinner party they would go to and the food they would eat. Then she froze, and her mind went dark as a cold, heavy liquid seemed to sink into her bones. There, in the dusty rose hallway, she saw something that didn't belong. "There was a hunched-over figure in a black robe," Kathleen (not her real name) remembers. "I thought it was a robber, though it seemed very sick or old." Kathleen turned on the light and watched the figure creep toward the bathroom down the hall. "Mom, who came in just now?" Kathleen called out as the figure continued on its way. "Nobody," she heard her mother answer from inside the bedroom.

"It was almost as if the figure were absorbing light instead of reflecting it," says Kathleen. "But even then, I never thought of a ghost." The following night Kathleen looked up from the sofa to see her mother standing in the doorway shaking. She had, it seemed, heard a whooshing sound in the hall and glimpsed a "transparent blackness" passing from the bookcase in the hallway to the bathroom. Gripped by a raw, anxious impulse, she yelled, "Kathleen! Kathleen!" and ran after the shadow, only to find nothing there.

PAINTING BY J. M. POUMEYROL

● Tall and gaunt, with a voice that rolls out like echoes from a cave, Osis is one of the grand old men of parapsychology. ●



When Michaela Mahler, a family friend who happened to be studying parapsychology at City College in New York, heard of the incidents, she leapt at the chance to check them out. Equipped with Geiger counter, infrared film, and a team of volunteers, she scoured the cavernous apartment to see what could be there. A scientist with a penchant for hauntings, Mahler is not alone. Today about a half dozen researchers around the country use the tools and techniques of science to study, of all things, ghosts.

It was the work of real-life ghostbusters like Mahler that inspired Dan Aykroyd, one of the creators of the film *Ghostbusters*. While writing the screenplay for the movie, Aykroyd spent hours in the library of New York's American Society for Psychical Research (ASPR). "Of course he diverged widely from reality," says one senior researcher with a certain degree of affection. "But he knew what he was diverging from."

Aykroyd's goal was to give the tools and aims of real-life investigators a kind of loopy, visual, wish-fulfilling form. He presented a grab bag of theories. "Maybe it's past-life memory intruding on present time," the fic-



tional ghostbusters said to the beautiful woman who saw a monster in her refrigerator. "Or it could be race memory or some kind of telepathic or clairvoyant contact." To cut through the supernatural veil like the proverbial hot knife, moreover, the Hollywood ghostbusters packed a dazzling array of tools: psychokinetic valence detectors to monitor movement, ghostbusting proton guns to catch the critters, and even a containment chamber to store the ectoplasmic remains.

In real life, of course, investigators like Mahler go out with film and wait and observe. There's no proton gun, no ectoplasm, no high-tech ghostmobile called ECTO-1. Yet, according to today's ghost hunters, modern scientific techniques

mean a new wave of ghostbusting is here.

While skeptics contend that these latter-day researchers are likely to encounter hallucinations, insanity, and fraud, their work is more relevant than one might think. According to a 1987 Epot Center poll, 13 percent of Americans claim to have seen a ghost, and one third of those surveyed by the Florida amusement park said they believe in ghosts. Even more extraordinary, a national survey by the University of Chicago's National Opinion Research Center found that 42 percent of Americans say they have been in contact with someone who has died. And among widows and widowers, the rate of contact with the deceased rises to almost two thirds. So whether ghosts turn out to be some artifact of the human psyche or actual entities from beyond, real-life ghostbusters may illuminate an issue of our times.

But the modern fascination with spooks is hardly new. Even the Romans believed that spirits of the dead could return to haunt the living. A 15th-century German woodcut depicts a crowned man appearing before his shocked wife. And the first official club for ghostbusters was organized by the British as far back as 1665. Meeting at a place called Ragley Hall, several leading intellectuals of the day, including the renowned physicist Sir Robert Boyle and the Reverend Joseph Glanvill, gathered frequently to study reports of ghosts.

Ghosts and related phenomena came under closer scientific scrutiny in 1882, when a British organization called the Society for Psychical Research (SPR) began to collect firsthand reports. The society's big contribution to the field was differentiating among various kinds of spooks: Traditional apparitions, for instance, were usually single incidents involving phantasms. Hauntings were places in which recurrent outbreaks of inexplicable phenomena occurred. And poltergeists were ghosts that rattled doors, pounded on walls, and threw rocks, though they themselves were never seen.

Later on, the SPR investigated traditional hauntings and poltergeists. Psychic research even formulated its first great controversy around what was called the crisis apparition—a ghost seen by friends or relatives at the moment an individual dies. Some SPR members said the apparitions were hallucinations created when the viewer sensed the death. Others said the ghosts were simply conscious entities invading physical space.

Greenwich Village ghost hunter Michaela Mahler, above, and Karlis Osis of the American Society for Psychical Research, right.

FICTION
**BRUNO'S
SHADOW**

BY MARC LAIDLAW



Through
the light which shines in natural
things, one mounts
up to the life which presides over
them.—Giordano Bruno
Creaking, the heavy door swung
open, and I stepped
into the darkened cell. The old
gatekeeper waited at my
back. Two hundred years ago he
would have been a jailer,
and this might have been my cell.
I straightened up slowly,
uncertain of the ceiling height,
and waited for my eyes
to adjust to the dimness. I had an
electric lantern with me,
but I wanted my first impressions

PAINTING BY ARMODIO



of the call to match those of its last tenant. What had he felt as the door closed behind him and the key turned in the lock? In the end, had his eyes turned huge and sightless from staring into shadows? Had he seen the pyre to which they led him after so many years in the dark? Or had that final dawn burned out his eyes, even before the flames of the auto-da-fé came leaping from below?

Poor Bruno. Burned alive, a conflagration, no more shadows.

"It's on the wall behind you," my guide called after me. "I'll close the door so you can see it whole."

I spun around in time to see the doorway closing up. "No!"

But he hadn't heard me. The old man was possibly quite deaf. Of course, I had wanted him to shut the door eventually—but not so soon. Not until I'd had time to grow used to my surroundings.

I could not bear the darkness. Quickly I switched on the lantern. And found myself staring at Bruno's masterpiece.

It was a composition in black and white and tones of gray, applied with a hand steadier and more revealing than that of any painter. At first it seemed to me no more than a subtle arrangement of dark and light planes, perfectly abstract, broken by slanting lines and gray arcs, with a row of dappled, leathery shapes suspended from above. It covered the entire wall, including the door through which I had entered the

cell. As my eye grew more familiar with the piece, I realized that it was not abstract but had been taken directly from life. The image was merely inverted.

Turning on my heel, I regarded the opposite wall. Yes, there was the window he had used, long since boarded up. In Bruno's day it had looked out on a square enclosed by imposing white walls, with arches along one side and slender trees lining the far end. It was this scene which he had captured, in reverse, on the wall of his cell.

All that architecture had long since been destroyed. Where the courtyard had been, there now rose a squat, gray monument to Roman finance. From the street one could see this modern monstrosity and the old prison of the Inquisition hulking shoulder to shoulder, like conspirators.

In that small window, now sightless and dark, Bruno had inserted a wooden shutter which completely sealed the cell from light. In the midst of the shutter was a circular aperture, over which he tacked a sheet of gold leaf. And in the very center of that sheet was the finest possible hole, no more than a pinprick, admitting only the faintest imaginable light.

Faint, but suitable for his purposes.

I wondered what his jailers had thought when he dispatched them to search for the various strange materials his camera required. He must have had some friend outside the prison to furnish the gold leaf and chemicals. His requests should have sur-

prised no one—he was already thought a sorcerer after all—but I was amazed that they had ever been honored. What might he have concocted in the years he spent in prison? Gunpowder? Poison gases? Why not the philosophers' stone?

But his materials were actually quite harmless and must have seemed so even to the warden: silver salts, bitumen of Judaea, pewter sheets, and lavender oil. A lesser man would have given up after months, perhaps even days of frustrated experimentation. But here, for once, Bruno's muscular ego served him in good stead. He had eight years in which to work without interruption, undistracted. Eventually he succeeded in rediscovering principles he had previously taken for granted. Leonardo's own processes had been kept a careful secret by his estate, which depensed fine cameras, paper, and peroxide chemicals to those who dared to purchase them in violation of Church decrees. It was not until more than a century after Bruno's death that Da Vinci's self-imposed patents expired, and the chemical principles of chiroscurography became widely understood. But long before that time, following the brilliant suspicions that had made him such a terror to the Church, Bruno had managed to duplicate Da Vinci's findings and develop his own ingenious techniques.

Imprisonment had slowed his pace but not his mind. It took the flames of the Inquisition to make that engine fail.

No record remains of the trials he conducted. History has not preserved his failures. All that remains is Bruno's triumph, cast in light and shadow on the wall of his living tomb. He must have labored all through the year's shortest night, painting the wall with the mixture he finally settled upon as ideal, namely an asphalt which hardened on exposure to light.

The entire wall beneath that bituminous layer was covered with sheets of polished pewter, tacked up edge to edge to form a seamless canvas. He had pewter-plated even the door.

At dawn he took his position. The waxing sunlight pierced the tiny hole in the sheet of gold leaf, throwing thin rays over Bruno's wall. It was Midsummer Day, the trees in leaf, the shadows stark and simple on the plaza as the sun crawled overhead. Those shadows were conducted into the dark cell by the pinhole and focused on the light-sensitive coating. Bruno never moved, not for an instant of the year's longest day. Sunlight poured through the golden hole, hardening the asphalt wherever it touched. Gradually, invisibly, the bright image of the outer world, that expansive courtyard, was frozen in the hardening bitumen of Judaea, while all the shadows remained soft—none softer than the region directly behind Bruno, which bore his Umbra! shape. When at last the pinhole went dark, had he collapsed exhausted on the floor of his camera? I do not think so. There was much to do while the asphalt was still



"Okay, Mr. Smarty-Pants, you come down here and show me how you'd perform a heart transplant."

soft; he had to act quickly to reveal the mystery hidden on the wall.

He worked through another night with a rag or brush soaked in lavender oil, gently dabbing the cooled powder to remove the soft bitumen, taking microscopic care not to destroy the hardened areas. By candlelight he watched the image emerge. The lines of walls and columns, the sweep of the arches, the sun-flecked leaves of inverted trees—these were captured in dark pewter and white asphalt. And last of all, his own form emerged.

But where was it?

I raised my own lantern, sending the shadows shifting over the wall, casting light at last upon the door itself, which was slightly recessed in the wall.

There he knelt, Giordano Bruno himself—the true shadow of the man!

I had not expected this. No one had described him. In the Church records, there was no mention of the shadow's posture.

As I have said, he was kneeling. His head leaned forward. In his perfect silhouette I could see the blunt, broken shape of his nose, barely touched by his upraised fingertips. His hands were together in prayer. Thus had the heretic portrayed himself—worshipful, dedicated, a devout shadow darkly captured on the door of his cell, imposed in turn on the inverted sky above (or beneath) the courtyard.

I brought my lamp close to his shadow. More than the perfectly rendered pillars,

trees, and arches, it was Bruno's own outline that fascinated me. I had seen him before, naturally, in his crumbling self-portraits. But those had been done in the brief days of his glory, most of them in Wittenberg. Here in Rome at the end of his life he seemed a different man, broken—

Yet not without his triumph.

He had achieved a great part of his aim, had he not? The wall bore testimony to the scope and practicality of his dreams. Here was miraculous evidence that fleeing man could collaborate with the immortal sun. He had proven it in the face of the Church's ban on cameras, when all chiroscurographers had been considered heretics—with Bruno merely the worst of them.

In 1591 Giordano Bruno had returned to Italy, his birthplace, in order to convince Pope Clement VIII that the camera and its images were divine in nature—direct gifts from God. Bruno had made a name for himself as a chiroscurographer and philosopher of the camera. In his *De umbris et obscurum*, he had eloquently stated his thesis that no other instrument was so inspired by pure, heavenly principles. In its renderings of light and darkness, the camera seemed to Bruno the perfect tool for the Church, an actual key to the Kingdom of God, the City of the Sun. He pointed out that while the Bible was itself largely incomprehensible to the common man, these images—named chiroscurographs by their inventor, Leonardo da Vinci—could

be widely appreciated, highly instructive, and capable of infinite subtlety, surpassing even the interpretive powers of a Michelangelo, a Raphael.

But Bruno's words had gone no farther than the porches of the papal ears. The Church had already condemned all camera images, the instrument itself was dubbed the Eye of the Devil. For it was blasphemy to think of collaborating with the Sun. The hand of a painter at last was guided by God, who could thus reveal or disguise His plan as He saw fit. But this perfection—it was unholy! Clement himself had toyed briefly with the device—and with impunity, given his position—but he abandoned it as too complex and never looked kindly on the attempts of lesser men to "dabble in light." So Bruno asked, How will we ever erect the City of God unless each man understands the design and knows his part in the building thereof?

Clement remained silent, averted his gaze. For Bruno, to be ignored was the greatest of hardships. He decided he must go beyond words to make his point. He must let the images themselves speak to the Church and to the common mind.

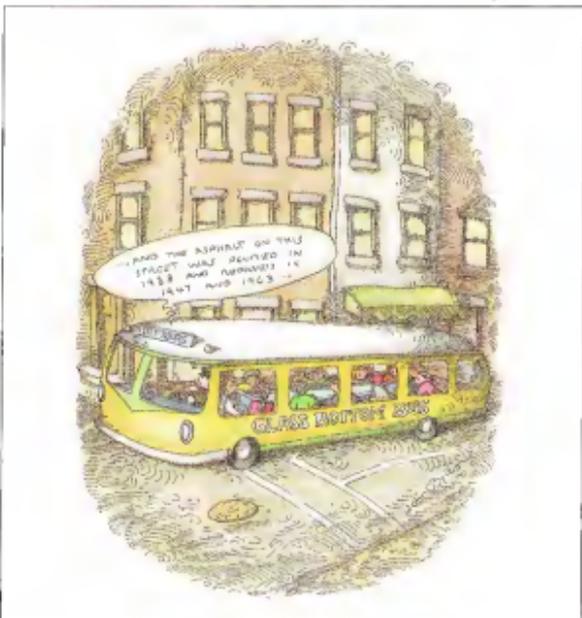
In Wittenberg, Bruno had been welcomed and much admired by the Lutherans. He had taught chiroscurography at Luther's own university until Calvinist scholars rose to power and drove him out, protesting in particular his scandalous use of the town's young men and prostitutes in composing his more elaborate scenes. He had never lost his fondness for the memory of Martin Luther, and now he followed Luther's example from the Diet of Worms—although in a style more true to his own extravagance. To the doors and walls of the Vatican he fastened a hundred of his images, the best of his life's work. He hoped they would persuade the Church to reconsider its position. And indeed the Church did revise its previous attitude, much to Bruno's mortification.

That very morning, while Rome babbled of all it had seen or thought it had seen on the Vatican walls, Giordano Bruno was arrested. His camera was destroyed, his chiroscurographs seized and his soul confined to a dark cell where it was hoped that he would presently rot.

The Inquisition could not comprehend a creature that flourished in the dark. Apparently the masterpiece on his cell wall was the heresy that made all the others seem unbearable. Composed on Midsummer Day in 1599, it was not discovered until the following year. He was promptly burned at the stake, on February 17, 1600, like a martyr lit to warm in the chilly new century.

I marvelled that the Inquisition had let the image stand.

For two hundred years no one had touched this wall. No other prisoner had occupied the cell. It had been sealed, toured occasionally by prison curators and Vatican scholars, and whispered of in imprecise terms. But it had not been destroyed. The Church kept it locked away





LETTERS HOME

ARTICLE BY DOUGLAS PRESTON

Many people become scientists because of the allure of fieldwork. There's romance and a dash of the daring in trekking off to the farthest reaches of the earth to study an obscure tribe of hunter-gatherers, to collect tropical beetles, tundra mosses, or dinosaur bones. Television has shaped our popular conception of fieldwork, as it has everything else: On TV we see the great scientist in the field taking notes, offering pithy observations to the camera, making splendid discoveries between commercials about detergents and cars.

But is this an accurate portrait of life in the field? One scientist I talked to laughed when I asked him that question. "You know those National Geographic specialisms?" he said. "Very funny. I wish my fieldwork was like that. Ninety percent of fieldwork is sheer hassle—one screw-up after another."

"It's one terrific pain in the ass," another scientist told me. "All you do is fill out permits and fight with Third World bureaucrats and sit around in airports and bus stations."

Many unpleasant incidents occur in the field. I personally know one scientist who, while working in Africa, was accused of murder by a witch doctor, arrested, and thrown into the most frightful jail imaginable. Another fellow, while doing research in a Latin American country, tried to obtain maps from

the local jefe, or military commander, and was mistaken for a revolutionary guerrilla; fortunately, the mistake was straightened out before he was shot. Primate researcher Dian Fossey was murdered, possibly as a result of her efforts to protect the mountain gorillas she was studying. More than half a century before, in the same area, African explorer and scientist Carl Akeley died of dysentery. One expedition to western Mongolia in the Twenties was captured, tortured, and put through a mock execution—because their passports weren't "in order."

Most scientists rarely, if ever, write about what fieldwork is really like. You certainly won't find accurate accounts of fieldwork in reports, scientific articles, newspaper stories, or television programs. But there is one place where you can sometimes get a whiff of the real thing—in letters home. Unlike the neat, condensed vision of televised fieldwork, the letters researchers write to their friends and colleagues reveal the rough edges of their endeavors, their impressions of life in the field, and the not-so-scientific thoughts that run through their heads on lonely, wet nights in the jungle.

Because of the personal nature of letters, some scientists who were asked to contribute declined the offer. A paleontologist told me, "If I gave you the letters I wrote to my wife after I'd been in the field for three months, you



couldn't print them anyway. They're totally X-rated." When I suggested that he censor the personal stuff before sending me the letters, he laughed. "There'd be nothing left."

Other scientists were reluctant to contribute for political reasons. "If the government of Pakistan read what I'd written about them, I'd never get back there as long as I live," one zoologist says. "And don't you dare even print my name with that quote."

And then, a lot of scientists don't write letters. Some take their spouses on field trips with them. Others are too far away from a mailbox or too close to a telephone. The following epistles are a few of the best from scientists past and present, famous and unknown. We begin with letters from two contemporary researchers whose field experiences were on the rugged side: One had his blood sucked by a vampire bat; the other nearly starved on a high plateau in South America.

The first is from Robert Carneiro, curator of South American ethnology at the American Museum of Natural History in New York City. During a trip to the Amazon basin he spent some time with the Yanomamö, a tribe of legendary fierceness that lives along the Orinoco River in Venezuela.

Caracas, Venezuela, May 31, 1975

Well, I have met the Yanomamö and survived. Indeed, I have thrived. They may spit each other's heads open with clubs, but with me they were a bunch of pussycats. The contrast between their docility at home and their ferocity away impressed me greatly. To me, no better evidence exists of the falsity of the ethnologists' claim that warfare is

just the spilling over of an ever-boiling natural reservoir of aggressiveness. Actually, the Yanomamö have to psych themselves up to fight. Their aggressiveness is an amalgam of dark thoughts about murdered and unavenged kinsmen, the taunts of women, and the freezing force of powerful narcotics. Take that away and they are remarkably gentle souls.

