02454

OMNI

MARCH 1981 $2.00

MUSIC FOR THE 21ST CENTURY · PROGRAMS FOR PLUNDER: COMPUTER CRIME TAKES OFF · FLOATING CITIES, INTERCONTINENTAL SUBWAYS, AND GIANT AIRSHIPS · SEX ROLES: PRESENT AT THE CREATION · CAR WARS BY ROGER ZELAZNY

0 778845

Austria 54 S Belgium 87 FF Denmark 20.00 DKr Finland 11.90 FM France 15.00 F.F Germany E 00 DM Greece 160 Dr Holland 7.50 Fl Italy 2900 L Japan 980 Y

OMNI

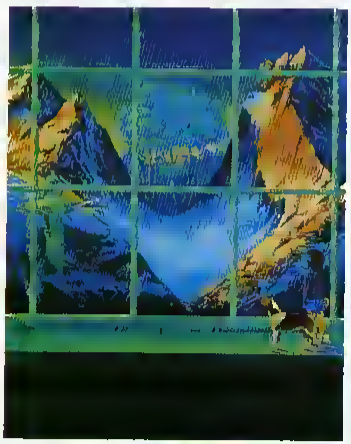
MARCH 1981

EDITOR & DESIGN DIRECTOR: BOB GUCCIONE

PRESIDENT & ASSOCIATE PUBLISHER: KATHY KEETON
EXECUTIVE EDITOR: BEN BOVA
ART DIRECTOR: FRANK DEVINO
MANAGING EDITOR: J. ANDERSON DORMAN
FICTION EDITOR: ROBERT SHECKLEY
EUROPEAN EDITOR: DR. BERNARD DIXON
DIRECTOR OF ADVERTISING: BEVERLEY WARDALE

EXECUTIVE VICE-PRESIDENT: IRWIN E. BILLMAN
SENIOR VICE PRESIDENT: MARIANNE HOWATSON
ASSOCIATE PUBLISHER (INT'L): FRANCO ROSSELLINI

CONTENTS



The dreamlike realization of a child's world view provides this month's cover painting, by Japanese artist Sadao Naito. A surrealist, Naito has illustrated many publications, including Tokyo's daily newspaper Asahi. He has won numerous awards for his commercial work.

OMNI, 1981 (ISSN 0149-0711), U.S. Volume 3, Number 6. Copyright © 1981 by Omni Publications International Ltd. All rights reserved. Published monthly in the United States and in Canada by Omni Publications International Ltd., 909 Third Avenue, New York, N.Y. 10022. Tel: (212) 593-3301. Printed in the U.S.A. by Meredith Printing Corp. and distributed in the U.S.A., Canada, U.S. territorial possessions, and the world (except the U.K.) by Curtis Circulation Company, 21 Henderson Drive, West Caldwell, N.J. 07006. Distributed in the U.K. by SM Distribution Ltd., 16–18 Trinity Gardens, London SW9, England. Entire contents copyrighted. Nothing may be reproduced in whole or in part without written permission from the publishers. Any similarity between places or persons mentioned in the fiction or semi-fiction and real places or persons living or dead is coincidental. Subscriptions: U.S., APO: $18.00 one year. Canada and elsewhere—$24.00 one year. Single copies $2.00 in U.S., APO; $2.25 in Canada. Address changes to Omni Magazine, P.O. Box 908, Farmingdale, N.Y. 11735. Postmaster: Send form 3579 to Farmingdale address. Tel: (516) 420-1994. Controlled circulation postage paid at Des Moines, Iowa. Publisher disclaims all responsibility to return unsolicited editorial matter, and all rights in portions published thereof remain the sole property of Omni Publications International Ltd. Letters to Omni or its editors become the property of the magazine and are assumed intended for publication in whole or in part and may therefore be used for such purposes.

FIRST WORD

By Akio Morita

"The most important concern in modern industry is to get these countless numbers working together without further wasted effort."

The ability to think of something that has not been known before is creativity. This is an ability that is unique to man. No matter how much a computer may be developed to accumulate knowledge and no matter how great its capacity may be for processing the information, it cannot have the ability to be creative. The leap, which is necessary in creative thinking or invention, might be described as giving birth to a new concept beyond a system of theory already known or discovering a concept that breaks through the walls surrounding the existing theory. This is true creation.

We live in a different age from the Renaissance when a creative genius like Leonardo da Vinci appeared, in which one man's creativity elevated the entire level of science and scholarship or produced innovative changes in the structure of society or generated a major new industry.