But when they fight they fight. As a result of one club fight that occurred while I was there, twelve or thirteen men from my village (Hasuböwatan) came home with deep scalp lacerations which would have put us in the hospital. Yet they showed no pain and went about their day's work as if nothing had happened.

One young man of sixteen, though, had six gashes on his head, one of them right on top of one he had received a few days before in another club fight. He had to be carried home on the back of another man, and he arrived more dead than alive. In fact, for three days I thought he might easily die.

The women... are petty in that they average four feet eight, but they can carry a load of firewood or bananas that would break your back.... As you know, Chagnon (Napoleon Chagnon, an anthropologist who studied the Yanomamö) says that most Yanomamö wars are fought over women, their abduction or seduction. I got the feeling from his books, though, that women were passive and innocent victims of it all. However, now I wonder. I found Yanomamö women to be forward, saucy, flirty, finicky, snuggly... and that's without a thesaurus. In the very presence of their husbands I've had women put their hands up my



Life in the field: Margaret Mead at work in Samoa (pages 46 and 47). These pages: An Eskimo from the Crocker Land expedition (top left); explorer Waldemar Jochelson in Siberia (top center), and the home of some of his research subjects (top right); anthropologist Robert Carneiro (below left), vampire bat victim who studied the Yanomamö (below), who are known for war; Clyde Roper (center), an observer of Indian squid.





THURSDAY'S CHILD

PAINTINGS BY ILENE MEYER

"Do you know where we are?" The child gazed at Jingles but didn't answer him. "On Earth they call this place a black hole. They can't see us. Do you know why we're here?" (A millennium had passed since the mishap with Jingles's last apprentice.) The underling knew to keep quiet if he was to learn. Jingles continued, "I am the Keeper. You shall learn what I know in order to take my place someday. This system, ruled by the sun, is our



domain. We are responsible for the sun's child—Earth. When Earth lost the gentle giants that roamed her surface, she cried so mournfully that the sun look pity on her and called for me. I supply the life forms, she nurtures them. It was my sole intention to

fill the world beyond with beautiful, harmonious life. But things went wrong. A long time ago, I had an apprentice not unlike you. He was impatient to learn the secrets. In his haste to understand the Maker of the creatures, he broke open the crown and let loose all life before it had been perfected. Even things not allocated for Earth escaped. Just imagine the



wonder of Earthlings



when they first came across the dragons. Oh, that was quite a mix-up! But man, eventually destined for Earth, was released way before his time. What a mistake! Man was premature, undeveloped—given the mind and body of a Keeper but the heart

of a beast. The situation has gotten progressively worse. Man has brought about destruction and imbalance. Our job now is saving the innocent entities, not rescuing the venal breeds. We must finalize our task before the planet dies." The child queried, "When will she die?" With sadness, Jingles explained,

"When the sun cries himself into an eternal sleep. The pain of his child, Earth, has made him grieve." The Keeper returned to his tale. "I have slowly recalled all the creatures, a male and female of each species who are as pure as the day they were created. The creatures like being

with us; they aren't limited to the confines of their earthly inhabitation. Here their environment is limitless. There is grass beneath their feet wherever they wander, and the fish need only a single, drifting water droplet to harbor them. Once we have them back, we





my animals through is
we finish collecting the
beasts we provided, the
earth will purge herself
of all that is unnatural.
Bursting from her belly,
every evil being that
walked upon her will
rise to face and turn on
each other. And every
product of man will burn
in her fury. Stillness will follow."



can finish perfecting them. The poor swans were taken from the Maker before we had the chance to color them; they are stark white like an untouched canvas. It's no wonder they have a nasty temperament. Man, who had a greater start than his fellow beings, is not the same as when he was introduced to Earth. He has tampered with the natural order of things. The poor humans, in their quest to understand, have become bewildered. They make their little lists of endangered species and explanations of what has happened to them, not realizing they are safer here. And the small hole that I created over Antarctica to retrieve causing a panic. When



bring man back here?" the helper asked. "No," Jingles strapped. Noticing the look of dismay, he added, "Child, when his time comes he will be reborn as he was intended to be." The little one's thoughts raced, filled with pity for man. If they knew what to do, what was right, they could come on his journey. There was always hope that he could teach them, for he knew the secret. Impatiently, he planned his own escape, to slip away and share his newly learned wonders.—Nina Guccione **DO**



SHADOW

CONTINUED FROM PAGE 44

but perfectly preserved, in the most perverse hypocrisy imaginable. They found the image intolerable and yet they treasured it, just as they treasure their pagan idols, their hundred-breasted Aphrodites, their forbidden books, and the thick compendiums of heretical chiroscurographs which lie under lock and key in carefully humiliated vaults in the Vatican library.

No one but those librarians and a few select others have been allowed to glimpse

A pale Madonna nurses a silver babe, her face half in darkness with one eye gleaming out of the darkly textured shadows.

A white dove's weight curves the olive branch on which it rests, forming a precise and delicate arc that resembles the expression of some forbidden equation.

Sunlight on craggy mountains, sunlight on the towers of a walled town, pillars of sunlight falling through broken clouds, settling pools of fire upon a sea of grain.

White breasts, dark nipples, the faint gray stipple of pores—all against a background of deepest black.

A penis, uncircumcised, nestled in dark

sculptors of gargoyles, his face hideously contorted by a syndrome which has yet to be named. Then a succession of dark-eyed Magdalenes, all of them different yet somehow similar. Bruno's lovers? I wonder. I wonder that these marvels have survived. The door creaked and swung open, taking Bruno's captive shadow with it.

"Wait. I told the keeper 'just a moment longer. I'm not quite finished yet.'"

He peered in at me, puzzled, and shrugged. "As you like. Knock when you're ready." He shut the door.

I set my lantern on the high window ledge and sat it at full radiance. Crouching, I let

triggered the shutter, exposed my image. One was all I made. Like Bruno, I felt I had one chance.

It was as I approached the door for a final time, to leave the cell, that I noticed faint scratches within the head of Bruno's shadow. Lines of poetry, engraved there by the prisoner himself!

"Escaped from the narrow murky prison
Where for so many years error

held me strally,
Here I leave the chain that bound me
And the shadow of my fiercely
malicious foe."
"My fiercely malicious foe..."

as he led me out of the prison, amably chatting the whole way. I did not hear a word he said until we stood nearly on the threshold of the building, when he opened the last great set of doors to let me out onto the street. The noise of the world pressed in, with all its sights and sounds, its complex shadows and harsh images. I wondered what Bruno would have made of this. I wondered how different this street might have looked today had the Church reconsidered its position in Bruno's hour and let him continue his work—with some modification—under its aegis.

I could not envision it. The lens of time

his eyes widened. "Are you allowed?" "Allowed?" I asked, uncovers my ground glass.

"I don't think—well, you being the Vatican's 'scurographer and all... Someone like me is of no importance."

"On the contrary," I uncapcured the lens. "The sun shines on us all."
He stood waiting, stiffly posed, his eyes appearing empty as a statue's in my viewing lens. I wondered how to unlock his face's expressiveness.

"You know the reason why I've come here today, don't you?" I asked.
"Not exactly, sir," he answered, still look-



NOTHING ATTRACTS LIKE THE IMPORTED TASTE OF BOMBAY GIN.

CHAMFINDER SEEDS FROM MOROCCO ANGELICA ROOT FROM SAXONY JUNIPER BERRIES FROM ITALY CASSIA BARK FROM INDIA/CHINA

ALMONDS FROM CHINA LEMON PEEL FROM SPAIN CITRUS (FRUIT) FROM ITALY LICORICE FROM INDIA/CHINA



Bruno's camera work for these two hundred years. I have looked on them. I have seen the hundred images he lacked deftly to the Vatican wall. De imaginum, signorum et idearum compositio. They were seized by the Church so quickly that none of the public seemed quite sure of what they had witnessed. But those images will never leave my mind: softly lit nudes—male and female both. Adam and Eve stand gleaming. We statures in a sunlit grove, their hands joined, staring up at the sun. No fig leaf hides Adam's sex, no modest forest of the pelvis obscures the folds of Eve's thighs, the curls of her pubic hair

curls. Another standing erect against a shadowed backdrop. I remember the smooth arch of public bone beneath the flesh. A couple entwined in a forest; their clothes plied at the base of a tree whose long branches stroke his back and her legs. Images of dangerous beauty, of course these dominate the memory.
But had the ascanzated church fathers even looked at half the images they snatched down? What of the street scenes? What of the portraits? These were the people of Bruno's day, the people of any day. Laughing, grieving, beautiful, and disfigured. One was a man who posed for the

my eyes rove over the entire surface of the wall. They returned again and again to the door, the praying hands, the profile. A curve of the doorway hid the cuff of Bruno's sleeve. I moved the lantern slightly to one side so that the entire shadow lay revealed. When I was satisfied, I unclasped the leather cover on my own camera and peered down into the lens. Bruno's wall more than filled the ground glass. There was no room to move back, to encompass more of the wall.
I took in a deep breath, let it out, and in the turning of the next inhalation—the moment of greatest stillness in the soul—I

Had he meant the Inquisition or himself? I sensed the frustration in the scratched handwriting. If only he had been quieter, subtler in his methods, the Church perhaps would have let him go on with his work, even ignored him. Other chiroscurographers had thrived, albeit on other continents. With time the world might have come to appreciate him. He might not have had to die upon the cye. But Bruno was Bruno. He could be no one else. And who can escape his own shadow?
Moments later, I stood in the corridor with my camera packed away, my lantern dark, watching the back of the old gatekeeper

lay focused on this moment to the exclusion of every other. Combustion carriages roared and turned in the street, terrifying the few remaining horses. I prefer to walk, to take my time in this swiftly changing world, to look for images that seem to embody our progress—and our decline.
The doorman fell silent, as if in sympathy. I turned back to him. He had a good face, skin that held the light. I thought of taking his image as he stood there half in shadow, dwarfed by the huge iron doors. The sur's position was ideal.
"Would you mind?" I said, raising my camera slightly.

ing somewhat awkward and expectant. "I wanted to get a record of Bruno's cell. You see, they're planning on tearing this old prison down."
The doorman wrinkled between his teeth, eyebrows raised. Now there was a look worth capturing. In that instant I exposed the image.
"And what's to go in its place? Another bank? Will they be needing a doorman, do you think?"
"I imagine so. It's to be a gallery, a museum of art. The Giordano Bruno Institute of Chiroscurography."
"And with that, I bid him good day. ☐"



How all-American plant biologist Gary Strobel ran afoul of the law by rescuing the elm trees from a killer—and risked his career to loosen the government's restrictions on recombinant DNA research

INTERVIEW

GARY STROBEL

Where 14 young elms used to stand behind the stadium, nothing but grasses now bends in the winds that blow down from the Gallatin range. A year ago at Montana State University (MSU) in Bozeman, in front of national television cameras, plant pathologist Gary Strobel hefted a chain saw and topped the trees. Tough guys can cry. With his hair cut-out so short you could see his tan scalp and looking rather like Lee Marvin in his prime,

Strobel teled his experimental subjects with tearful determination. "Science should be fun," he said. "This is hell!"

Strobel's trees had harmed neither man nor beast. But they were treated with a bacterium that he had genetically altered—and released—without telling the proper authorities. That, to one government agency, spelled violation; and to some people, it stirred up *Andromeda Stream* fears of tiny life forms on the rampage. By flouting Environmental Pro-

PHOTOGRAPH BY ALAN LEVENSON

tection Agency (EPA) rules, Strobel became an overnight sensation, the center of a fiery controversy over who controls genetically modified organisms in agriculture, medicine, mining, and lots of other industries. To the scientist the 14 trees symbolized biotechnology in chains—an extraordinary research hung up in red tape.

In the science of plant pathology, Strobel is a world-class investigator. He is the author of more than 180 papers on plant biochemistry and diseases. But phytopathology is not exactly a high-visibility field, and until last summer few folks outside the discipline had ever heard of him. The professor had pursued his chemical explorations of plants—their diseases and insect problems—in peace. He toiled around Bozeman in his 1969 Chevy pickup or on his Honda motorcycle, told shaggy grizzly bear jokes, and tracked the wilderness rivers. But after news broke that he had "wilyfully" released mutant organisms into the environment without permission, he felt the full force of a media storm. A year later, he says, visitors to the university still want to drop by his office, "even if they're in physics or math. I'm a curiosity, like a freak in a sideshow."

Since the mid-Seventies Strobel and his colleagues had been devising a strategy to protect elms from Dutch elm disease. *Ceratocystis ulmi* has destroyed half the elms in the United States since it was first seen in Cleveland in 1930. The lethal fungus threatens to eliminate all the older, large elms in America. Injecting the young elms with a genetically altered bacterium, *Pseudomonas syringae*, was the most recent stage in Strobel's successful attack on the fungus. In 1981 Dutch phytopathologist Rudy Scheffer had visited Strobel's lab and taken a strain of *P. syringae* back to the Netherlands, where he inoculated and protected thousands of elms. Three years ago Chris Murdoch at the University of Maine began an outdoor test of *P. syringae*. He claims nearly 100 percent success in protecting healthy elms against subsequent attack from the disease-causing fungus.

At the heart of the Strobel case is confusion about what mutants and other life forms are considered man-made and what are not. Strobel and his colleagues enhanced wild-type *Pseudomonas* with some gene-tailored *E. coli*, the workhorse bacterium of genetic engineering. But the altered *E. coli* itself never left his lab. The *P. syringae* he injected into the trees was the product of natural mating. So when he inoculated the elms, Strobel assumed he was acting within NIH (National Institutes of Health) Recombinant DNA Advisory Committee guidelines, which allow for some recombinant products to be released without review. He hadn't read the EPA's newly revised regulations, which demand prior approval for release of all mutant forms. When Strobel told the EPA he had injected the trees, four agents swooped down on Bozeman. On August

12, 1987, the MSU biosafety committee called a hearing.

As tension and confusion mounted Strobel got fed up and eventually lost his cool. "I am expressing civil disobedience," he said to a local reporter. "We can sit and talk about Dutch elm disease, or we can do something about it. I chose to do something about it." At the hearing Strobel claimed the remark was taken out of context. But by then not only his actions but his attitude had flashed across headlines. Strobel received letters of support from colleagues the world over. But some researchers condemned him with such speed and fury that their reaction seemed a knee-jerk attempt to avoid guilt by association. "He'll get us all in the soup," remarked Bernard Davis, professor emeritus of bacterial physiology at Harvard, "but many will secretly cheer." Just as Strobel was being branded "rogue," "monster," "lunatic," and "miscreant," however, the National Academy of Sciences released a

report stating that Strobel was wrong.

Strobel was born in 1938 in Massillon, Ohio. As a child he was an obsessive crusader for the environment, and he is still openly proud that as a sixteen-year-old Eagle Scout he won the William T. Hornaday award for conservation. He graduated from Colorado State University, then received his doctorate in plant pathology from the University of California at Davis in 1963. Since then his base of operations has been MSU, where he is R. G. Gray professor of plant pathology. Strobel is director of the National Science Foundation-sponsored MONTS (Montana on a New Track for Science) funding program and gave paleontologist Jack Horner his first grant to excavate the dinosaur eggs Horner discovered in the Montana Hills.

Some MSU faculty members claim Strobel is driven by a single-minded scientific fervor, and a few say he is wily, stubborn, and arrogant. But plant pathologist Scheffer calls him "one of the most generous men I know." Basically Strobel seems made up of happily compatible contradictions. Laid-back and almost naive, he does research with a network of colleagues on five continents. A devout Mormon, he has put his career on the line for recombinant DNA research—the Devil's doings, according to some Christian groups.

MSU's Plant Growth Center, which is Strobel's baby, opened in April 1987, just before the trouble began. Devoted to research on plant biology, the center could be a prototype for a food-growing unit on Mars or a hydroponics farm in deep space. The center's many green rooms can simulate any weather for precise humidity, light, and heat. The inner chambers can create a Sahara dust storm, an Indochina rain forest, or anything in between. As he passes through a room where strains of rice are being forced to take on their worst enemies, Strobel remarks, "Rice disease has caused more death than any war."

In 28 years Strobel has isolated and discovered the chemical structures of many phytotoxins. By observing the tactics of both pathogens and plants, he has cataloged unique molecular strategies that these organisms have evolved in their incessant war against one another. With genetic engineering he can tailor plants for optimum growth and resistance. No one may have more patents on life forms—40 to 60 worldwide—than Strobel. And the work goes on. In one project, grad student Greg Bunikers, postdoc fellow Doug Kendrick, and Strobel are investigating an odd antagonistic substance that a plant-eating fungus uses to preserve its life prey for future meals. By secreting a magic compound, the fungus can keep a section of cut leaf green long after the rest has turned brown. Strobel and colleagues are isolating the chemical the fungus makes to stop the aging effect. Once they discover how it works, they will use all the toys of biotechnology to play with its potential.

When Onrvi staff writer Kathleen Stein

● *The Dutch elm disease fungus is deadly. One poke of a syringe containing a few hundred spores of Ceratocystis ulmi and a 20-foot tree is dead in three weeks.* ●

report stating flatly that no evidence exists of unique dangers from releasing harmless genetically engineered organisms into the environment.

Ultimately, EPA sanctions were a slap on the wrist. Strobel would do no more recombinant DNA field experiments without a university cosponsor. The MSU biosafety committee recommended he receive a reprimand from the administration, though university president William Tietz suggested that the incident would increase "awareness of the tangled interpretations, definitions, procedures, exceptions, inclusions, and classifications that dominate biotechnical research." On September 3 Strobel cut down his trees anyway.

Two months later Strobel appeared before a Senate subcommittee and asked for sweeping changes in biotechnology regulations. Almost simultaneously the EPA announced plans to ease its restrictions and allow many recombinant DNA tests to be cleared by local biosafety committees. "A persuasive presence is not needed or desired," said the EPA's John Moore, the man who had personally reprimanded Strobel. In January, the NIH publicly ex-

first interviewed Strobel last winter, she admitted to never having seen Yellowstone National Park, 90 miles from Bozeman. Strobel said, "Let's go!" At dawn they drove along the Yellowstone River. With naked eye Strobel picked out herds of deer, buffalo, and antelope roaming the snowfields; he knew where the bighorn rams were working out for their upcoming rutting bouts. At the river's edge he spotted bald eagles poised for fish. Stopping the car, he whooped in excitement. This man was home. Yet throughout the spring Stein had to catch him between Caltech, Stanford, Italy, and Israel—where he's continuing research on olive trees genetically redesigned to flourish in the desert.

Omniv: You didn't have to, so why did you cut down the elms?

Strobel: I cut them because, as I've said before, science should be unencumbered. When reporters are looking over your shoulder and the public is out there beating around in the trees, science is encumbered. You should have seen the paths that were beaten to those trees. It reminds me of the *Little Black Sambo* story of the tiger running around the tree. He circles it so fast he turns to butter. Everyone had circled around them because they were famous trees, and many people said, "We've got to see these trees!" The MSU biosafety committee wanted me to cut them down, and the administration said, "No, he hasn't

gotten his data yet." But I told them I was done. That was the only way to stop the incessant questioning about what I was going to do next.

Omniv: Do you have any treed elms tucked away somewhere?

Strobel: I wish I did!

Omniv: What effect has your exoneration by the NIH had on your colleagues?

Strobel: They seem very quiet. Ha-ha. The issue is a little deeper than the press makes it out. Yes, the NIH exoneration me, but the EPA didn't. And if the USDA [U.S. Department of Agriculture] rules had been in effect three days before I did the test, I would have been in violation of that organization, too. The NIH could have simply sent me a letter. But instead they made it public. Doesn't that say something to the other agencies like, "Hey, we've got our act together, and our rules are simple and easy to follow"? And to the public they're saying, "How can one agency say it's okay and another say it's not okay?" Maybe a bureaucratic turf war is going on in Washington over biotechnology.

Omniv: Have your actions altered the course of debate over biotech regulations?

Strobel: Doesn't it often happen that after such an incident, the law gets quietly changed? The change in attitude of the EPA and other agencies is the result of my actions. My mother-in-law sent me an editorial in a California paper that called my case "the professor's Pyrrhic victory."

Omniv: Do you consider it a Pyrrhic victory?

Strobel: If by Pyrrhic you mean a victory with great cost and great sacrifice, then yes, to some degree it is. If change comes, regulations can be streamlined.

Omniv: *The Wall Street Journal*, which lauded you as a "Galleo of biotechnology," suggested your career may have been destroyed by this incident.

Strobel: Last August there was a definite feeling that it was in jeopardy. The journal *Bio/Technology* had an editorial that ran on and on about the end of my career, saying how sad it was, etcetera, etcetera, etcetera. I think the editors were responding to IBA, the Industrial Biotech Association, whose initial reaction was, "Throw the book at him!" Their rationale was that if one person got off lightly, maybe laws would become even more restrictive or they'd have to spend even more time and money on legal issues. So they said, "Sting him up."

Omniv: Another article stated that at MSU you've earned a reputation as a "loner, a maverick, a man with an almost studied ignorance of the rules."

Strobel: Yup. Concerning the maverick issue, yes, I believe it's important to think differently, to seek novel approaches to common problems. As far as the studied-ignorance-of-rules charge, maybe in the elm case it's true. But most biotechnology rules are absolutely ridiculous, and the charge isn't true for the rest of my life. I mean, the gravest violation I've ever committed is two speeding tickets: one on my Honda motorcycle going ten miles over the speed limit, then three years ago on the open highway with no one else on it, except the Montana highway patrol. I believe in adhering to the law, and most laws are well made. But it doesn't make sense to adhere to this artificial set of biotechnology regulations. It came to a point where someone had to make a statement.

Omniv: Has your life as a scientist been stilled since last summer?

Strobel: Time will tell. I don't see any evidence of it so far. I've submitted several journal articles since the episode, and none has been rejected. I've received a number of national and international invitations, and none has since been rescinded. Meanwhile I've been asked to work with a congressional committee on bioregulation. As someone said, as one door closes, another opens.

Omniv: During the uproar, didn't you say you weren't doing any more elm research?

Strobel: I said that at the time. That's the way you feel when your footpads are on the hot grill. The public is clamoring, "Carry on, carry on!" In the meantime you're smoking! But no, I haven't completely bowed out. We're in the process of isolating and characterizing the antimycotic agent that's so inhibitory to the elm fungus. That's tough. It's a complex peptide, probably affecting some critical function of the fungus cell like protein synthesis or respiration.

In Holland, Rudy Schaffer has had an experiment involving fifteen to twenty



thousand trees, half treated with *P. syringae* and the other half left as controls. He's keeping track of the normal rate of disease occurrence in those trees. And Chris Murdoch of the University of Maine Forestry School has inoculated some elms with the bacterium and then challenged them with the fungus. He's observed protection from the disease's development.

Omni: Are you just going to sit back and watch the field research move on? Isn't that painful for the ego?

Strobel: In certain research there's a lot of competition, like with the French and American AIDS teams. Some competition is tied up in ego, in priority, in success and recognition. But someone once said there's no limit to the amount of success one can have if one doesn't care who gets the credit. I give a lot of credit to Rudy. Basically, his ideas resurrected the initial observations we made here. If it hadn't been for him, there'd be no field application.

A number of people are now using this bacteria in the same fashion for biological control measures on potatoes and wheat diseases. *P. syringae* makes a wide range of compounds effective against many fungal parasites. I hope this episode will spark more people to get involved in tree biology. Forestry research certainly needs more investigators using molecular and biotechnology approaches. But who wants to work on a tree? You're talking about three or four years or even longer to get your basic data. There's so much more grant money in human biological research, but I view plants as critical to human survival.

Omni: What's the history of elm disease?
Strobel: It was seen in France right after World War I and then Holland. Initially people thought the trees were dying as a result of poisonous gases used during the war. But in 1919 a Dutch botanist, Dina Spiersburg, realized it was an infectious disease. In 1921 Beatrice Schwarz, also Dutch, described the pathogen as fungal in nature, having the classification *Ceratocystis ulmi*.

Because the disease wasn't seen in Europe before the war, botanists speculated that a migration of Asiatic peoples to Europe then might have brought it on the elm wood of wicker baskets. Thus the "wicker basket hypothesis." Another speculation is that it may have arrived at the completion of the Trans-Siberian Railroad in the late teens, as wood was being hauled on trains from Asia to Europe.

Organisms that arise in a specific area usually aren't pathogenic to the plants there. It's only when they move out of their native area that they wreak massive damage to related host species elsewhere. Dutch elm disease is an example of that phenomenon, an even more impressive one is the chestnut blight fungus, which arrived from Asia at the New York Botanical Garden around 1904. The fungus was not killing the Asiatic chestnut. But all the organism had to do was jump onto the American chestnut, which was extremely susceptible. It killed every major grove of

native chestnuts in the United States. It has been a massive, massive epidemic.

Omni: How does the fungus get from tree to tree?

Strobel: For the elm disease the vector is bark beetles that burrow into the tree and make galleries, or small cavities, under the bark, where they lay eggs. The spores of the fungus get into the beetles' GI [gastrointestinal] tract and ultimately into the fecal pellets the beetles drop in their next galleries. The fungus just spreads from there. It's deadly! One poke of a syringe containing a few hundred spores of *Ceratocystis* and a twenty-foot tree is dead in three weeks. In the case of the chestnut blight, the fungus is transmitted by everything from birds to squirrels. It even has a spore stage that is aerial, windblown.

A similar fungal disease is attacking lodgepole pines here in the Western forest, but few have written about it. We're losing about two billion dollars a year in timber. You can see it out the window here!

For decades I've promoted the development of science in Montana, and suddenly here I was as a potential cause of lost funding. Yet I knew I was right, and I'd go to the wall for it.

The mountain pine bark beetles attack the tree, carrying with them a fungus called *Ceratocystis montis*, morphologically and taxonomically related to the Dutch elm fungus. Boring into the pine, the beetles deposit the fungus, and together they kill the tree. Parts of Yellowstone country look as if they've been hit with an atomic bomb. Look at that! [shows photos of mountainsides of decaying pines] That's the north face of Glacier Park. Isn't that sick?

Omni: How did your history as a phytopathologist lead to last summer's episode?

Strobel: By the time I finished graduate school at the University of California, Davis, I was following plant diseases from the standpoint of the chemical interactions between the host and the parasite or pathogen. I had been interested in numerous problems on a number of plants: rice, sugarcane, cassava, corn, sorghum, alfalfa, and others. In 1974 some people at the Connecticut Agricultural Experimental Station in New Haven asked if I'd help them get started on some physiological studies of Dutch elm disease. For several years thereafter we studied the compound made by the fungus that causes the elm to wilt.

We isolated and characterized one kind of toxic molecule, a glycopeptide. Meanwhile, in 1975 I went to the University of Minnesota as a visiting lecturer in biochemistry and met Richard Gray, founder of the Freshwater Biological Institute. Gray is the former president of the IDS Investors' group, the largest group of mutual funds in the world. Months later one of his elm trees died, and he wanted something done. The people at the institute called me. I knew they didn't want me to invent another kind of chain saw. At Davis I'd had experience with bacteria that are antagonistic to fungi. So on the plane to Minnesota, I thought, I bet some of those organisms might be antagonistic to the elm-killing fungus. The next step is to see if the bacteria will grow on the elm sap and then put them in the tree. When I arrived Gray said, "We're giving you one hundred forty thousand dollars. Don't write a proposal. Just work on Dutch elm disease." We finished quickly. Now, this is about as nice an arrangement as you can get: complete trust and understanding based on research background.

Back at MSU Don Myers, a postdoc started screening isolates of pseudomonads. He assayed them on plates by spraying the fungus over them. Lo and behold, the elm disease fungus didn't grow around certain colonies of *P. syringae*. Four in the family were effective. We determined that the *P. syringae* did inhibit the fungus, and yes, we could put it in a little tree and make the tree resist the disease. Around 1980 Chevron Chemical Company began examining the commercial potential. They spent several million dollars putting the bacteria into diseased elms in parts of the country. They had zero success.

Of course I was disappointed. But Rudy Scheifer picked up the idea and examined its potential in Holland. Rudy has access to many thousands of elms because the polders, reclaimed lands, had to be planted with them. He used fresh cultures of bacterium—Chevron had used a kind of freeze-dried stuff that was half dead when it got into the trees. And Chevron was treating trees that were already sick because the marketing strategy was that it would be difficult to sell something to a person unless you—or your tree—were sick. Starting with healthy elms, Rudy realized, one can't force the bacteria into the trees, the standard technique for fungicide. So he invented a gun, the gouge pistol. [Strobel pulls a gouge pistol out of a drawer. A large, lethal-looking hypodermic is attached to a Luger-shaped frame. The underside of the barrel tip forms a sharp solution, and then with the heel of your hand you force the chisel right through the bark. It penetrates to the fresh ring of the xylem [water- and mineral-conducting tissue] and stops there because the wood is too hard for it to go farther. Then you pull the trigger, and the bacterial suspension flows down the gouge into the wound. The tree is under negative pressure, and you can ac-

tually hear it suck up the bacteria. Slurp, slurp, slurp—quickly the bacteria go up and down the tree just beneath the bark.

Ommi: How do the bacteria manage to survive in the trees?

Strobel: Genetics is the proper way to get at those questions. In the early Eighties microbial geneticists Brenda and Steve Lam came to my lab as postdocs and wanted to work on this question. A *Proceedings of the National Academy of Sciences* paper showing their research was the culmination of five years' work. Ironically, it was published in September 1987, just as everything blew.

Ommi: Your gene-insertion work with the Lams was at the heart of your success with the *Syngae* and the cause of your infamy. Please explain this biotechnology.

Strobel: We started with a strain of *P. syngae* labeled MSU174. It was the recipient of a transposon [gene-transposing element] that was part of a man-made plasmid. This is where things get complicated. A plasmid is a double-strand, circular DNA floating around in a bacterial cell. This little glob of DNA hangs out in the cytoplasm outside the bacterium's chromosomes, which are in the cell's nucleus. A plasmid has certain sites that can be cut by restriction enzymes. The genetic material in the plasmid has functions for replication, maintenance, and so on. In the Seventies David Figurski and Donald Helinski at the

University of California at San Diego took some pieces of plasmid DNA from *E. coli* and put them into a sort of man-made plasmid called pRK 2013. One of the pieces of pRK 2013 acts as a transposon.

Remember, in 1963 Barbara McClintock got the Nobel prize for discovering the principles of transposon mutagenesis in corn, although she never described the exact nature of a transposon. But her data said, "Hey, there's a genetic element that's jumping around within or between chromosomes in a corn cell." And it turns out that, sure enough, we have since learned that a transposon is a piece of DNA that can be inserted and copied in the longer recipient DNA. In some plasmids carrying a transposon, the remainder of the plasmid disintegrates after the transposon insertion. These are "suicide plasmids."

When Helinski made plasmid pRK 2013, he didn't know what he was doing for us. We discovered that this plasmid, carried in *E. coli*, was compatible with our *Pseudomonas* MSU174, and we mated them. The plasmid committed suicide, leaving only the transposon inside the *Pseudomonas*. Only the progeny of the *Syngae* containing the transposon would grow on a selected medium. This was the question for the NIH: Is it recombinant or not? Well, we had all the data to show that it was not man-made; that is, the man-made plasmid did not go into that *Pseudomonas*. Only the lit-

tle piece, the transposon, became incorporated into *P. syngae* MSU174.

Ommi: But wasn't the mutant *Pseudomonas* still man-made?

Strobel: It's man-made in the sense that the plasmid we used was man-made by recombinational events. But the *Pseudomonas* received the transposon by natural means—mating. And yes, the released organism had recombinant material, the transposon. But it was not put there by humans. Therefore the experiment did not fall within the NIH's review. The EPA, though, wants to see everything man-made. That means if you exposed a plate of bacteria to UV radiation or sunlight, conceivably the resulting mutants would be considered man-made by the EPA. And they'd want to review them. Now it looks like they're thinking of relaxing those rules. The term recombinant, incidentally, is a man-made word. But nature has been recombining DNA between organisms since the beginning of life. There are transposons within plants and other organisms, pieces of DNA that come out of one chromosome and insert themselves into another. So, I ask, what's new?

Ommi: What does this transposon do for the *Pseudomonas*?

Strobel: A few bacteria in fifteen thousand mutants produced by transposon mutagenesis had the ability to make an extra amount of the antibiotic that kills the fun-



gus. In these mutants the transposon both jacks up production of the antibiotic and carries a gene making it resistant to kanamycin, another antibiotic. Only the mutants bearing the transposon will grow on kanamycin. Since the kanamycin will prevent the growth of everything except the mutant bacteria, we can establish a pure culture and see if it's making more of the antifungal antibiotic. And it does. Why? Because in the *Pseudomonas* genome under normal conditions there may be a certain number of regulatory genes that control the production of the antifungal agent. By inserting the transposon at the right place, we knock out one or more of those control genes. That's like going to an intersection in Manhattan and shooting out the stoplights in one direction. Suddenly traffic is going to flow right through unimpeded. That's what happens. The amino acid precursors immediately flow to a greater extent into antifungal production.

Also, putting the transposon into the bacteria is like branding a cow and letting it loose in the forest. Two years later you come back, look at a lot of cows, and see which one is yours by virtue of the brand. Analogously, we made different transposon mutants and followed each of them in trees, starting in 1982.

We put the modified MSU174 *Pseudomonas* into the greenhouse trees and showed that, sure enough, they were protected—that the transposon was stable and that the bacterium remained in the trees. That's what we wrote in the *Proceedings* paper. The reviewers said, "Sure, but what will it do in the field?" They put the onus on me. That was in May 1987. So at that point I thought I had only a few weeks because the trees best accept bacteria during the time of maximum sap flow in June. The elms growing by the stadium had been planted in the mid-Seventies. There were just enough of them to do an outdoor experiment over a couple of years. I knew I had to get the bacteria into the trees in June if I didn't want to waste a year.

Omw: After the investigators arrived in July, what happened?

Strobel: The word spread that, Hey, Strobel's being investigated by the EPA! A local reporter called and told me the campus biosafety committee was conversing on "my case." I said I had other things to do. But I showed up.

Omw: Is that when you made your famous civil disobedience statement?

Strobel: Oh, yeah, my famous civil disobedience statement. I said, "Look, I just want to get on with things. I know the organism isn't a threat, and it's already been placed in the field. I can show you two trees I planted in 1982 that have the same bacterium—the same transposon as in the bacterium growing in the root—so logically both should have the same protocol." Yet I saw the logic the committee used. And it is the result of the malaise that hangs over the whole country—fear, threats of lawsuits, and the rest of it. It's sad because

Have You Heard The World's Most Advanced Cellular Phone

Hitachi Cellulares Are Your Best Buy Here Are Six Very Clear Reasons Why

1. Hitachi's cellular phones are the ultimate in small, lightweight phones. The hand-held weighs only 1.3 lbs. The portable weighs less than 4 lbs.
2. They are the new 800 spectrum cellulars. That means they free you from annoying cellular phone "gridlock." Too many phones in one area. Too many calls. Not enough channels. These Hitachi phones give you access to and from 33% MORE LINES than ordinary 600 spectrum phones do.
3. Hitachis can carry two numbers and eliminate out-of-system "roaming" costs.
4. They sound like a familiar touch tone phone when you place a call because they have true DTMF tones.
5. Hitachi's hand-held cellular's batteries are self-enclosed. The portable has a compact accessory battery pack.
6. Hitachi has soft-key control, 36-character display, 30-number dialing and readable memory.

CR-2111H
Hand Held

Why Own An Obsolete Phone
When You Can Own A Hitachi!
Another Masterpiece From



HITACHI

A World Leader in Technology

For your nearest dealer call Gary Kelley
at (800) 352-4502



CR-1111H
Portable



•With everything from
close encounters to book contracts,
the case has saucer
enthusiasts drooling in their cups. •

ANTI MATTER

On November 16, 1967, a Florida businessman walked into the offices of the Gulf Breeze Sentinel and placed five color Polaroid photographs on the desk of editor and publisher Duane Cook. The pictures all portrayed a squat, portholed, teapot-shaped UFO in startling clarity.

According to an accompanying letter, the photos had been taken on the afternoon of November 11, during which time a beam of blue light coming from the craft had literally lit the photographer three feet in the air. "I wish to remain anonymous," wrote the photog-

rapher, who signed his letter simply "Mr. Ed." Thus began the case that has flying saucer enthusiasts drooling in their cups. As one investigator gushes, "It has it all."

And indeed it does. From videos and close encounters to book offers and inquiries from *The National Enquirer*, the Gulf Breeze story has become one of the most controversial UFO cases to emerge in years.

That's no surprise. For apparently Mr. Ed. is not alone. Indeed, about a month after Cook published Mr. Ed.'s photos, another set of prints purporting to show the same object turned up in the Sentinel night drop. These pictures were accompanied by a note from someone who called himself Believer Bill. In the months that followed, more than 100 Sentinel subscribers corroborated Mr. Ed.'s account.

As for Mr. Ed., his encounters continued as well. On the night of December 2, he claimed, he surprised an alien near his bedroom. Mr. Ed. said he chased the creature but was paralyzed by the same blue light beam that had been used



UFO UPDATE

to levitate him earlier. A circle of dead grass was later discovered in the vicinity of the hovering craft.

Finally, last January, Mr. Ed. was driving his pickup about eight miles east of Gulf Breeze when the familiar UFO landed, depositing five more aliens on the road. The photograph he took through his windshield is widely regarded as the best of the lot.