Today however it has become possible to stimulate many persons to be creative by providing them with a goal in a broad sense. Although it has become very unlikely that one person will create a scholastic discipline or revolutionize an industry, it has now become possible to obtain collaboration from all corners of the globe which neither Newton nor Edison could ever have obtained. Present-day society, with its complex network of information channels, provides cooperation among many disciplines. This leads to innovation that coordinates many specialized fields of knowledge in a way that no single genius could ever have covered in preceding eras. These days major breakthroughs in industry are done by many in teamwork.

We are living in an age of innovation. We constantly see improvement and changes in every aspect of our lives. These may be said to have been brought about by the exercising of man's creativity in its broadest sense. The question is: How can such creativity be generated? Two factors suggest themselves as generators of creativity. These two factors are (1) the clear establishment of goals and (2) the provision of outside stimulation.

Although great inventions or discoveries of a high level are likely to appear suddenly without incentives supplied from the outside, it is often possible to motivate technologists to become creative by providing such outside influences as a specific goal or stimulation. The great goal of sending men to the moon was established, and as analyses were conducted to determine what needed to be accomplished, many specific objectives became clear. As each one of the specific objectives was further analyzed, the potential for new creativity was revealed. It may be said that in most cases in modern industry this is the process by which the creative quality of man is brought out.

In the case of outside stimulation, we can see many examples. One form of this is learning of other creative results, which happens very often in an industry that operates under the principles of free competition: very often the knowledge that a competitor has come out with a new product is enough to stimulate a different idea and produce a new product that serves the same purpose better.

An invention or discovery no matter how good will not become an industry until it is made into a product of excellent feasibility. A newly developed item produced through creativity will not lead to a new industry unless excellent manufacturing technology accompanies the effort. This is extremely important to industry and may be considered the difference between industry and academic science. Creativity in industry to be brought to fruition requires the development of the necessary technology in the production process.

And yet a good product that is successfully produced might still disappear. The newer and more innovative a product is, the more likely it is that the public might not appreciate it at the beginning. In 1950 our company marketed a tape recorder. Despite the fact that it was a great achievement and a technological innovation for us, at the time it looked like a toy to the general public. Nobody thought about recording speeches or using a tape recorder to learn languages. I believe that in the case of an entirely new product, a market must be created, not surveyed. Another way to say this is that a new product is the creator of a market, and a new product cannot survive without the creation of a new market.

Good collaboration and communication are needed over a very wide range of countless numbers of persons. Perhaps it can be said that the most important matter in modern industry is to get such countless numbers of persons working together in one direction without wasted effort. To bring it to collaboration many persons in this way is the function and responsibility of management.

In modern industry a strong management force is necessary that follows through with consistent philosophy from the stage of scientific research to the stage of production and marketing. Among the enterprises around the world the ones with this capacity are the ones that bring to maximum fruition the ability of man to create. They are the ones that continue to grow.

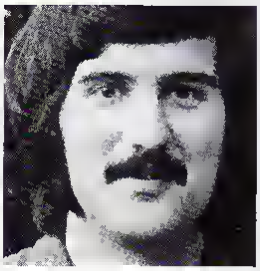
Thus we see that in this age of collaboration modern industry can draw from man's creativity far greater fruits for his well-being than ever before in history. This transcends barriers of nation, race or creed. In its best form this flowering of creativity is mankind's greatest hope.

"Creativity in Modern Industry," by Akio Morita. From the book Frontiers of Knowledge *copyright © 1973, 1974, 1975, by Doubleday & Co., Inc. Mr. Morita is chairman and chief executive officer of Sony Corporation.*

CONTRIBUTORS

OMNIBUS


SPEIGEL


RAPOPORT


GARR


ZELAZNY

Imagine floating cities twice the size of Manhattan. Think of a subway from New York City (or even Paris) to Los Angeles. In "Macro," *Dan Ross* and *Arthur J. Maher* tell us what it's like to think big. Macroengineering means more than just erecting new colossal structures. It's a way to improve our planet and our lives. MIT professor of engineering Frank P. Davidson, the world's leading expert on macroengineering's far-reaching possibilities, says, "The Reagan Administration has an opportunity to make a new start in marshaling the country's resources behind a sensible and sustained program of macroengineering." See page 90 to learn how macroengineering offers the world a new basis for international cooperation.

The future of music is examined by writer *Doug Garr* in "The Endless Scale" (page 44). It's a look at how young composers are using computers to expand our concept of music. Garr's belief that home computers someday will become "tools for living" prompted his interest in computerized art. "Young composers will change the way we hear, think about, and compose music in years to come," he says. "It will be a new aural awareness, a rebirth of sound." Garr has written for many publications, including the *New York Times*, *Family Circle*, *Cue* and *People*.

Can science and humor coexist? University of Michigan psychologist James V. McConnell ought to know. Founder and publisher of the outrageous *Worm Runner's Digest* and author of one of the world's best-selling college psychology textbooks, *Understanding Human Behavior*, McConnell thinks humor is a great equalizer in the world of science. *Omni* associate editor *Kathleen Stein* visited McConnell to find out whether this man is a Pavlovian fantasy out of Thomas Pynchon's *Gravity's Rainbow* or just another Steve Martin. To understand more about a scientist who is not afraid of fun, read "King of the Worm Runners" beginning on page 58.

UFO zealots and doubters sat down at the same table for the first time at a recent symposium in the Baird Auditorium at the Smithsonian Institution's Museum of Natural History. Leading the panel in this unprecedented debate was Frederick C. Durant III, formerly special assistant to the director of the National Air and Space Museum and a frequent contributor to this magazine. *E. Lee Speigel* and *Karen Ehrlich* report what happened, on page 140. Previously a science consultant for WNBC, Speigel is host and producer of *Unexplained Phenomena*, an NBC-radio feature program presented weekdays. Ehrlich is a New York hypnotherapist and coauthor of *UFOs: The Credibility Factor*.

This month's fiction highlights Hugo Award winners *Roger Zelazny* ("Last of the Wild Ones," page 52) and *Spider Robinson* ("Serpents' Teeth," page 66). Zelazny, an SF writer for nearly 20 years, has published 25 books and has received several awards that are given only to great SF writers. Last December Pocket Books published *The Last Defender of Camelot*, Zelazny's first collection of short stories. Robinson, another master whose work is often seen in *Omni*, is now completing his seventh book, *Mindkiller*. His third collection of short stories, *Time Travelers Strictly Cash*, has just been released.

Despite feminist propaganda, men will be men and women will be happy. This is the view of *Donald Symons*, a University of California anthropologist. For a macho examination of human sexuality, see Claire Warga's interview (page 94). A research psychologist and radio journalist, Warga is a frequent contributor to popular science magazines. She has interviewed many leading scientists on her radio programs originating from Lugano, Switzerland, and Woodstock, New York.

Electronic thievery is ubiquitous. Why? In "Programs for Plunder" (page 72), *Roger Rapoport* writes about some of the most successful light-fingered criminals. He tells how they got started and what happened to them. Rapoport, who knows a lot of computer criminals, says, "Some of them can't wait to get caught. They are the only breed of criminals who like to tell all." The author, whose popular piece "Unbreakable Code" appeared in our September 1980 issue, foresees computer crime rising until an effective graphic system, as described in "Unbreakable Code," becomes widely available at low cost. Discover how the computer revolution is becoming an invitation to steal. ∞

OMNI

BOB GUCCIONE
editor & publisher
KATHY KEETON
associate publisher
OMNI PUBLICATIONS INTERNATIONAL LTD

THE CORPORATION
Bob Guccione (*chairman of the board*)
Kathy Keeton (*president*)
Irwin E. Billman (*executive vice-president*)
Anthony J. Guccione (*secretary-treasurer*)
Marianne Howatson (*senior vice-president*)
Benson Saler (*chief financial officer*)

EDITORIAL
Editor in Chief: Bob Guccione *Executive Editor:* Ellen Boyle *Managing Editor:* J. Anderson Doming *Senior Editors:* Dick Teresi, Scott Morris, Owen Davies *Fiction Editor:* Robert Sheckley *Humor Editor:* Bill Lee *European Editor:* Dr. Bernard Dixon *Associate Editors:* Ellen Datlow, Michael Edelhart, Kathleen McAuliffe, Kathleen Stein, Alex Wagner *Assistant Managing Editor:* Paul Hitts *Pictorial Editor:* Robert Malone *Assistant Editors:* Geoffrey Golson, Marc Kaplan *Copy Chief:* Robert Boylan *Copy Editors:* Charles J. Attardi, Brian McKernan, *Editorial Assistants:* Susan Caputo, Leslie Epstein, Jayne Gassman, Francesca Lunzer, *Contributing Editors:* Stuart Diamond, Dr. Patrick Moore