UFOlogists are divided as to the merits of this case. Walt Andrus, director of the Mutual UFO Network in Seguin, Texas, traveled to Florida to view the Polaroids as well as Mr. Ed.'s video of

the sightings. "I had been expecting some kind of hoax, but I don't know what to think now," Andrus says. "If those pictures stand up under scrutiny, they're the best I've seen in more than thirty years of personal investigation."

Laser physicist Bruce Maccabee of Silver Spring, Maryland, agrees with Andrus. "If it's a hoax," he says, "it's an extremely sophisticated one in terms of the psychological and physical evidence involved."

James Oberg, a NASA engineer and UFO skeptic, is not so sure, however. "This is a classic example of a case that's simply too good to be true," he says. "In UFOlogy, as in business, if something seems too good to be true, it might be wise not to believe it at all."

As for Cook, who first broke the story, he says he never would have used the photographs in the first place except that they were local news. "If it had happened in the next county over," he claims, "it would have been their problem."—DENNIS STACY



MAYAN UFO'S

Ever since researchers uncovered the jungle-shrouded cities of Mexico and Guatemala, the Mayan culture has remained an enigma. Why, scientists have long asked, would an apparently Stone Age society take such great interest in mathematics, astronomy, and recorded time?

Now José Argüelles, a Colorado art historian, says he has the answer. The Maya

were intradimensional travelers who settled in Mexico, breeding with Olmec Indians around 600 a.c. Their mission, he says in his book *The Mayan Factor: Path Beyond Technology*, was to place Earth and its solar system in alignment with the universe.

According to Argüelles, he hit upon his theory after meeting a Mayan holy man named Humbatz Men, who said our solar system was the seventh one the Maya had navigated. The Mayan

leaders departed in the ninth century A.D. Argüelles contends, losing behind their sacred calendar as a system of prophecy. For instance, he believes, when the Mayan calendar ends in 2012, mankind will shift to a decentralized, nonindustrial culture in which contact with alien beings is commonplace.

The publication of Argüelles's book notwithstanding, critics are quick to relegate his ideas to the realm of fantasy.

"If the Maya knew more than we do in certain respects, so be it," says Charles LaCombe, an archaeologist at Florida International University and founder of the Institute of Maya Studies in Miami. "That's still no reason to attribute their origin or calendar to extraterrestrial inspiration."

—Rob MacGregor

"A warm human plumpness settled down on his brain."

—James Joyce

"I wonder if I shall fall right through the earth!"

—Lewis Carroll

REINCARNATION HANDBOOK

When he was six, writer Michael Talbot remembers, he was drawn to a book about prerevolutionary Russia. Sergey Rachmaninoff's music moved him to tears as an adult. Once while walking in New York he noted that the sunlight on the buildings reminded him of St. Petersburg (now Leningrad)—a Russian city he had never seen. "Another time I saw a

picture of a czar in a magazine," Talbot says. "I thought, *My picture of the czar has been stolen!* Then it dawned on me that I'd never owned such an object—in this life."

Talbot now claims he can recall 20 past lives, and he insists that most people can figure out who they were in other incarnations by using the techniques he outlines in *Your Past Lives: A Reincarnation Handbook* (Harmony Books).

For example, Talbot says that by searching out the cities, foods, time periods, religious objects, and other things that cause you to feel déjà vu or a subtle sense of familiarity, you may uncover other lifetimes. Talbot also recommends meditating and keeping a dream journal to tap into unconscious memories.

But what difference does it make whom you might have been centuries ago? "Learning about past lives has helped people alleviate phobias and even physical problems," Talbot answers. "It can also awaken latent talents—*one woman became*



an excellent teacher after she found out she had been a teacher before. And re-incarnation helps us to understand our spirituality."

University of Oregon psychologist Ray Hyman, however, is skeptical. "For there to be enough past lives to go around for everyone living today," he says, "the earth in the past would have to have been heavily populated. But we know that the population was very, very small compared to what it is now, even if you just go back a few generations."

Even so, Hyman adds, people who use Talbot's handbook will probably get results. "Those who buy the book want to believe, so they will convince themselves they've lived in the past." —Sherry Baker

WALDO'S MOUNTAIN

In the early Sixties Waldo Sexton built a mountain in his otherwise flat hometown of Vero Beach, Florida. He carved steps up the 50-foot precipice, crisscrossed it with two chairs, and donated it to

the city. In 1972, five years after the death of the pregnant and developer, Waldo's mountain was leveled.

Now, 16 years later, Lori Heuser has fingered Waldo as the source of mysterious troubles plaguing her restaurant, built where the mountain stood. Glasses have shattered in her hand, Heuser says, and objects have fallen off walls. Then one night after closing, she saw the image of a bronze statue that resembled Waldo himself.

To ease the situation, Heuser now plans to erect a bronze statue of Waldo and a miniaturized version of his mountain. "Things still happen," she says, "but now I just tell Waldo to get off it and help me."

Not everyone in town, however, is convinced Waldo is at fault. Vero Beach psychiatrist Berthold Schwarz says the legend itself might be influencing perception. "When emotions are altered by low lights and a drink or two, it's not hard to imagine a legend coming to life."

—Rob MacGregor and
Tish Janeschutz



STRANGE SCIENCE

If you look just at their titles, most of the papers in the new *Journal of Scientific Exploration* sound like the kinds of academic treatises you'd find in any other scholarly publication. But a closer look shows there's a big difference in subject matter. For example, "Alterations in Recollection of Unusual and Unexpected Events" suggests new ways to evaluate UFO sightings. And "Engineering Anomalies Research" discusses experiments in psychic phenomena yet another piece covers the Loch Ness monster.

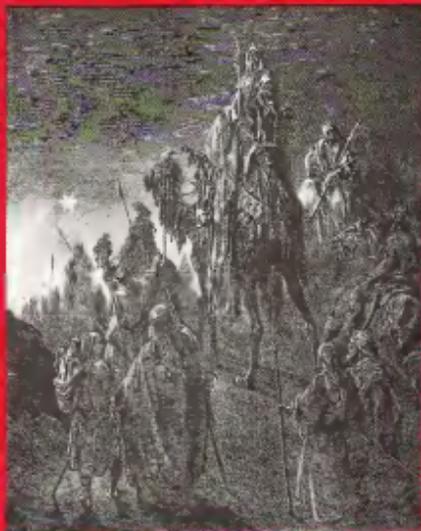
What are references to monsters and flying saucers doing in a scientific journal? "Scientists are just as curious about strange phenomena

as anybody else," says editor Ronald Howard. "Our new journal provides a way for scientists to publish their work in the area of the paranormal in a scholarly publication."

Howard, who teaches in Stanford University's engineering economic systems department, says we must "remember that hypnosis was once labeled a magician's trick. And meteorites were long regarded as fanciful peasants' tales until there was such a huge shower of meteorites in France that the evidence could no longer be ignored. It's clearly not wise to put limits on science."

For information on subscriptions to the *Journal of Scientific Exploration*, write to Pergamon Journals Inc., Fairview Park, Elmsford, New York 10523 —Sherry Baker





BETHLEHEM REVISED

In the Gospel according to Saint Matthew, a mysterious star in the eastern sky is said to have guided the Magi to the place where Jesus Christ was born. This phenomenon is often accepted as a miraculous event. But stargazers have long hoped to explain the occurrence in terms of astronomical fact.

Now Roger Sinnott, an associate editor at *Sky and Telescope* magazine, says that the star of Bethlehem appeared when the planets Jupiter and Venus converged in the night sky, looking like one very bright heav-

ily orb, in the year 2 a.d.

Astronomers have known about the conjunction of Jupiter and Venus for some time. They have, however, dismissed it as the star of Bethlehem since it supposedly occurred after the death of King Herod, who was said to be living when Jesus was born.

Now, Sinnott says, it seems that historians and astronomers have miscalculated the date of Herod's death. Indeed, the ancient Jewish historian Flavius Josephus recorded that Herod died around the time of a lunar eclipse. And modern-day astronomers have long as-

sumed it was the eclipse of March 12 in 4 b.c. New evidence, however, suggests that Herod lived until another eclipse—one occurring on January 9 in the year 1 a.c. If this is accurate, then the star of Bethlehem may have been the Jupiter-Venus conjunction, Sinnott suggests.

Kurtis Kaufman, a retired astronomy professor at the University of Minnesota, disagrees with Sinnott's hypothesis, claiming the famous star was created instead by the conjunction of Jupiter and Saturn. "Jupiter was regarded by Jewish astrologers as the symbol of a king, while Saturn represented the Messiah," Kaufman says. "So the conjunction of the king star with the Messiah star falls into the framework for the birth of Christ."—Cathy Spencer

"Science is the record of dead religions."

—Oscar Wilde

ABOMINABLE PHOTOGRAPH

Everyone interested in the Himalayas knows about the yeti, or Abominable Snowman, Nepal's version of our own homegrown Bigfoot. Recently, however, the journal *BBC Wildlife* published what it says is the first well-documented photograph of the critter.

The photographer, Anthony Woodridge, was traveling in the Himalayas when he says he spotted a large animal standing by some nearby slopes. It seemed to be six feet tall and Woodridge shot several photo-

graphs. "My skepticism was overturned by the at-foot-real creature standing with its legs apart, looking down the slope," he explains. "Its head was large, and the whole body appeared to be covered with dark hair."

The British magazine submitted the photo to two expert anthropologists interested in the yeti legend. Most astounding was the evaluation given by John Napier, an expert in anatomy and a noted Bigfoot skeptic. He admitted that the creature in the Woodridge photos was definitely a hominid and not a bear or human.

More conservative is the opinion of Robert D. Martin, a physical anthropologist at University College in London. While he feels the photograph offers "marginal" evidence of a large-bodied primate, he's not totally convinced. "There is a marginal possibility that a large primate as yet undocumented by zoologists inhabits the Himalayas," he states, but he adds that the creature might be a human langur, a monkey that lives in the area.

Martin's suggestion has not gone unchallenged by other experts. Richard Greenwell, secretary of the International Society of Cryptozoology, states that "while I tend to agree with Martin in principle, I personally don't like explanations that raise as many questions as they answer." In this case, langurs are simply not large enough to be misidentified by Woodridge, who had already seen them at lower elevations and was familiar with them.—D. Scott Rogo

REAL GHOSTBUSTERS

CONTINUED FROM PAGE 36

Psychic researchers seemed to abandon the search for ghosts altogether in the Thirties, when Dr. J. B. Rhine initiated his famous studies of extrasensory perception (ESP) at Duke University. Rhine showed that psychic phenomena, or psi, could be studied with empirical methods borrowed from experimental psychology. His basic procedure was to have subjects sequentially guess geometric symbols—stars, circles, wavy lines, squares, and crosses—printed on special cards. Rhine's seminal work, published in a 1934 monograph called *Extra-Sensory Perception*, claimed statistically significant evidence for the existence of psi. Though critics have uncovered serious flaws in Rhine's methodology, psychic researchers nonetheless found the results so intellectually stimulating that they dropped their prior concerns to focus on studies in the lab.

In fact, it wasn't until the Sixties that a handful of American researchers (by now called parapsychologists) showed they could study spooks using the tools of science. For these serious researchers, the laboratory wasn't the only scientific hunting ground; outside it lay the tantalizing realm of fieldwork and its elusive quarry—poltergeists, hauntings, and ghosts.

The person who spearheaded what has come to be known as the statistical approach to the haunted house was Gertrude Schmeidler, a psychology professor at City College. Now seventy-six, Schmeidler sits and smokes cigarettes ("There are still a few of us left," she says) in her cozy house in Hastings-on-Hudson, New York. It is a brilliant late-spring day, and wild violets poke up through the cracks in Schmeidler's walk. A dish of violets—the only flourish in her simple, almost threadbare home—sits on the coffee table in the living room, distinguished by a mountain of books. Schmeidler is deliberate, even courtly, and she communicates in her answers a deference to the unknown.

It was a respect for the unknown, she explains, that drew her into the study of the paranormal more than 40 years ago. Back then, she happened to meet the legendary psychologist Gardner Murphy, who had become interested in the study of ESP. Despite her profound skepticism about the paranormal, Schmeidler found Murphy "well-informed and sophisticated." And when he offered her research funds to do an ESP experiment, she agreed. In that classic study, Schmeidler coined the terms *sheep* and *goats* to respectively describe those who were open-minded about the paranormal and those who rejected it. The sheep, or believers, she determined, showed a greater propensity for psi. These results shook the foundation of what she describes as her "simplimented, materialistic view of the universe" and set her on

the parapsychological course for good.

Schmeidler had already established a reputation for her quantitative studies when, in 1966, a friend confided she was the victim of a ghost. The entity, the woman added, seemed to be a meek, gentle, anxious man of about forty-five.

To begin the study, Schmeidler had an architect visit the house and make floor plans to scale. Then using the floor plan, the mother, daughter, and son marked the spots where they sensed the ghost.

Next, nine psychics were each given an unmarked set of floor plans. Each copy was divided into units and ruled off with coordinates like a map for statistical analysis. Schmeidler also gave each psychic a revised version of a standard psychological adjective checklist. One by one the psychics toured the house, marking locations they considered haunted. They scored the personality checklist by circling the adjectives they thought described the ghost and crossing out those that did not.

◀ *Maybe it's
past-life memory intruding
on present time,
the fictional ghostbusters
said to the
beautiful woman who
saw the
monster in her refrigerator.* ▶

Analyzing the data, Schmeidler found that two of the nine psychics sensed a haunting in the same places the family did. Four chose personality descriptors that seemed to match the family's notion of the entity as anxious and meek. According to Schmeidler, these results were statistically significant, showing a greater correlation between the psychics and the family than one would expect purely by chance.

What to make of all this? Perhaps, Schmeidler proposed, the furniture and layout suggested particular traits and locations for the ghost. Or maybe the higher-than-expected correlation was due to ESP between the psychics and the family. The house may literally have been haunted, she added, harboring an entity or a ghost. But Schmeidler leaned toward a fourth interpretation: "An autonomous presence may have been created by the strong needs of a living person," she explained, "causing the family and the psychics to respond."

In a second study Schmeidler and University of California at Los Angeles colleague Thelma Moss used a similar approach to study reports of a haunted house in L.A. But they added refinements as well

For instance, in addition to asking psychics to identify the ghost's location and personality, they asked them about its physical appearance and activity as well. The researchers also created a control group, posing the same questions to the psychics who walked through the house and to people at the ASPR. As in the previous study, the correlation between psychic reports and witness reports was statistically greater than what would have been expected through pure chance.

More recently, Schmeidler's statistical techniques have been used and expanded by Michaelson Maher. Tall and attractive, Maher today earns her living as a research editor at New York magazine. With her heart and soul in the ghost research she only occasionally gets to do, she enthusiastically describes the Greenwich Village investigation of 15 years before.

To start her experiment, Maher explains, she devised a quantitative study with Schmeidler's help. First a scaled floor plan of the apartment was created; then Kathleen and her mother checked off where they had seen the ghost. Next an assistant who knew nothing about the case handed unmarked copies of the floor plan to each of four psychics. The psychics in turn, toured the apartment, marking any locations where they sensed or saw the ghost. To ensure that the family and psychics were not merely responding to spooky-looking areas in the apartment, Maher had a control group of eight skeptics tour the apartment as well. In addition, Maher constructed a checklist that jumbled together both accurate and inaccurate descriptions of what Kathleen and her mother claimed to have seen. When they finished touring the house, both psychics and skeptics checked off descriptions that corresponded most closely to their own impressions of the so-called ghost.

Though the ghost spots sensed by psychics and witnesses differed, Maher says, "the accounts seemed to correspond well." For instance, psychic Ingo Swann reported an apparition moving toward him, following a trajectory that seemed to be an extension of what Kathleen and her mother had observed. As for the nature of the ghost, one psychic described a "very malevolent presence." Another cited images of "a black woman, a black man, or a young black girl."

Recalling the centuries-old legend of the "cold spots" that accompany ghosts and clued by Kathleen's description of the ghost as a kind of "black hole," Maher then asked a photographer to take infrared photographs in the hall. When developed, the roll of film showed a strange "parabola of fog" in one of the central frames. Maher played down this anomaly in her published report because she couldn't rule out a defect in the film. The unexpected finding, however, did inspire her to continue the investigation. She asked a friend to bring a Geiger counter. When it reached the pantry—the room that one psychic projected

as the ghost's destination—the machine went wild. Maher played down this finding as well because the total number of Geiger counter blips in the apartment fell within the normal range.

"It's impossible to interpret these findings with any certainty," says Maher. "They shouldn't have been there, but they were."

That's why, despite the lack of financial support for her work, Maher has pushed on. Recently, for instance, she used a machine devised by a scientist friend to investigate a New Jersey ghost. This diabolical instrument, jokingly dubbed the demon detector, is actually a random number generator, so called because it generates a random distribution of numbers. If the numbers deviate significantly from this random distribution, a red light flashes on.

Maher and her friend set up the random-number generator at various sites in the house, speculating that if there were something abnormal present, it might interfere with the normal random functioning of the machine. The fact that the light remained on or off for significant periods showed that the machine had deviated from its expected random functioning and suggested the possibility of a ghostly presence to Maher.

"Without more tests you can't be certain," she says, "but these are not the results you'd expect if nothing were there."

To get to the bottom of the matter, some ghostbusters say one must apply the tools of science not to the elusive apparition but to the poltergeist—the noisy ghost that thrashes and bashes about. Enter William Roll. A professor at West Georgia College in the town of Carrollton, Roll is a slight, sprightly, mustachioed man who speaks with what can only be called an international accent—part British and part American, though peppered with Danish consonants and flourishes throughout.

Despite his natural enthusiasm and ebullience, Roll's pursuit of the poltergeist has been anything but smooth. Back in the Fifties, he studied parapsychology at Oxford under parapsychologist Henry H. Price. Though he received a grant to run an ESP experiment for his doctoral thesis, eight years later he was forced to conclude, "It was harder than I expected to get convincing results." In 1967 Roll joined Rhine's laboratory at Duke but felt that true paranormal phenomena eluded him still.

Then, in 1958, a frustrated Roll got his break. In March of that year, it seems, the Herrmann family of Sealord, New York, heard a series of loud, explosive sounds. Checking the house, they found that several bottles with screw caps—including those containing holy water, shampoo, starch, and Kaopectate—had unscrewed and spilled. The family also reported mysteriously broken objects, including a ceramic doll and a model ship. Before long, a local detective contacted Rhine, who in turn contacted the Herrmann family to launch an investigation, and before Roll knew it, he was involved.

Working with fellow researcher J. Gaeher Pratt, Roll first tried to find a normal explanation for the bottle poppings. For instance, hypothesizing that someone in the family might have been inducing the phenomenon with chemicals, he created pressure under bottle caps with applications of dry ice but could not simulate the pattern using that technique. He also investigated the possibility that high-frequency radio waves were somehow involved.