ART
Art Director: Frank DeVino, *Assistant Art Directors:* Margaret Richichi, Elizabeth Woodson *Photo Editor:* Hildegard Kron *Assistant Photo Editor:* Lisa Shapiro *Staff Photographer:* Pat Hill *Art Assistant:* Patricia Lubin

ADMINISTRATIVE
VP/Director of Advertising: Beverley Wardale *VP/Administrative Services:* Jen Winston, *VP/Production Director:* John Evans *Midwest Advertising Mgr.:* Norm Kamikow *Southern Advertising Director:* Peter Goldsmith *Western Advertising Director:* John Romein *Controller:* Marc Bendesky *Director of Marketing and Distribution/Publications:* George Colesworthy *Nat'l Marketing Mgr.:* Ralph Portichelli *Nat'l Sales Operation Mgr.:* Richard Fogel *Director of Newsstand Sales:* Robert Castardi *Newsstand Distribution Mgr.:* Vincent DeLisi *Liquor Sales Mgr.:* Paula Fierman *Dir. of Pub. Rel.:* Ted Hannah *Advertising Prod. Dir.:* Toni Wagner *Advertising Admin. Mgr.:* Leslie Moses *Editorial Prod. Mgr.:* Robin Berliner *Dir. of Research and Marketing Services:* Carole Rossant

ADVERTISING OFFICES
Omni Publications Ltd. *New York* (Beverley Wardale) 909 Third Ave., New York, N.Y. 10022 Tel. (212) 593-3301 Telex no. 237128 *Midwest* (Norm Kamikow) 111 East Wacker Drive, Suite 2036, Chicago, Ill. 60601 Tel. (312) 565-0466 *South* (Peter Goldsmith) 1707 H St., N.W. Washington, D.C. 20006 Tel. (202) 296-6050 *Detroit* (John Bluth) 950 East Maple, Suite 201, Birmingham, Mich. 48011 Tel. (313) 646-3646 *West Coast* (John Romein) 9220 Westwood Blvd., Suite 1002, Los Angeles, Calif. 90024 Tel. (213) 824-9831 *U.K. & Europe* (Eleanore Graham) 2 Bramber Road, London W14 9PB, England Tel. (01) 262-0331 Telex no. 919865

EDITORIAL OFFICES
New York: 909 Third Ave., New York, N.Y. 10022 Tel. (212) 593-3301 Telex no. 237128 *West Coast:* 9220 Westwood Blvd., Suite 1002, Los Angeles, Calif. 90024 Tel. (213) 824-9831 *London:* 2 Bramber Road, West Kensington, London W14 9PB, England Tel. (01) 385-6181 Telex no. 919865
U.K. & European Editions
Director of Publications, U.K.: David Jones *Advertising Director:* Eleanore Graham *Public Relations:* Molly McKeller *Editorial Assistant:* Andie Burland

BUREAUS
Washington, D.C.: William R. Corson, 1707 H St., N.W. Washington, D.C. *Berlin:* Hans Hohn, Enzianstrasse 1, Berlin 45 *Rio de Janeiro:* Andre Fodor, 98 Rue Mexico, 15th floor, Rio de Janeiro ZC39 *Budapest:* Paul Kirlyhedgyi, 5 Regi posta utca, Budapest 5, Hungary *Zagreb:* Cedomir Kompenovic, Strebrnjak 96, Zagreb, Yugoslavia

MARCH

LETTERS

COMMUNICATIONS

Origins of Equality

I am an elderly woman with a keen interest in, but no formal knowledge of, the sciences. Nevertheless, Patrick Moore [Stars, October 1980] has confirmed a personal belief with respect to mankind's knowledge of the origin of the universe. My total ignorance of that subject is in the illustrious company of the world's greatest thinkers, past and present. Maybe this is the one — and only — area in which we can declare all members of the human race equal.

Patricia Michell
Scamander, Tasmania, Australia

Odd Man In

Whatever one may think of Julian Jaynes's concept of the bicameral mind ["Odd Man Out," January 1981], it is certainly daring. The Jaynes hypothesis cannot be ignored, nor can it be accepted, either. *The Origin of Consciousness in the Breakdown of the Bicameral Mind* left me with much the same impression as did Immanuel Velikovsky's *Worlds in Collision*. It presents a preposterous concept buttressed by selective interpretation of evidence drawn from just about everywhere. The analogy is close, but Jaynes does it better.

Jaynes speculates that the bicameral mind broke down during the same period written language was developed. His evidence is drawn primarily from early writings. Consider, though, that the earliest form of written language had nothing to do with spoken language. Markings used to maintain inventories of sheep and jugs of wine did not necessarily connect to the spoken word.

As language became pictographic, it continued to carry this highly concrete nature and was incapable of expressing abstractions because the association of written and spoken language had not yet occurred. With the invention of alphabetic (phonetic) writing, the identification of spoken and written language began. The transition complete, we now find language used to express abstractions, the meat of consciousness.

On this basis one might conclude that Jaynes's evidence from early writings is largely true but that his conclusion is mistaken. Rather, he has detected the development process by which written and spoken language became identified with each other.

Raymond J. Schneider, Jr.
Apple Valley, Minn.

Julian Jaynes's theory about the bicameral mind is one of the most intriguing ideas I've seen in psychology for some time. We have all read about the elaborate sets of rules and compulsive rituals followed religiously by certain gurus and erstwhile philosophers.

Look in the Bible (especially Leviticus), the Koran, and any other holy book and you will find enough world views, most of which nobody even thinks about anymore, to start you thinking.

Paula T. Steiner
Pasadena, Tex.

Being one of the 50,000 who purchased Julian Jaynes's book, I was delighted to come across the article "Odd Man Out" in *Omni*. I find far more logic in Jaynes's theory of consciousness development than I do in the now-accepted Darwinian evolutionary theory. And if memory serves, Charles Caught his lumps, too.

Perhaps the one drawback in being so excited with a new idea is trying to convince others that they should read *The Origin of Consciousness in the Breakdown of the Bicameral Mind*. Your article will convince them that I am serious.

Patricia K. Barnett
Park Ridge, Ill.

Alcohol Recall

I read with amusement your Continuum item "Memory on the Rocks" [October 1980].

Psychologist Geoff Lowe discovered that Charles Dickens arrived at a similar conclusion in his labyrinthine *The Mystery of Edwin Drood*. I quote from Chapter 3, "The Nun's House": "As in some cases of drunkenness, and in others of animal magnetism, there are two states of consciousness which never clash, but each of which pursues its separate course

CONTINUED ON PAGE 137

DIALOGUE

FORUM

In which the readers editors and correspondents discuss topics arising out of Omni and theories and speculation of general interest are brought forth. The views published are not necessarily those of the editors. Letters for publication should be mailed to Omni *Forum, Omni Magazine, 909 Third Avenue, New York, NY 10022.*

Moonstruck

I wish to go on record again as being opposed to the U.N. Moon Treaty [December 1980]. In November 1979 I wrote Secretary of State Cyrus Vance that Article XI needed considerable rework by our U.N. personnel before the Senate could consider ratification of the Treaty.

As currently written, Article XI will whittle away the technology lead that we currently enjoy and will absolutely inhibit commercial exploitation of space.

Strom Thurmond
U.S. Senate
Washington, D.C.

I was enlightened by Ben Bova's article on the Moon Treaty, and I have a few thoughts on it. While I agree with the principle that extraterrestrial resources are the common heritage of all mankind, I am realistic enough to appreciate the dangers imposed on such a treaty by present world conditions. As an alternative, I would suggest this: Private or nationalized business concerns would be considered temporary explorers on the moon or any other celestial body—paid agents of Earth, if you will. The proposed "International Regime" would act not as a regulatory body but as a financial institution representing the interests of all the world's inhabitants. This institution would tax a certain percentage of profits earned in space (starting when an investment has been paid off) and fairly distribute them throughout the world according to need; also, it would retain part of the taxes as interest-free loan money to economically disadvantaged nations that wish to expand into space. Business concerns would accept this tax as just another operating expense.

There is no reason to believe that in the near future the Third World will put aside its anti-U.S. hostility as it regulates private enterprise; unfortunately, I foresee a ganging up similar to the one observed in the General Assembly of the United Nations. We cannot ignore these hatreds or allow other countries to deny them. It is not within my knowledge to say whether they are justified.

Space industry, quite rightly, should be for the advantage of the entire world economy and the poverty-crippled peoples that I believe are the responsibility of all industrialized nations. If this preposterous Moon Treaty is allowed to stand, no one—neither industrialist nor starving African baby—will benefit for a long, long time to come.