Finally, because most of the incidents occurred only when the Herrmanns' twelve-year-old son, Jimmy, was home, Roll had a psychologist administer a Rorschach inkblot test to the boy. Interpreting the standard designs, young Jimmy was soon describing "rockets exploding, volcanoes blowing their tops, and things like that. As a psychologist," Roll says, "I thought the tests definitely suggested a large degree of tension and repressed hostility in the boy." Roll naturally began toyng with the notion that poltergeists were related to

● *The Herrmann family had heard a series of loud, explosive sounds. Checking the house, they found that some bottles, including those with holy water and Kaopectate, had spilled.* ●

mental disturbance, suggesting that Jimmy's rage created a psychic disturbance that made objects tumble and break.

A decade later, while investigating a case in Miami, Roll says, he was able to put his ideas to the test. The Miami case took place in a novelty-goods warehouse, where alligator ashtrays, zombie glasses, and other products constantly flew off shelves—especially when a nineteen-year-old shipping clerk named Julio was around.

To track the poltergeist, Roll actually moved into the warehouse and set up specific target areas—regions in which he had previously determined the identity and location of every object. Monitoring the target zones, Roll soon began producing a frantic-looking number-coded flowchart of the novelties as they careened about. He used dark lines when witnesses reported Julio could not have thrown the objects and broken lines when there was doubt. He also had psychologists give Julio a battery of standard personality tests, which were assessed by the ghost lady herself. Gertrude Schneider (Julio was a passive, unhappy young man), she concluded at the time, "He saw his boss as a phony and a cheat and

needed to express his moral rage."

The result, Roll decided, was something he called recurrent spontaneous psychokinesis, or RSPK. In the parapsychologist's lexicon, psychokinesis is the ability to use psychic powers to move objects from one location to another. And as far as Roll is concerned, the poltergeist phenomenon results when unconscious turmoil induces violent psychokinetic episodes again and again. "This avoids the assumption that ghosts or spirits are responsible," he says. "We are still making an assumption, namely that poltergeist effects are produced by the mind or psyche of a living person."

Back in his tiny office, Roll explains that RSPK may flow from some still-undetected epileptiform disorder in the brain. Poltergeists, he notes, are a kind of paranormal temper tantrum usually observed in children around the age of fourteen. And, according to Roll, "disturbed people in disturbed households are affected most."

To prove his point, Roll describes the notorious case of the Columbus, Ohio, poltergeist and its apparent vehicle, fifteen-year-old Tina Resch. The Columbus poltergeist announced itself quietly, flicking light switches off and on at the home of Mr. and Mrs. John Resch. Within days, however, furniture and knickknacks were flying. At their wit's end, the couple appealed to The Columbus Dispatch, which suggested they contact Roll.

Roll ended up spending a week with the Reschs, soon pinpointing Tina as the locus of the poltergeist activity. While he was observing Tina, for instance, he saw a picture and its hanging nail rip from the wall.

The case is problematic, to say the least. While Roll was dogging Tina's footsteps, the Committee for the Scientific Investigation of Claims of the Paranormal (CSICOP) came knocking at the door. Though James "The Amazing" Randi stood there with two investigators, they were denied entrance. As a result, they denounced the case as a fraud. The charge was strengthened when news reporters filmed Tina deliberately knocking over a lamp.

Roll, however, is convinced the case should not be denounced as a fraud, so much so that he took Tina to North Carolina for observation. Through hypnosis, he and a psychotherapist re-created the occurrences in a controlled setting. Roll asserts, and several target objects moved. "There's no way," he says, "she could have physically caused the incidents to occur."

Despite the controversy surrounding the Resch case, ASPR researcher Karlis Osis asserts that ghosts are objectively real. Tall and gaunt, almost ascetic, with a soft Latvian accent that makes his words roll out like echoes from a cave, Osis, at seventy, is one of the grand old men of parapsychology. Although ostensibly retired from the society, he comes in regularly.

Born in Riga, Latvia, in 1917, Osis spent his youth surrounded by the physical devastation of World War I. This war-torn landscape, he says, provided the perfect

backdrop for "a taste of the mysterious and sublime." As an adolescent lying in bed with tuberculosis, he suddenly saw his room fill with "a joyful white light." He later learned that at precisely that moment, his aunt had died. Remembering the incident years later as a student in parapsychology, Osis felt sure that great discoveries had to be formed by experience, not merely by research in the lab.

Despite this notion, Osis nonetheless spent years working for Rhine, convinced that the parapsychologist's research held out "the promise of a higher transcendental meaning for man." As a research associate in Rhine's lab from 1951 to 1957, he performed ESP experiments with animals and conducted landmark studies on the strength of ESP over distance and time.

As time went on, however, he began to step out of the lab in search of the quintessential experience he had come to value in youth. Toward that end, Osis began examining the deathbed reports of doctors and nurses and comparing near-death reports from India with those from the United States. In 1977 he presented the results in his controversial book *At the Hour of Death* to the chagrin of his colleagues. Osis claimed he had gathered evidence for life after death. "There was no question about how the wind blew," he said. "The idea of survival after death explained our data better than the idea of death as the ultimate destruction."

In the course of his near-death research, moreover, Osis gathered some evidence that he believed suggested the reality of ghosts. For instance, he collected a smattering of information on so-called transit disasters, NDEs in which "excessively self-centered individuals cruise in a void with no one to meet, instruct, or rescue them."

To bolster his ideas, Osis recently set out to show the incredible: that characteristics such as intelligence and purpose can be attributed to ghosts. The case he studied involved the so-called apparition of a thirty-six-year-old businessman who had been killed in an air crash. The man reportedly appeared to two different people at two different locations and at, two different times. The story began, Osis reports, when a distant relative interested in psi tried "contacting" the dead businessman, imploring him to appear to his grief-stricken mother holding the hand of his little boy, who had drowned. Subsequently the deceased man's mother woke to see the apparition of her son and grandson standing at the foot of her bed. The dead man also apparently appeared in identical form to his six-year-old niece.

Osis administered a battery of personality tests and conducted a spate of interviews, concluding that ESP simply could not explain the course of events. "The ESP model becomes strained," Osis says, "when one realizes the extent to which ESP would have to have been operating." First of all, the dead man's mother was a "supergod," highly skeptical of paranormal forces or life

from beyond. Second, the relationship between the distant relative and the dead man's mother was extremely vague. And third, the relative had been unaware that the young niece existed at all. The notion of survival beyond death, he contends, "does well in explaining the nearly exact congruence between the communicator's request to the dead man and the two apparitions. This is so because it assumes a coordinator of events, that is, the personality of the apparition itself."

If Osis' theories are to be proved—or, for that matter, if we are to understand ghosts in any sense at all—the phenomenon must be studied with instruments more sophisticated than any in use today. That, at least, is the opinion of Charles Tart, professor of psychology at the University of California, Davis. Tart says that electronic sensing devices and computers might show whether the phenomenon is real. For instance, he notes, various detectors with appropriate filters could be used to monitor different

● *Poltergeists are paranormal temper tantrums that are usually observed in children around the age of fourteen. Disturbed people in disturbed families are affected most.* ●

parts of the electromagnetic spectrum, and transducers could detect even minute omissions of light or other energies. Electronic detectors and filters could detect sound at extremely high or low frequencies. Heat sensors or infrared imaging devices could detect precise temperature changes. And strain gauges would not only detect movement but also measure the exact nature of the force that caused the movement to occur. Biosensors could be attached to animals and even human observers, monitoring heart rate, breath rate, brain waves, and skin resistance. And measurements of such things as radio waves, odors, chemical content of the air, magnetic fields, and radiation levels could prove to be helpful as well. "The way to go," suggests Tart, "is to connect all these sensors to a computer so changes could be charted and correlated from moment to moment and so patterns, subtle though they might be, would become instantly clear."

Indeed, an increased emphasis on instrumentation would certainly help the field. As it stands now, critics say, much of the ghost and poltergeist research is imprecise, lacking adequate theories, method-

ologies, and controls. Part of the problem, says Terence Hines, professor of psychology at New York's Pace University and author of the book *Pseudoscience and the Paranormal*, is that even honest accounts are often beset on powerful hallucinations the witness believes are real. "Ghosts are usually spotted at night by someone who has just retired," Hines explains. "After going to bed, people fall into a sort of in-between state, where they are neither fully awake nor fully asleep. During this period, what's known as the hypnagogic hallucination, which may be auditory or visual in nature, is quite common. These hallucinations are distinct from dreams in that they may seem to the individual to be real. A similar type of hallucination can occur upon waking up as well." In one recent study, Hines adds, scientists found that more than 70 percent of a sample of 375 college students had at some time experienced auditory hallucinations in which they heard voices while they were awake. This sort of experience, he notes, "can engender strong belief. Hallucinations are responsible for a great number of impressive reports of ghosts."

Ray Hyman, professor of psychology at the University of Oregon, adds that even the most rigorous of these investigations really occur after the fact. "They are historical investigations, not true scientific investigations at all," he says. "And the ambiguities that exist are endless. You can't be there to set up equipment at the moment the incident occurs, for instance. You can't repeat the experiment, so you must rely on the testimony of people you don't really know. Most major parapsychologists have had to concede that they couldn't establish any scientific evidence on the basis of spontaneous cases. That's why Rhine tried to set up laboratory experiments."

But Hyman thinks that the biggest problem is a deep and systemic flaw in parapsychology. "Every other science has textbook examples of experiments that can be repeated in the laboratory," he says. "The only school or science that doesn't have a single paradigm is parapsychology. For a hundred thirty years people have been chasing after ghosts, and they haven't been able to find one case that others have been able to verify. The argument is still whether there is a phenomenon at all."

"Most people don't realize that the rationality in science comes from the group process," Hyman adds. "When you're operating within a real discipline, everything you do is monitored, and it's hard to be a loose gun. When you leave that disciplined field and go into something like parapsychology, and on top of that, when you leave the laboratory and go into psychical work in the field, there are no standards, no checks and balances. No one is able to develop standard procedures," says Hyman, "so it's impossible to assess whether any procedure works or not."

The investigation of the Heisch case, Hyman adds, is an obvious example of that disastrous blend of unchecked procedure

and romantic belief. "Roll believes in poltergeists, and that enables him to find evidence in the muddiest case," Hyman states. "But even if he believes it's authentic, he's got no right to claim it, because he made every kind of goof that you could make. His diagrams and testimony describe things that had to have happened behind his back. Everything he said is consistent with what this girl does best, which is cheat."

Sue Blackmore, who has studied the investigation of the Resch case, agrees. A research fellow at the University of Bristol in England, Blackmore spent much of her career researching the paranormal before studying psi from a skeptic's point of view. "Much of the research is based on pseudophysical theories," she says. "The problem with this field is that we keep coming up with mad ideas that lead nowhere."

When asked to comment, the American Psychiatric Association (APA) simply refused. "We don't make statements about ghosts," said Dr. Harvey Rubin, public affairs chairman of the APA.

But many of the harshest skeptics agree that the study of spooks may be important from an experiential point of view. According to Marcello Truzzi, professor of sociology at Eastern Michigan University in Ypsilanti and the director of Ann Arbor's Center for Scientific Anomalies Research, the scientific study of ghosts will ultimately "allow investigators to get back to the true

task of looking at the mind. If you told people fifty years ago that there was a ghost in a house," Truzzi says, "everyone would ooh and aah and stay away. You tell people now, and everyone wants to spend the night there. People are more playful, they're more willing to approach ghosts today, not because they believe in them more but because they believe in them less. There has been a breakdown of organized religion, which means less fear of the supernatural—of demons stealing your soul."

That's not true for those who have had ghostly encounters, those like Kathleen. After the initial shock, Kathleen says, seeing a ghost became a metaphysical adventure, a personal window on the miraculous and unknown. Today she sits at the table in her newly renovated kitchen in the apartment on Washington Square. In the 15 years since the haunting, she has become an accomplished photographer, and her smoky, evocative pictures line the walls.

Michaelen Maher shows Kathleen the infrared pictures that were taken in the hall. There is the inexplicable parabolic arc of fog with a detail that Maher has recently rediscovered. "Look at this dark spot," she says, pointing to a shadow that resembles the black circle and the white beard of the yin-yang symbol. "Why would this be here? What could have produced this strange effect at this one spot?"

"To me it looks like a face, a black face

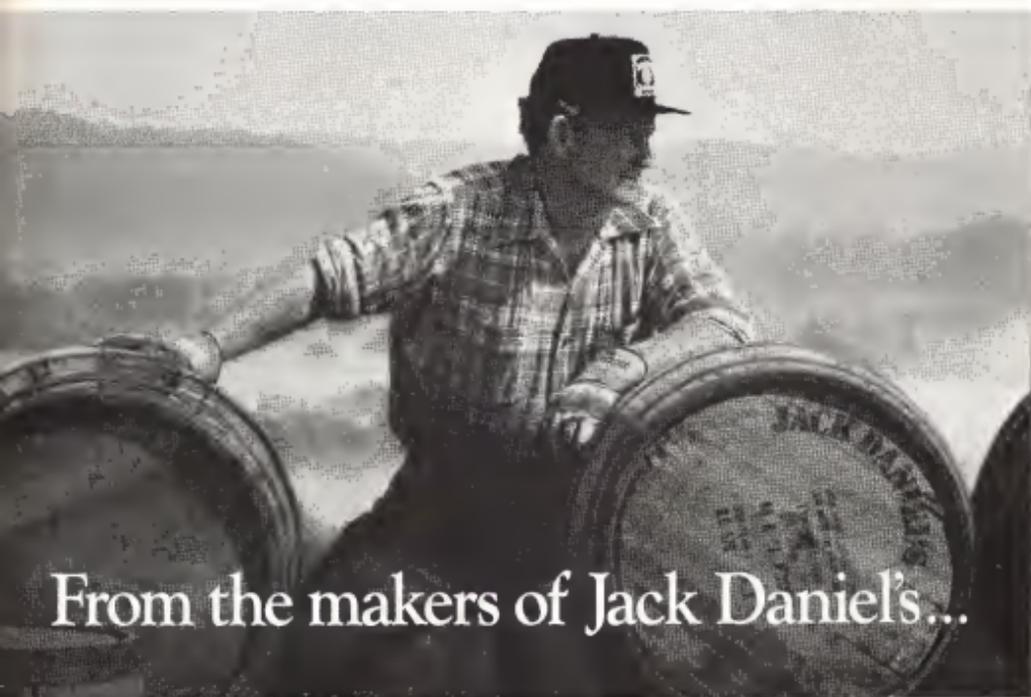
up close to the camera," says Kathleen. Maher slowly smiles, recalling that one of the psychics had reported the figure of a black person as well.

Kathleen and Maher then reenact the haunting, stopping in the pantry where the Geiger counter went off. Then Kathleen demonstrates how the ghost stooped and slowly glided down the long, curving hall, turning a corner midway. The tour ends at her late mother's room and the window that overlooks Washington Square Park.

Kathleen explains that certain historical fragments have helped illuminate the mystery, deepening it and giving it a human face. Directly across the street, for instance, is a massive old elm. According to a book she read recently, the last person to be hanged in New York City—a black woman who was a servant in one of the grand buildings lining the square—hung from that tree.

"Personally," Kathleen says, "I don't want to have an experience like that again. It opens up a world of forces and influences that science can't possibly understand."

Maher responds with a look of wonderment. She concedes a huge gulf between science and an experience this intense. "But I am a scientist," she says. "And I believe that one day, when we have much finer tools, we may be able to get hard physical evidence for these forces. Until then, we're searching in the dark." **DO**



From the makers of Jack Daniel's...

LETTERS HOME

CONTINUED FROM PAGE 61

except sit in the camp and wait for a helicopter. We have called [on the radio transmitter] the base camp repeatedly, and we get no information . . .

This morning I collected some giant plants that have insike leaves and put the bases on the fire in a pot of water. In a few moments we will have lunch—celerylike leaf bases and one-fifth can of tuna. I am keeping a list of all the things we are eating just for fun. I am going down to the creek to collect some orange berries that the birds are eating. The ornithologist had some this morning and is not dead yet, so at least we can try them.

Everyone is behaving very well, although I am having depressing dreams. Last night's were full of hostility and futility and must represent all the suppressed emotions I have. I suppose that it's a healthy way to handle the situation, but I wake up in the morning depressed . . .

1:00 PM

We are postponing eating the last can of tuna, probably for symbolic reasons—no one wants to admit that we are completely out of food . . .

I finished the book about running across the U.S. and right now it doesn't seem very relevant. He keeps talking about food all of the time, and it just made me hungry. Also, it is hard to read about someone doing the soul-searching aspect when you are worried about surviving. In a way, I chastise myself for being so concerned when we have only been three days on half rations and one day without food—it seems so overreactionary. However, it is the not knowing and the inability to do anything about it that really gets you . . .

22 Feb, 8:00 PM

We are still here. If I am writing funny it's because I am lying down in my sleeping bag listening to another storm blow in. It quit raining about five PM, and we got out the radio and called base camp. They said the mechanic and the pilot went back to Caracas for another part and should be back tomorrow or Friday to fix the helicopter. . . . Tonight we had a soup made of four tangers that the ornithologist caught and twelve plain hearts that the entomologist and I brought back. It was very weak, so we added some powdered milk and salt and hot sauce. It tasted funny, but it will keep our stomachs from growling until we go to sleep.

It's funny, when you are in this type of situation so many other things seem so trivial, and other things become very important. For instance, a lot of the things I worry about at work and at my apartment seem less important, and my friends and the people I love are more important. The problems I have had with my parents pale in comparison to the awareness that they

love me and have always just wanted me to be happy. I hope I can hold that until I see them again. . . .

23 Feb, 9:02 PM

Well, the helicopter was fixed and arrived at the base camp today at four-thirty PM. Unfortunately, the wind was too strong, and it could not get up the valley. It was really disappointing to hear on the radio that we would be here another night at least. I fear if we do not go down soon, one or more of us may come down with hypothermia. We had bird and palm heart soup again. . . . That was our only food today. It is surprising, but I am not thinking very much of food now. I am not nearly as hungry as I was when we were on half rations early in the week. Tomorrow will be five days since we have had a full meal. . . .

24 Feb, 2:33 PM

We had all counted on being down this morning. It was nice here with blue skies

◊The village
we had to walk through was
a horror
of filth. What it does to you
to see a
beautiful child rotting away
with leprosy.
She'll be dead by twenty.◊

but somewhat cloudy. On the radio they said it was cloudy in the valley. Now it's raining again and very cloudy. On the whole I am holding up well, but I have a couple of problems. I get very dizzy when I stand up, even slowly, and am getting cramps in my legs. As long as I sit down I am okay. We had our last full meal six days ago. I promise that if we ever get to eat together again that I will not leave food on my plate. . . . All of us have stomachaches, and Roy and Dick are very tired and listless. The entomologist raced after a butterfly and almost fainted. I did some collecting this morning but mostly easy stuff. . . .

It's 3:01, and we have three hours until dark, and then it's hunger for another night. Mercedes is really losing weight, and so is Roy. I don't think I am, but having worn the same clothes for nine days now it is really hard to tell. . . .

24 Feb, 7:41 PM

I am still here. The helicopter broke before it could pick us up. So we have no idea when (?) we will be picked up. We had soup again tonight—only we had two bricks instead of four. Tim and I outtan palm trees

and we added salt, oil, and hot sauce . . .

They just said [on the radio] that they would try for a food drop tomorrow, weather permitting. Also they said that the helicopter made it to San Carlos de Rio Negro and is being repaired. . . .

25 Feb, noon

No helicopter or food drop yet. But it is a beautiful day, and I am sitting on my favorite outcrop. Wait, I hear it—

2:30 PM

We are down safe & sound. Someone is leaving for New York, so off goes the letter
Love & Kisses,
Vicki

Although Vicki Funk and her companions escaped disaster, not all members of expeditions have. The Crocker Land expedition, for example, was an ill-fated effort launched in 1913 to find "Crocker Land," a large landmass or archipelago thought to lie near the North Pole. Explorers Fitzhugh Green and Donald MacMillan were determined to be the first to map Crocker Land, which was originally sighted by Admiral Robert E. Peary in 1905. What none of them realized, however, was that Crocker Land was a mirage, a large mass of Arctic ice that merely looked like land. In this letter to his mother and father, Green writes about the promise of the expedition and the allure of exploration. It was sent from Etah in northwestern Greenland, shortly before the expedition was to depart.

I leave two weeks from today, when the moon is up and increasing daylight permits traveling.

We cannot take tents and shall depend on the natives for our snow shelters. We are taking tea, biscuits, and pemmican [dried meat, berries, and nuts] for eighty days but do not expect to be back until June, depending on game for food later. . . .

I know you care not the snap of your fingers whether we find Crocker Land or not. I realize that I must come back to you. But even that cannot change the everlasting desire inside of me, the passion to travel, to fight the cold and the wind and the nights, to be hungry and kill game. Unless the Devil himself gets into my luck and lays me up with a frozen foot or the like, I am going to have the time of my life on that trip.

The hills are silent, there is no answer to my footsteps from the great white plains. I walk and walk! Cold? No! The thermometer says it is bitter cold, but the glass tube is a plaything of the south. . . . My hands are bare—from one dangles my mittens wet with sweat, in the other is my whip [for the dog sled] with which I clip little dents in the snow around me. . . . Over my head circles a great round moon, brighter than any you ever saw. Round and round she goes, rolling lazily along, underfoot the road is miles wide and leagues long, whiter than the whitest marble, it stretches away into the dreams to come. . . .

The same mirage that fooled Peary egged the expedition farther and farther out into the polar sea until they finally admitted they were following a chimera. On the way back, Green began to suffer from delusions; he thought his Eskimo guide was attempting to steal his sledge and shot him dead. But that was only the first tragedy. The ship that was sent to bring the expedition members back home was crushed by an ice pack, a second ship was sent, and the crew mutinied. It wasn't until five years later that a ship finally rescued the men and returned them to civilization.

Although few expeditions suffer the fate of the Crocker Land party, fieldwork is usually rough going in one way or another. Waldemar Johanson, for instance, who was hired by the American Museum of Natural History to study the remote tribes living in northeastern Siberia, stoically endured great hardships during his fieldwork (including being shadowed by spies of the czarist regime). Usually he related his escapades impressively in letters sent back to the museum. In this excerpt, though, written in 1902, he finally broke down and complained to Franz Boss, the man responsible for sending him on his expedition and one of the founding fathers of modern anthropology.

While among the Maritime Koryak, we lived most of the time in their underground

dwellings, which are reached by a ladder leading down through the smoke hole. It is almost impossible to describe the squalor of these dwellings. The smoke, which fills the hut, makes the eyes smart. It is particularly dense in the upper part of the hut, so that work that has to be done in an upright position becomes almost impossible. Walls, ladder, and household utensils are covered with a greasy soot, so that contact with them leaves shining black spots on hands and clothing. The dim light which falls through the smoke hole is hardly sufficient for writing and reading. The odor of blubber and refuse is almost intolerable, and the inmates, intoxicated with ly agaic, add to the discomfort of the situation. The natives are infested with lice. As long as we remained in these dwellings we could not escape these insects, which we dreaded far more than any of the privations of our journey.

Occasionally a letter written from the field reveals far more about the personality of the researcher than it does about his or her work. Take this letter from Margaret Mead written during her first field trip to the South Pacific archipelago of Samoa. Although Mead was only in her mid-twenties, her great desire to teach was as strong then as it was later in her life. This letter, like so many written during this time, is to her grandmother, Martha A. Mead.

Tau, Manua, Samoa, Sunday Nov. 14, 1925
Dear Grandma,

I've been trying desperately to get time to write you a real letter, but this is a twenty-four hour job. I succeeded in chasing the first comers away this evening with the announcement that I had to write letters and that it was the custom in America to write letters on Sunday. Anything which is the custom is binding, and I spend hours matching custom for custom with the old Tulafoles. The Tulafoles, though lower in rank than the chiefs, are the real power here—they are masters of ceremonies, depositaries of all the sacred lore—bankers, brokers, and political bosses. . . . But two chiefs of Samoa, the high chief of Sutaaga came to call, and I didn't dare send them away. This constant need to be endlessly affable, enthusiastic, gay is an awful strain, though they are really a most lovable people, and there are several small girls and one boy to whom I am already much attached. The one boy's name is Eto. . . . He says he's sixteen, and he's the least in rank but the best of the four school-teachers here. He has asked me to visit school tomorrow and give him some instruction. Poor youngster—he has pitifully little English, and he's trying to teach in English. But we have a compact now—he is to correct all my mistakes in Samoan, and I will correct all his in English. I am continuously trapped by my instinct to

To the drinkers of Jack Daniel's.

Our very own, very special recipe for sippin' Jack Daniel's in the summertime.

JACK DANIEL'S LYNCHBURG LEMONADE
 1 Part Jack Daniel's
 1 Part Sweet & Sour Mix
 1 Part Triple Sec
 4 Parts Sprite®
 Add ice and stir.
 Garnish with lemon slices and cherries.



© 1997 Jack Daniel's Inc. All rights reserved. Jack Daniel's is a registered trademark of Jack Daniel's Inc. Tennessee, USA. Jack Daniel's is a registered trademark of Jack Daniel's Inc. Tennessee, USA. Jack Daniel's is a registered trademark of Jack Daniel's Inc. Tennessee, USA.

teach. I really shouldn't stop to teach at all, it's not my business here, but the youngsters who want to learn are up against such frightful odds—I can't resist them. . . .

Dear little Grandmother, keep very well,
Margaret

Clyde Roper conducts his fieldwork in the oceans. A cephalopod expert at the Smithsonian Institution, Roper has spent much of his life studying squid in the farthest reaches of the earth—from Australia to Japan to Hawaii. Roper and a colleague discovered "counterillumination," a remarkable camouflage device used by squid. Like a number of other animals, squid are capable of bioluminescence—emitting light or glowing—but unlike other animals, they can do so at the exact level of background illumination, effectively rendering themselves invisible. Here Roper—in India, where he was gathering "ceph" specimens and data for a book on cephalopods used for food—writes to his wife, Ingrid, and their children.

Cochin, India, 29 January, 1979

I'm lying on my bed after a hot, then cold soak in the plastic ancient bathtub in the Grand Hotel. Remember the Grand Hotel in Taipei? Well, this ain't no relation!

The cab [they had to take to Cochin after their flight was canceled] was an "Ambassador," made in India and modeled after a 1956 Austin Minor. Driver was bent on self-destruction and everyone else in sight, including us. His brother calmly took shotgun. I can unequivocally state that never in my life have I spent such a harrowing five hours. . . . Insane, horn constantly screaming and constantly ignored, weaving in and out, missing kids, people, bikes, cars, buses, and trucks laden with copra, fish, etcetera, by millimeters, certainly not inches! Once, well after dark, we were screaming through a village, rounded a turn, and just by the thickness of one of his tail hairs, we missed a firsthand observation and examination of an elephant's large intestine! . . . As we roared around him, he (definitely a he) gave us one beady eye and went on sweeping the side of the street with the coconut palm frond sweeper held in his trunk. Honest.

With a broken spring incessantly hammering beneath me, and the seat having insidiously been stuffed with rocks, my backaches were pleading for a soft bed of nails before the trip was half over.

Bed felt pretty good! So here we were, over thirty-three hours late in getting to our first stop, having lost one and a half days of work, and next day was Sunday! You'd think I'd sleep till noon, right? Wrong! Blaring horns and reverberating motorcycles awakened me at seven. . . .

February 2nd, 0930

What a day yesterday. Up at five-thirty to go to the beach to watch the ancient beach seining fishery [in this type of fishing, very finely woven nets are used to pull

in entire schools of fish.] Magnificent beach—would have been fabulous to run, swim, and sun, except that it is home to these fishermen—and fishermen are among the poorest. Unbelievable wretchedness. Really have to watch your step—human feces everywhere. . . . We got some cephs and, of course, drew a huge crowd of spectators, as we always do! They're fascinated with the cameras and our close inspection of specimens and our interest in small inedible crustaceans and mollusks which they throw back or let die.

Yesterday afternoon we went to the Macras fish landing center, and that really about did us in. I won't describe the horrors we saw in detail—suffice it to say that the village we had to walk through was a horror of filth, rats, misery, poverty, hopelessness. What it does to see a beautiful child, though, filthy and dirty, rotting away with leprosy—hands and feet falling off. She'll be dead by twenty. . . .

☛ *The boy chases
after us, eyes aglow, cheeks
puffed in a
smile, waving a cow's scapula
at us, as he
yells, "Bone! Bone!" In some
odd way, he
knows why we are there.* ☛

While in Kenya in 1986, Richard Potts, a physical anthropologist at the Smithsonian, discovered a portion of a fossilized elephant bone sticking out of the ground. After excavating the site, Potts found that, in fact, it was not just an elephant he had uncovered but one that, if the stone tools surrounding it were any indication, had been slaughtered by our hominid ancestors 900,000 years ago. Last year Potts mounted an expedition and returned to the site to construct a gigantic fiberglass cast of the entire excavation for exhibition and scientific study. He also began observing the bone collecting habits of hyenas to better judge whether the broken bones surrounding the elephant were more likely the work of animals or early humans. He sent this letter to his girlfriend.

June 5 1987

The rift is alive. In the last two days the clouds have put together configurations that I might have conceived only if I put my full imagination to it. Sharp rainbows slanted curtains of distant rain, a laser beam of light escaping from a mass of clouds, lighting and shadowing the deep

wrinkles of an old mountainside, actually a volcano ten million years dead. And the sounds—the righter (class Aves) chirp-pounding like a jackhammer in the distance, the exploding drub, which I will tell you more about sometime, and tonight even a faint, slow, lonely, repugnant whoooooop of a hyena informing us (thankfully) that the vast distances still exist on this dark, dark night!

June 7

Yesterday was our first full day of work here. The excavators are now down to the burlap sacks tucked over and around the elephant. When an elephant dies, often its skin, impenetrable, deflates around the bones as the inner flesh disintegrates. That's what the burlap looks like, giving the elephant a death shape. John, Yin, and I look around for fossils and new sediments to interpret. Anne tried to track the morning hyena, searching for its den.

Besides the excavation of the elephant site, one of our projects this year is to excavate an unused part of a modern hyena den we found last year. Yesterday afternoon we found a bump-filled way to take our vehicle close to the den, to wait. Night fell, but no hyena visited. We will do this on a few other nights to try to glimpse whether spots or stripes cover the hyena, one of two different species. While waiting, we could all sense activity, the bush becoming animated as light faded to nil. We could see only a couple warthogs—primitive tusked creatures, too small and fierce to hassle—and a quick, darling hare. Perhaps it's the hominid imagination that helps to animate the nighttime bush, an alertness of ancient survival value, an ability to see and feel things where they are not yet—a source of cunning. . . . I feel "back" here. I know you know what I mean. . . .

August 17

There are children everywhere here. One is a small boy who we see each day as we travel along the lakeshore from the excavations back to camp. This boy chases after the vehicle, eyes aglow, cheeks puffed in a triumphant smile, and waving a cow's scapula at us, he yells, "Bone! Bone!" in some odd but laughable way, he knows why we are here. Every afternoon usually two dozen or more children come to watch the "bone hunters" and the "map-makers." . . . Our leave of Kanjera each day is eventful. It's to a chorus of "Bye Bye!" high-pitched screaming and squealing, and other incomprehensible ooh-sounding calls of "So long" (in the local Luo dialect). And then we undergo what Tom has dubbed running the gauntlet of waves. Scores of children waving, screaming with apparent, though inexplicable, delight, some stark-naked out of the lake, unabashed, to glimpse and wave at this unusual sight—A truck full of guys from Nairobi who have come to their neighborhood to dig holes in barren ground. . . .

Low, Rick ☛

CONTINUED FROM PAGE 21

we've wasted a lot of time

Omni: Because you used an innocuous bacterium to save a species driven to extinction by a fungus foreign to it, people were screaming at you?

Strobel: It's madness. I have hundreds of letters of support comparing the situation to the Luddites of the last century who destroyed factories during the industrial revolution in England. It's a similar reaction. There is even a historical similarity in that an era's just beginning. Biotechnology now is a new technology, but in another ten years just about any aspect of life—whether waste, disease, or nutrition—may be tackled with the tools of biotechnology.

Omni: How did you feel as everything was breaking loose around you?

Strobel: Depression and many other emotions such as I've never before experienced. And it could not be a private experience. The repercussions spread all the way from the MSU administration to the people I work with, to my supporter Dick Gray, to the agencies, to the MONTIS program, to my colleagues around the world. Yet I knew I was right, and I'd go to the wall for it. But I also saw I was in a dilemma. For decades I've promoted the development of science in Montana, and suddenly here I was as a potential cause of losing sup-

port. If faculty don't comply with federal regulations, the government can take funds away from the university. I felt terrible! It was a total twist of everything I've worked for, and it happened overnight.

Omni: How did your colleagues react then? There were statements in the press from scientists that seemed clearly distancing.

Strobel: There were a few in that category, but it was surprising how many were supportive, especially from corners of the country I wouldn't have expected. Ninety-nine percent of the letters from the public were supportive. On the other hand, many colleagues demurred from the whole thing.

But the drama and the emotions were a surprise. Look, we're not talking about giant corporations or private development here. We're talking about the most recognized plant disease in the country, a disease that affects elms, a plant that has about the same status as motherhood and apple pie. How could any environmentalist come down on my work when the other choices for the elm are so clear? Either you let the trees die or you spray them with the very pesticides the environmentalists are trying to get rid of. So here we have this nice, soft alternative of biological control. During the Senate hearing I said, "We need to encourage this kind of work rather than put it down." But in fact the USDA has introduced yet another set of rules this year. They will cause more damage and despair among scientists working in the field with

organisms than anything I know.

Omni: How did you deal with the pressure?
Strobel: I was inundated with phone calls, letters, people hanging around my house. My son, Scott, a doctoral candidate in biorganic chemistry at Caltech, was here writing editorials. I asked him if he would prepare evidence showing that the organism did not contain man-made recombinant DNA. It was a very close family experience, with help from everyone.

Last summer the local press was saying, Here's this twenty-five-year veteran going berserk. And for folks in this town—and anywhere, for that matter—the technology is not easy to comprehend. The MSU administration found itself in a peculiar position. They were generally quite supportive but couldn't be totally so because they had to show the EPA they were tough on those not adhering to regulations. The EPA itself was in a pickle. Here's this agency set up to protect the environment. They must have had to sit and think long and hard before they took action. The repayment they gave me was a gentle one.
Omni: Jeremy Rivkin complained that it was "less than a parking ticket."

Strobel: He did more than that. Every agency I've ever dealt with called and asked if I had any of their money in this project. It's a sorry state that one man—through his money, organization, and legal experience—can have so much influence against a technology that's so promising.

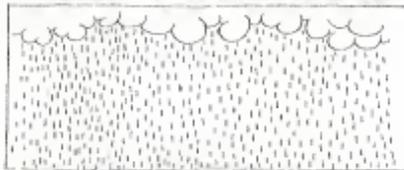
Omni: What was the hearing in front of the Senate like?

Strobel: I took a taxi to the Dirksen Building and asked the driver which entrance I should use. I said, I'm supposed to testify. He stared at me in his mirror and said, "Are you Ollie North?" The meeting was jammed. Val Giddings from the OTA [Office of Technology Assessment] got up and said that the public is ready to receive biotechnology, so let's get on with it. The next three were fellows from the EPA, the NIH, and the USDA. Each talked about his regulations. Well, anybody with the least bit of brains could see that no one can make headway through a maze of that garbage. Then Senator John Chafee from Rhode Island said, "I have Strobel's testimony here" and began reading it, starting where I'm talking about regulations, their complexities, and how I'm a voice in the wilderness. Then he points at the three agency men. "This makes a lot of sense to me. Now, tell me why it doesn't make sense to you." So the USDA fellow started to talk, and Chafee interrupted him and said, "I don't want process, I want substance!" The USDA fellow was reduced to monosyllables. Afterward I had the feeling that something is going to change, and it's not going to be tighter regulations, it's going to be clearer ones and fewer of them.

Omni: If the EPA can't handle a trickle of reviews involving relatively simple recombinant organisms, what's going to happen when there's a flood of proposals?

Strobel: A bottleneck is about to happen.

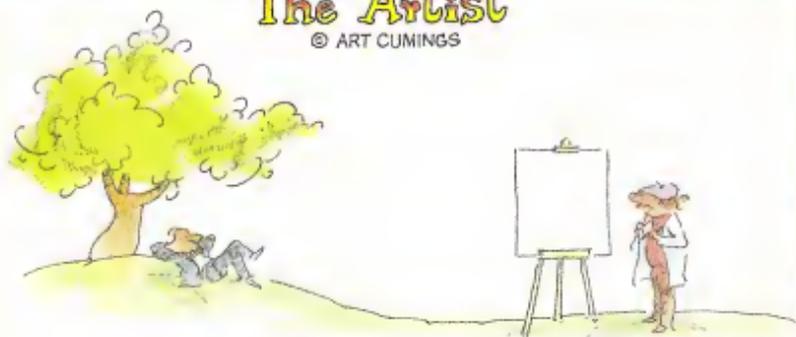
ACID RAIN HITS NEW YORK CITY



Art by [unclear]

The Artist

© ART CUMINGS



My wife's
been nagging me
for a portrait of herself—
Name your price!



Chaos. You can imagine all sorts of scenarios, like people saying to heck with the regulations. But they can't, really. Because if they're developing a product to go on the market, the agency can come back and say, Forget it, it's not cleared. Why are we wasting our time worrying about these nonexistent risks? An intermediate phase would best put more responsibility on local committees with expertise in the local environment. The local committee could put something on file with the Feds. Today's phenomenon has more to do with people building and maintaining their own bureaucracies. There are already many more people regulating modified organisms than there are modified organisms on the docks to be reviewed for release. There's only about two handfuls of organisms. Even if you line up a couple of technicians behind each organism, there are still more regulators than scientists!

Omniv: Well, there's also that horror-movie fear of virulent bugs.

Strobel: And Rifkin has capitalized on that. Many of these "science-related" movies think you must have death, blight, catastrophe in order to instill fear and be entertained. When you walk out of the theater, there's an imprint of fear. Then you pick up the newspaper, and some scientist is creating one of these "death organisms"! Someone in Hollywood should be challenged to make a movie depicting the real drama of a scientist.

Omniv: What about a dedicated plant pathologist trying to discover a cure for Dutch elm disease, when suddenly . . .

Strobel: It has already happened. Last January my wife Karen and I were sorting through correspondence and newspaper articles about the elm tree episode. By chance I turned on the TV to the *Macgyver* show. In this plot Macgyver recovers a probe bearing a vial of bacteria sent to outer space to be mutated. (These mutations can easily be done in a lab.) At any rate, the "space bacterium" is observed to be mutating at an ever-increasing rate. Macgyver's boss decides the organism should be destroyed, but the lady scientist who concocted the experiment is reluctant. The boss indicates that while she has a long, distinguished record of accomplishment, two years ago she did get into trouble with the authorities by releasing a bacterium for the control of Dutch elm disease without permission! The story ends with her mutant bacterium getting out of control, infecting her, and causing her to age prematurely to a state of death in five minutes. Absolutely absurd!

Omniv: Just a quiet night in front of the TV, right? Despite Macgyver, do these organisms require any review at all?

Strobel: Some review, of course, is important. But most can be done locally, especially when you plan to delete genes. Usually when deletions occur, the organism is wounded in some way and is not competitive in the environment. The only thing that's really dangerous is to move an organism



What did you do to deserve Beefeater?

BEEFEATER
MULTIPLE ENGLISH GIN

The best of times deserve the best of taste.

from one part of the planet to another. You can see it with the Dutch elm fungus, with the rabbits being introduced to Australia, with the *Phylloxera* grape insect that went from the United States to Europe and nearly eliminated the French grape and wine industry years ago.

But even introduction of new species has been more beneficial than detrimental. Around ninety-nine percent of this nation's cropland is planted with nonindigenous plants. The only indigenous ones, for example, are squashes, pumpkins, sunflowers, walnuts, a few wild berries—blue and black. All the major plants on which we're so dependent were brought from somewhere else: corn, tomatoes, rice, soybeans, potatoes, wheat, and barley. All the land you see lying between here and New York is planted with alien species. We talk about risk, and yet life itself is a risk. And as far as making new organisms is concerned, ultimately there may be a few risks, but the benefits are going to far outweigh them. Even if you make a new plant, I don't think there'll be a runaway sort of species. All we're talking about in most of these microbes or plants is putting in one or two new genes. That's not enough to confer ecological threat.

Omni: How did you first become interested in plant biology?

Strobel: I grew up in the heart of a steel town, Massillon, Ohio, just a half-dozen blocks from the railroad and the big mills—

Republic Steel, Union Drawn Steel. There was a coke plant and roller-bearing factories. Immigrant workers were still coming from all over Europe. I don't know whether it was from reading or just a sailing of my spirit into something more serene, but I knew I wanted something—a better world. From near my house I could see the Tuscarawas River on the other side of the tracks. It was so polluted that one year upstream in Barberton, paint fell off the houses. The river was dead. The air quality was so poor that breezes blew soot balls from the trains under our door. The factories had no concern whatsoever for the air. You could see the degradation of wildlife and its habitat. Somehow I felt compelled as an individual to change things.

One plan was to reforest parts of the state. Ohio is a coal belt state, and acres had been strip-mined. There were no laws for reclamation. A friend purchased some of this land for a pittance, and we proceeded to reforest it. I planted thirty to forty thousand trees when I was twelve to sixteen. I wrote articles and gave speeches, raised animals and had bird- and animal-feeding stations all around the countryside. I had my own network of conservation acreages set aside. I enlisted people in this service and convinced them to survey their land so they could better conserve soil. Every week I concocted some scheme. I was serious!

I still have a letter from my Ohio con-

gressman, in 1954, responding to my request that there be a federal agency created to oversee environmental activities. It's that very agency, the EPA, that was to come down on me thirty-three years later. I was probably one of the first in the country to say we've got to do something. I specifically outlined what we needed. And that's what we got! Ha-ha!

Omni: So your childhood projects grew into research networks, grants, and things?

Strobel: Yes, grants and things. Many, many grants over twenty-five years and an international network of people addressing some of the same interests. One colleague, Avi Nachman in Beersheba, Israel, and I are investigating agrobacterium and olive trees. One type, *Agrobacterium rhizogenes*, carries a plasmid that upon infection of a plant's root becomes integrated into the plant's genetic material. It soon causes the proliferation of small, functional secondary roots. So we thought if we used the plasmid of *A. rhizogenes*, we might supply added root growth into plants for agriculture, forest reclamation, and ground cover. We found dicots [two-seeded plants] were most beneficially affected—especially olive trees. It looks as if one can double the top growth of an olive plant over fifteen months. Experiments in collaboration with M. Hamani are also being done in North Africa. Pistachio, peach, and a number of vegetables like cabbage and tomato are also being tested in their reaction to *A. rhizogenes*.

Another important collaboration is going on deep in the Negev with ecologist Moshe Shachak of the Ben-Gurion Institute of the Desert. For more than ten years he has studied one rocky desert slope that gets only about an inch of rain annually. He has looked at the distribution of moisture on the hill. The upshot is that we found one can make minicatchments to trap what little water falls and then plant trees in them. He has lost very few trees, and his little forest is starting to grow where there's no evidence that there was ever much growth before. There's a potential for cultivating and places by improving water-use efficiency and by planting proper species.

Sue and Brenda Lam also succeeded in moving the *rhizogenes* hairy root plasmid into rhizobium. Rhizobium is another bacterium that, in its symbiotic relationship with roots, causes the formation of small nodules. These bumps are actually factories for nitrogen fixation, biological N_2 fertilization. With all this new DNA from the hairy root plasmid, we doubled the number of nodules on the alfalfa root. The subsequent result was a fifteen percent increase in nitrogen fixation. That we did in 1983. Nitrogen fixation is critical for replacing the fossil fertilizers we're now using to make nitrogen fertilizer.

I told the EPA, "Hey, I've done this before. This organism was made and field-tested before you made any of your rules!" If you were going to do that test today you'd have to go through great gobs of paper-



work and get it reviewed by them first. The *Agrobacterium rhizogenes* and the hairy root plasmid in rhizobium are both products of genetic manipulation. It's a tremendous discovery—a way of moving new genetic material into a plant.

Omniv: What are your long-term goals?

Strobel: They could be broadly classed as biotechnological goals. I don't feel happy when I see children starving, when I read about famines caused by man's inability to grow plants. That's the problem in Ethiopia, whether you say it's political or technological. Healthy plants are the key to the cleanliness of the environment, to the landscape, to human survival.

In agriculture there are three biological factors limiting productivity: insects, weeds, and pathogens. I decided to concentrate on pathogens. How do they produce the symptoms they do? Why is one plant of a species vulnerable and another not? One answer: Attacking organisms have their own biochemical factories that produce a flood of substances toxic to their target. One goal has been to isolate these toxic compounds and characterize them. We make crystals of these toxins, which we put into an X-ray diffractometer and find out how the carbons, oxygens, and nitrogens are arranged. Then we can find out what the toxin's action might be.

Previously, to screen a plant for susceptibility to a pathogen, one had to plant thousands of plants, then spray them with the toxin to see which ones didn't get sick. But by culturing a plant's protoplasts, or individual leaf cells, with the isolated toxin, one can see immediately which plant is susceptible. A researcher can utilize the resistant ones. Each leaf of a large-leafed plant may contain five million protoplasts, and in some plants each protoplast can be grown into a new plant.

Omniv: Weren't you among the first to use protoplasts to screen for resistant strains?

Strobel: Yes, with colleagues in Hawaii. Using sugarcane protoplasts we showed that the eyespot fungus attacking the cane makes a very selective toxin. Since 1970 sugarcane protoplasts have become a standard tool in screening for eyespot-disease resistance. Protoplasts have more variations than you could possibly imagine. Jim Shepard, an MSU colleague, broke down a potato leaf into individual protoplasts with enzymes. We saw that the new plants, grown from the protoplasts of a single leaf, didn't all resemble the mother plant. Some had flowers with two female sexual parts called pistils; some had leaves only a few centimeters, rather than inches, in size; others looked more like climbing ivy than potato plants. Shepard, Ulrich Matern—on leave from Freiburg University in West Germany—and I showed in 1978 that protoplasts contained genetic changes that we could take advantage of. This somoclonal variation, as it's now called, is being used today all over the world to develop variant strains in plants like banana, corn, and sunflower. And companies have

formed to utilize the principle of somoclonal variation. The potato was the first important crop to have been regenerated from these single-leaf protoplasts. By going through the protoplast of only one leaf, it's possible to get a disease-resistant plant from a normally susceptible leaf.

Omniv: Plant DNA seems plastic. Is it more changeable than the animal genome?

Strobel: Sometimes a plant may need more genetic options than an animal. Some plants have more DNA than any animal. Because plants don't move around, they have to cope with a much harsher set of environmental circumstances than most animals. They can't escape, can't position themselves in a protected site like a bear or a fly can. When the harsh wind comes, they can't move, except to bend with it.

Elm trees are a good example of this adaptability. Elms survive to about minus forty Fahrenheit, no problem. Absolutely pure water doesn't freeze until minus forty. Ice at thirty-two degrees is the result of

◊ I took a taxi to
the Dirksen Building and
asked the driver
which entrance I should use.
I said, "I'm to
testify." He stared at me in
the mirror and
said, "Are you Ollie North?"

crystallization centers growing around dust particles. If you look at elms with magnetic resonance imaging techniques, you'll find liquid water in those critters at minus thirty-five, thirty-eight.

The tree builds some unknown compound that blocks ice nucleation. The adaptation begins to occur in mid-June, and it's connected to day length. In September, say, there's one day when it's thirty-two degrees for a few hours. This brief exposure at thirty-two will set up the plant so that within a few hours it can be taken to minus forty without being damaged. But if it isn't exposed to thirty-two for a few hours first, it will die at the lower temperature. The change has to do with light and that small exposure to thirty-two degrees.

But in other ways plants aren't so plastic. Every week species are disappearing. Instead of destroying diversity, we have the potential to add to it with biotechnology. Monsanto has made a tobacco plant with several new genes conveying to that plant information that it never could have gotten under standard crossing or even somoclonal variation—a new gene for *Bacillus thuringiensis* toxin that kills the tobacco

hornworm. That gene originated in a bacterium. I say hooray! We're doing something that's not a threat but a marvel! And the government is putting restrictions on releasing such plants. It's stupid!

Omniv: Is there a secret life of plants?

Strobel: There is a sensitivity, certainly, to the environment. It might be a sensitivity to sound, to temperature to the chemical environment. That is the definition of a living organism. Whether there's a spiritual sensitivity, some would say there is. The Bible says there is.

Omniv: What will be the role of the plant biologist in the future?

Strobel: From looking at the details of photosynthesis to seeing the landscape as a whole. But the first priority is to supply food. As world population grows, the main food resource will be plants. Plant biologists will be responsible for maintaining croplands and healthy crops and for finding new ones. We use only ten or twenty plants to feed the world. There are thousands whose potential hasn't been explored, especially in tropical areas—fruits, legumes, grains that could be domesticated.

Second priority would be to supply plants that provide fiber and fuel and all the attendant technologies, such as seeing that the plants are free of pests, not competing with weeds. And another priority would be to create plants that are drought resistant and can survive periods of climatic change.

Omniv: Hasn't your career ridden the wave of new technology?

Strobel: Yes, and I'd like to think there are some little waves we've started ourselves. Somoclonal variation, the hairy root plasmid, phytotoxins, and toxin receptors. Industry has modeled and is testing some of our toxins as herbicides. Some also are being used in tissue culture selection and breeding programs. Twelve years ago we looked at rhizobia that have little flagella allowing them to move. If you were a rhizobium moving in the soil with the capacity to go anywhere, you'd pick a plant that makes only those substances that appeal to you. We isolated a number of compounds and demonstrated that they attracted the bacteria. So now there's a whole movement in different universities and government labs studying the chemotaxis of rhizobium. If we can ask the right biological questions and then apply this new, powerful biochemical technology, we can create waves.

Omniv: Are there any parallels between plant and animal biology?

Strobel: The first virus ever isolated and characterized was the tobacco mosaic virus. This discovery, by Wendell Stanley in the Thirties, was the beginning of all animal and human virology. In the Seventies Ted Diener of USDA described an agent called a viroid that causes diseases in potatoes such as the spindle tuber. It turns out to be a naked, infectious RNA. It has no protein coat. People are beginning to think that a number of animal and human diseases, in-

"THE DESIGNER"



The Third Dimension
in Modeling Systems

Crate Patterns • Models • Molds • Prototypes

Create three-dimensional "models" or "prototypes" out of any flat-plane material (card, paper, stained glass, cardboard, wood, metal, etc.) Put your ideas into production, by making liquid-to-solid production molds or prototypes (engry, wets, plaster, etc.)

"The Designer" allows you to track model's nominal wall thickness, surface area, cost, volume, weight, and much more.

The unique system includes all you need, including hardware, and even includes an instructional video showing you how to quickly and inexpensively create models or prototypes you can hold in your hands.

What you can create is "limited only by your imagination!" No other system in the world does this... for any price! You can buy "The Designer" system, complete, for only \$995.00* or \$429.95** (Introductory offer only). Please call us now toll-free (800) 227-9986 (9-5 PST***). VISA Mastercard, check or money order accepted. Allow 4 to 6 weeks for delivery. Make checks payable to: HYPERTRIG, INC. P.O. Box 2308, Santa Cruz CA 95003.

* Add \$35.00 shipping & handling. U.S. & Canada. California residents please add sales tax.

** In California please call (408) 438-9986.

Investor and Distributor inquiries accepted. Price scale only call R.E. Orlander at (408) 438-9986. COPYRIGHT © 1988 HYPERTRIG, INC.

RELAX IN MINUTES



NEUROPEP™ Uses light and sound pulses to create...

- Alpha-Theta states in which the brain is relaxed yet alert.
- A state in which the brain goes into asynchrony and harmony, producing endorphines.
- A true sensation of inner peace.
- Visual imagery and kaleidoscope patterns.
- Superior to \$8000 systems... **ONLY \$299.00**

ENDOMAX™ Retrains your brain to...

- Operate more efficiently
- Permanently increase levels of neurotransmitters linked with creative thinking... **ONLY \$799.00**

Many other brain machines are available!



Mega Dynamics
866 Huntley Dr.
Los Angeles, CA 90069
Phone: (213) 854-5959

Dealer inquiries welcome. Write or phone for additional information or return brochure. All Mega Dynamics products carry a 30-day unconditional money back guarantee. Call requests include 60% tax. All U.S. orders include \$4.95 postage and handling.

SPECTRA-



A SYMBOL OF THE TIMES

Staring Silver Pendant L.J. \$9.50

14K Gold \$ 135.00

CHECK OR MONEY ORDER TO:
KIJUTSU
P.O. Box 243
Paia, Maui, Hawaii 96779

(SHOWN ACTUAL SIZE)

RUSSIA WINS?



In a controlled scientific study* the technology used in our equipment was proven to be more effective than weight lifting for training or re-educating muscles. This technique pioneered by Russian scientists is now used throughout their winning Olympic athletic program with fantastic results. *Published in *Physiology* (March, 81, No. 3)

- 30 day money back guarantee
- 2 year warranty
- Free instructional video
- All with optional
- Multiple power supplies
- New improved design



- □ □ 12000 4 Pad Unit. \$249
- □ □ 14000 6 Pad Unit. \$475
- □ □ 16000 12 Pad Unit. \$775
- □ □ 18000 16 Pad Unit. \$975

Please add \$30 for shipping and handling.

Send check or money order to:
HEALTHTECH, INC #11207
3430 Glen Ave. N.W. Washington, DC 20008

1-800-333-8663 • Ft. Rancho, Spgs. EST. 1-800-473-4767 (4-line)
For more information call: (202) 362-0821

cluding multiple sclerosis, might be of similar etiology.

A field progresses with people, technology, and money. In the plant world in the United States we spend about one hundred and fifty million dollars annually for research. It's a pittance compared with its importance for agriculture, forestry, environment. It's not until there's a blight or drought and starvation that plant biology really attracts attention. Then governments throw money at it.

In the corn blight epidemic in 1970, for instance, millions immediately were made available for research. Plant biologists had thought the crop were secure. Although ninety-five percent of the country's corn was planted in a type called male sterile cytoplasm, there were differences in the corn nuclei from one area of the corn belt to another. They didn't suspect that the cytoplasm—the stuff surrounding the nucleus, which was all the same across species—could possibly be vulnerable. It was. We lost about twenty percent of the crop to that blight.

Omn: Will public concern about the greenhouse effect and the ozone hole enhance funding?

Strobel: Probably not until someone can say with certainty what the bottom line is—until people start to collapse or countries get ruined. I feel as if someone's ringing a bell. But its sound is so vague against the background noise in the everyday life of John Q. Public that I doubt he'll even hear it until the worst happens.

Omn: You've said science has to be fun. What do you mean?

Strobel: People talk about the scientific method, going in and setting up the experiment. But there's no experiment without intuition. And you cannot have that intuition without a free mind. You can go through the motions of science, the administration and other window dressing, but to do the good hard science means you have to be open to the inspiration that allows you to form the question. If you're working with a biological system, that means putting yourself in the place of the organisms involved. It certainly means being removed from the daily conflicts. You can't be encumbered with extra baggage.

Because of the MONTS program I interact with people in many disciplines. I can give you examples of family disasters that have obliterated a career, divorces or illness that have sapped a person's creative energy, scientists who have been inundated with sheer numbers of graduate students, conflicts within a department or on campus where people feel their jobs threatened. Nothing creative comes out.

People haven't looked carefully enough at what the secret of creativity is. I don't know how well the Russian system works, but they make communities, and there are advantages to having housing close by. In my case, I need to be on a fishing stream, on a ski hill, or in the glacier country on a trail to find inspiration. **DO**

COMB

Authorized Liquidator



JASON

40mm Objective Lens!

TABLETOP TELESCOPE 15x-45x Variable Zoom!

Crystal Clear Close-Ups are yours with this precision Jason Discovery Scope 1000. Actually a high quality refractor telescope for terrestrial use, it's ideal for skyline scanning, nature study, sporting events, target practice, or people watching. Fully portable, lightweight unit also makes a handsome office accessory. Buy this exciting closeout item today at our LOW liquidation price. Hurry, quantities are limited!

- Large 40mm Objective Lens
- Variable Zoom Focusing (15x to 45x)
- Adjustable, Lock-Into-Position Alt-Azimuth Adjustable Metal Tripod.
- Fully Coated Optics for Bright, Vivid Clarity and Superb Magnification.
- Field-Of-View at 1000 yds.: 8.1 ft. at 15x, 2.2 ft. at 45x
- Easy to Use. Just Point at Your Subject, Adjust and Focus.
- Takes You Four Times Beyond the Power of Hand-Hold Binoculars for Long-Range or Sustained Viewing.

Lifetime Ltd. Mfr.'s Warranty.

Mfr. List Price \$60.00
\$39
 Liquidation
 Priced At
 Item H-3794-7357-189 S/H: \$5.00 ea.

Credit card customers can order by phone, 24 hours a day, 7 days a week.
Toll-Free: 1-800-328-0609

SEND TO:

COMB Authorized Liquidator

1403 Junction Lane N/Messissippi, MN 55641-4484
 Send..... Jason Telescope(s) Item: H-3794-7357-189 at \$39 each, plus \$5.00 each for insured shipping, handling (Minnesota residents add 6% sales tax. Sorry, no C.O.D. orders).

My check or money order is enclosed (No delays in processing orders paid by check)

PLEASE CHECK

Acct. No. _____ Exp. _____

PLEASE PRINT CLEARLY

Name _____

Address _____ Apt. # _____

City _____ State _____

ZIP _____ Phone (____) _____

Sign Here _____

STARS

CONTINUED FROM PAGE 22

"closed"? Will its expansion continue forever (the "open" case)? Or will gravity eventually bring outward motion to a halt (the "closed" case), causing the universe to collapse back into itself? To find the answer, researchers need to know more about the distribution and density of mass in the universe.

"If you throw a stone up, it will eventually stop and fall back down to Earth," Yahf explains. "But if you send a rocket up from Cape Canaveral, it doesn't come back down, because it has 'escape velocity.' The question we're trying to answer is whether the universe has 'escape velocity' over itself." And the solution to this challenge all depends on the mass density of the universe, estimates for which vary widely.

Dressler believes much work has to be done before we have a precise measure of the universe's density. First "we have to determine whether the local region of the universe is characteristic of the whole universe," he explains. "We may learn the universe is open or closed here but different on the large scale."

Vera Rubin, who has been involved in the study of large scale motions since 1951, is also cautious. "I don't think these incredibly complicated questions will be answered in a few months or even a few years," she says. "Astronomers are still at the stage Columbus was before setting off to cross the Atlantic."

But one astronomer in the thick of this work believes he has already seen significant progress. "Things are moving intractably fast right now. We're in the middle of a scientific revolution," claims David Burstein, one of the samurais at Arizona State University in Tempe. "If you had talked to me a year ago, I would have given you a completely different story. The idea of a Great Attractor—let alone several great attractors—never would have come up."

CREDITS

Page 11 clockwise from top left, Jeff Sauer, J. M. Proulx, Michael James Meyer, Alex Lomonosov, Armand Avignone Institute for Interstellar Studies, New York, page 96, Dr. G. Scharf, San Diego State University, page 15, Tim Wolfe, page 20, Jessica Cohen, National Zoological Park Smithsonian Institution, page 22, Geoffrey Cheshire, page 26 top, Clay Buchholz, researchers, page 28 bottom, David Scharf, 1984-Park Animal, Inc., page 27 top, 40000 Face Systems, Inc./Nancy Burton, page 27 bottom, Richard Cropp/Steve Arvid, Inc., page 28 top, Steve St. Arches, page 28 bottom, Alisa Simmons/The Stockmarket, page 29 bottom, George F. W. Searles/Robertson-Roberts, page 30 bottom, Richard D. Woodhouse/Photo Researchers, page 30 bottom, William Gray, page 31 top, Martin Gardner/Photo Researchers, page 31 bottom, Texas A&M University, page 32, whole Milky Way/Photo Researchers, page 36, Sean H. Wain, pages 45 to 47, Institute for Interstellar Studies, New York, page 46 top left, American Museum of Natural History, page 46 top right, American Museum of Natural History, page 46 center, G. Harshbarger, page 46 bottom, American Museum of Natural History, page 49 bottom, Chicago Anthropology, page 73, bottom, page 74 top, The Smithsonian, page 74 bottom, David Wright/Photo Researchers, page 75 top, The Smithsonian Archive, page 75 bottom, Alan Morley, page 76, The Smithsonian Archive, page 100 top left, Steve Kragstad, page 101 top left, Dan Morley, page 101 left center, The Smithsonian, page 101 bottom, Steve Kragstad, page 101 right, Steve Kragstad, pages 102 to 103, Role and the Association

MEDITATION

The Psychic Bridge . . .



to the Inner Mind

Have you ever experienced a sense of fulfillment—seemed to be thwarted in your accomplishment? Have you ever struggled for a new vital idea or solution to a problem? **Behind your thinking mind** may lie the very answer or vision you need.

You have a tremendous reservoir of mental power waiting to be called forth. It lies just beyond your surface thoughts. True meditation is not idle random thinking—or mere concentration which ties the mind to fixed ideas. It is a **technique** that opens channels to the full power of mind and a realization of self. Every achievement—in anyone's life—began with meditation.

THIS FREE BOOK EXPLAINS

Meditation is neither strictly an oriental nor occidental practice or fantasy. It is a natural function of mind power. Let the Rosicrucians (not a religion), an international society of men and women devoted to the study of natural laws, explain this marvelous phenomenon of meditation to you. Write today for the free book, **The Mastery of Life**. It tells how you may use this technique for a fuller life. Write to: Scribe BNN

The ROSICRUCIANS
 (AMORC)
 San Jose, California 95191

Scribe BNN
The ROSICRUCIANS (AMORC)
 San Jose, California 95191

I am sincerely interested in the practical application of meditation and related natural laws. Please send me a free copy of THE MASTERY OF LIFE.

Name _____
 Address _____
 City _____ State _____ Zip _____

STARTECH

ACCESSING THE FUTURE



LOTTERY AID

Perfect for the truly lazy fortune hunter, this pocket-size random number generator from Lottronic Ltd. of Brentwood, New York, will save lottery addicts from having to think up their own number sequences. It costs \$24.95 and runs on two three-volt batteries.

—George Nebbs

STAIR CHAIR

The first stair-climbing wheelchair has been built by Quest Technologies Corporation of Sunnyvale, California. Sensor measures the angle of the stairs, and then the chair wheels give way to a set of tank-style treads that can negotiate stairs of angles up to 36°. The price is \$12,500.

—Bill Lawren





COWS IN HEAT

University of Arizona's Frank Wierma has invented an electronic ankle strap that detects when cows come into heat. Cows in heat get fidgety, and Wierma's strap, which counts leg movements, will alert herdsmen by activating a red light when time and cow are ripe. Available soon from Dairy Equipment Company located in Madison, Wisconsin.

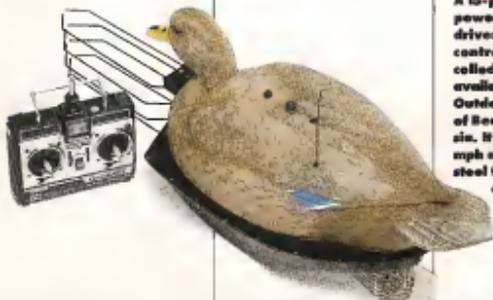
—George Nohke



HELTER SHELTER

Inventor Constant V. David of San Diego wants to license his patented design for a 1,000-person nuclear war survival structure. The design includes two steel skins separated by six to ten inches of foam padding, a blast-and-wall security perimeter, and diesel electricity generators.

—George Nohke



MOUTHGUARD

Anthony Oliver has invented the OliverShield: a mouthpiece-shaped paper guard coated with Mylar and backed by a peel-off adhesive. Stuck on a phony mouthpiece, it stops bacteria and viruses in their tracks. It comes in \$8 packets of 100 from OliverShield of Cambridge, Massachusetts.—Bill Lawrence

ROBO-DUCK

A 15-pound, battery-powered, propeller-driven, electronically controlled robot decoy called Robo-Duck is available for \$1,250 from Outdoorsman Herter's of Beaver Dam, Wisconsin. It can cruise at 10 mph and has 20-inch steel fingers to retrieve downed waterfowl.

—George Nohke

Brains versus brawn: Using your head to outperform superior athletes

GAMES

By Scot Morris

To save money, eighteenth-century English lexicographer and author Samuel Johnson and his student David Garrick hired only one horse and used the so-called ride and tie technique. While Garrick followed on foot, Johnson rode the horse a certain distance, then tied it to a tree and began walking. When Garrick arrived at the tree, he mounted the horse and rode past Johnson. After a while, he dismounted, tied the horse to another tree, and walked ahead. Johnson then reached the tree and mounted the horse again. They repeated this leaptrogging all the way to London.

The ride and tie method of transportation scheduling has been around for ages, used even in Colonial America and the Old West. In 1971, Bud Johns, then vice president for corporate communications at Levi Strauss and Company, rescued ride and tie from the dustbin of historical curiosities. Drawing up rules, he developed a 40-mile-long relay race involving teams, each consisting of two people and one horse. The object is to get all three team members across the finish line in as little time as possible.

The first race, sponsored by Levi's (as were the next 16 annual championships), attracted 67 teams—134 people and 67 horses. According to Johns, there are now about 350 races a year in the United States, Canada, Switzerland, West Germany, and Australia. Contestants have ranged from a ten-year-old boy to a sixty-four-year-old man,

and roughly one third of all racers are women. This year approximately 125 teams entered the Eighteenth Annual National Ride and Tie Championship, held on June 19 in Alturas, California.

The attraction of Ride and Tie is, in part, the complex strategy required. "It's a thinking athlete's race, involving so many variables it makes chess seem like tic-tac-toe," says Duke University professor of economics Peter Klopfar, who has competed in mixed-doubles races with his wife, Martha.

"I've beaten guys who are much better runners and horsemen than I am," says three-time Ride and Tie champion Ken Williams, an economics professor at Chabot College in Hayward, California. "Strategy is what wins. You have to optimize the performance of each team member (including the horse), balance their abilities to best effect, and be able to revise your plans on the spur of the moment."

The need for good planning makes Ride and Tie one of the most cerebral sports ever invented. For example, team members should arrive at the finish line at the same time. If either partner has to wait for the other, they could have had a better strategy, an additional switch along the line could have kept them closer together and given them a better finishing time.

If partners change often, the runner can spring at his fastest rate over a shorter distance. He can then catch his breath while riding the horse. There is, however, a



point of diminishing returns. The seconds you gain by running shorter distances don't make up for the time you lose by stopping, tying or untieing the horse, and accelerating. During a race, some teams will switch only six times—the minimum number required by the rules. Others, however, will switch as often as 100 times.

Ride and Tie rules prohibit the two human team mem-



bers from riding the horse at the same time. Exhausting the horse, moreover, can result in the team's disqualification. There are also "vet checks"—similar to pit stops in car racing—at three or four points along the course, where the horse is thoroughly examined by veterinarians. They measure the horse's pulse and respiration and won't allow the animal back on the course until its vital signs are at safe levels.

Another factor to consider is the amount of time the horseman should continue riding after passing the runner. To determine this, Ted Ruprecht, professor of economics at Humboldt State University in Arcata, California, relies on the formula $T = R - [(S - s) - 1]$. T is the riding time before dismounting, R is the length



of the horse's rest period; S is the rider's speed; and s is the runner's speed.

Williams is skeptical that any such formula will work, because of all the interacting variables. On flat terrain, for example, a horse can run almost 60 percent faster than a human. On hills, however, the difference between a horse's and a human's speed is less.

Williams uses a computer to devise his strategies. It tells him how many exchanges to make, what part of the course each partner should run, how they should pace themselves, and how much rest the horse will need. "But so many things can go wrong during a race," Williams says.

"Suppose, for example, you plan to leave the horse at a certain point, tying it to a



tree. When you get there, you may find all the trees already have horses tied to them and you know you can't tie more than one horse to any one tree. You may have to ride another half mile or so before you find a usable tree, which completely disrupts your finely tuned plan."

VARIATIONS ON A BIKE

As an exercise in computer modeling and decision making, Harvard Business School students have analyzed a six-mile Ride and Tie race with a team of two humans and a bicycle.

One student analyzed how long it takes to come to a full stop and to achieve top speed. If it takes seven seconds, for example, the optimum number of changeovers might be only seven during the entire race. With a

four-second exchange, partners should change 12 times. If they can get it down to two seconds, 23 switches would be most efficient. The shorter the distance between changes, the faster the runner can run and with less fatigue.

Another student considered the frequent problem of partners with unequal ability. If A is a better runner than B, what percentage of the race should A run for the greatest advantage? According to the computer, if B runs at 85 percent of A's speed, for example, then A should run 69 percent of his race time and cycle 31 percent; and B should run 56 percent of his race time, cycling the other 44 percent.

Participants in real-life biking Ride and Tie are some of the same people who

are interested in other multi-discipline sports, like the triathlon. In a recent event along a 13-mile canyon trail near San Diego, the winners happened to be Scott Tinley, two-time winner of Hawaii's Ironman triathlon, and Jay Larson, a top triathlete who has run the 5K race in 14 minutes and 32 seconds.

Ride and Tie with horses is still the bigger sport, however. In fact, these players will be able to compare their skills with ordinary horse riders in Davenport, California, on August 20. For the first time the annual 100-mile horse race, which now attracts about 60 riders, will include Ride and Tie teams. There may also be some ultramarathoners running the entire race, offering a unique opportunity to compare the two oldest forms of transportation.

Anyone interested should contact the Ride and Tie Association's race director, Barbara McGrary, 330 Swanton Road, Davenport, CA 95017. Telephone: (408) 423-4572. For general information about Ride and Tie, write to the Ride and Tie Association at Box 1193, Manhattan Beach, CA 90266. Telephone: (213) 546 3781.

RETURN OF THE SINOSIGN

David Moser's sinosign is shown above, right side up, as it should have appeared in June's column on ambigrams. Beside it are the characters that inspired Moser. A quarter turn to the right translates his highly stylized version into its English equivalent CHINA. □□



LAST WORD

By Steve Nadis

● *Owing to a rash of fad diet schemes, the problem of missing mass had reached epic proportions. At the center of the crisis was lab-show host Richard Simmons, but who'd pinched the missing mass?* ●

I was busy rearranging my sock drawer when I got a call from the agency. "Where's the assignment, Chief?" I asked.

The gunshow at the other end replied, "Harvard School of Cosmology."

I dragged my fat body off to Harvard Square. By the time I reached the school, a riot had broken out. (Of course, a riot at Harvard is just more than one person publicizing at the same time.)

These were the facts: Owing to a rash of fad diet schemes, the problem of missing mass had reached epic proportions. At the center of the crisis was TV lab-show host Richard Simmons, whose "Deal-a-Meal" scam had caused half a million people to lose up to 100 pounds each. That's a lot of missing mass.

The question nobody wanted to face was who had pinched the missing mass, quizzed the eminent Dr. Herholz, M.D., Ph.D., Sc.D., Q.E.D., ipso facto.

"We used to believe in mass—energy equivalence," he said. "But that was a different era, long before the advent of high-intensity and sugar-free Kool-Aid." All of a sudden it came back to me. "One bowl of All-Bran has less calories than ten bowls of Product 19." Of course it, the quacks in Beta Creek mistakenly upped the fiber ants, we could eat until the cows came home and still lose weight. "Doc," I said, "What's the bottom line?"

"I finally got the story if we don't finger the mass soon, it could dean the difference between an 'open' and a 'closed' universe. The gravitational field would weaken, meaning that stars, quasars, iron stands, everything would fly farther and farther apart until we all rise to doom."

My prime suspect was an old burlesque artist from Glasgow—alias Maxwell's Demon. Years ago I'd sent him up for a long stretch for violating the second law of thermodynamics. Now he was back on the streets.

Time was running out. I had a lot of questions but few answers. Like, what caused the Big Bang, and was it related to the Big Sleep? The only thing we knew for sure was that the corpses were piling up fast. Dr. Pitkin was dead. Adelle Deane was dead. And if you believed the rumors, Simmons himself had been bumped off and replaced by a windup toy. It didn't get soon, every death from here to Kalamazoo would be flooding down the Chattahoochee.

I sent my stinger Dick Foley to track down the Demon while I headed to Elsie's to track down some lunch. If I'd learned one thing during my 20-odd years with the agency it was this: Never chase a weight lifter on an empty stomach.

I had just finished eating my Kitchen-sink Special when a shadow descended on my potato knish. It was Foley. "Here's over at Charlie's," he bursted.

"I know the dive," Relax. "I told the kid 'I'll get to the Demon and the universe's missing mass.' But first things first, I still had an egg cream waiting for me.

The other thing I had learned during my stint with the agency was that I never, boys to eat and run. If I get indigestion, I pay less than usual attention to the dictates of gentility. I finished eating slowly and then studied for the hash house.

Charlie had the usual crowd of lowlives. Trust to form, the Demon was eating there watching the CBS take-out with the Sixers on the big screen. On his lap was a moug named Drish Blue. She flamed me a look that could ignite TNT. We'd tangled before in Louisville, but relations had been strained ever since I gave her a one-way ticket to the fat farm.

"Ginny," the Demon said, "meet the nicest dick in Beartown."

I snapped back, "Can the crap, Demon. Where'd you slash the mass?"

"Where's the beef?" he sniped. "What if some housewife lost a few inches?"

He was trying my patience. "That's a sham, and you know it. Even if some wastrel's are shrinking, the universe as a whole is expanding. It's called the second law, in case you've forgotten."

The Demon doesn't like having his memory jogged in public. "Never heard of it," he said, throwing a pitcher full of spit over my face.

Concerned, I inquired, "Demon, don't tell me you're into this diet stuff, too."

"Who drives it?" he asked, smacking the probe over my head. I had the feeling this snarl tale wasn't getting us anywhere.

I buried my fist in the middle of his belly. That felt pretty good, so I hit it again. Every time I hit it, it got a little bit softer. I hit it often.

"Wait," he cried. "I'll talk."

"Don't plead entrapry. We heard it before." Next thing you know I got a screaming maniac of a woman clawing at my back. "Forget it, boy," I said, losing Blue inside. "At this stage in my life, I can't get involved with anyone."

We took the Demon downtown for a little chat. After a few minutes under the big lights he was talking his head off.

Sure enough, the missing mass was where he said it was—waggled in Weight Watchers conferences it, a warehouse on Commercial Street. I had the blabber paroled in chains and called off to the Harvard School of Cosmology. Herholz was ecstatic. "I'll recommend you to the National Academy, my friend."

"Save it, Doc, I'd rather hold out for those MacArthur boys." I dragged my bulk to the non-controlled flat on Hampshire Street. With the missing mass returned, it looked like the universe was closed, at least for another night. To play it safe, I scarfed a bowl of Oreo's and washed them down with a quart of warm buttermilk. I gave myself a few minutes to digest. Then I got back to the sock drawer.

When he's not watching Mike Hammer and *Cosmos* reruns, Steve Nadis works for the Continental Detective Agency in Cambridge, Massachusetts. **DD**