Daniel A. Pendick
(No address given)

Omni's article on the Moon Treaty rather more confused me than enlightened me. I have not read the Moon Treaty, nor am I an expert in international law, yet some points that were raised in your article seem not to fit together so neatly as a first reading might imply.

You quote from Article XI, paragraph 7(d): "... the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon shall be given special consideration" to the "benefits derived from [the moon's] resources." It is true that these benefits are to be shared equitably among "all States Parties," and developing countries also receive special consideration. However, the basic idea that countries that do the exploring should receive benefits of that exploration is enshrined in the Treaty.

The question is: Who owns the moon? Who is going to collect the rent? The corporations that would make the most money from exploitation of the moon's resources don't want to pay any rent at all. If these corporations made a lot more money from the moon, certain of *Omni*'s advertisers (the auto makers and the electronics firms) might share in the larger pie. But it is difficult to believe that most Americans would similarly benefit.

CONTINUED ON PAGE 132

EARTH

By Kenneth Jon Rose

For eight months MAGSAT orbited the earth measuring the planet's magnetic field. By the time the NASA satellite reentered the atmosphere last June, its data had confirmed the suspicions of scientists at the Goddard Space Flight Center, in Maryland. Earth's magnetic field is weakening.

Scientists don't really understand why. Current theory attributes the magnetic field to the fluids within Earth's molten core. When these fluids' normal motion becomes disrupted, so does the magnetic field. "The theoretical physics inherent in a rotating fluid of the kind within the earth is complex and difficult," says Gilbert Mead, of NASA. "No one has been able to make a model with any predictive character."

Magnetic reversals come as no surprise to scientists. Throughout its 4.5-billion-year history, Earth's magnetic field has periodically dipped to a fraction of its normal strength, remained that way for a few thousand years, and then reversed polarity. Compass needles that normally point in one direction (north, for now), point the opposite way. By studying molecules preserved in old lava flows, scientists have determined that the field reverses itself every half-million years. If the rate of magnetic decline continues, another reversal can be expected in 1,200 years. Oddly enough, the reversals occur at the same time a significant number of plant and animal species die out.

Furthermore, geomagnetic reversals seem to correlate with human evolution. In a paper published in the *Journal of Field Archaeology*, John Steven Kopper of Long Island University and Stavros Papamarinopoulos, of the University of Edinburgh, compared the dates of magnetic reversals with the development of the human race. They found that the first appearance of the genus *Homo* and that the earliest stone tools in Europe coincided with a magnetic reversal about 2 million years ago.

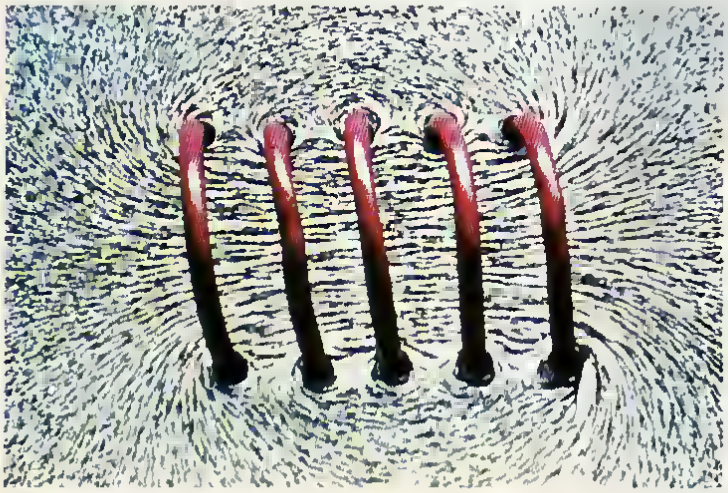
Much of Kopper's evidence comes from the fossils and tools found at archaeological diggings. Tools are especially important because they evolve as man evolves. They not only provide a record of man's development but also identify particular species and even subspecies. *Homo erectus* used crude pebble tools early in his evolution. But when hand axes appeared in ancient toolsheds 700,000 years ago, "it was a cultural jump," says Columbia University geologist Rhodes Fairbridge. "It was like a jump from the covered wagon to the automobile."

Despite its quirky cultural effects, the magnetic field of the earth provides a life-supporting umbrella without which life would be impossible. If the field disappeared, the sun's cosmic radiation would be free to destroy the ozone layer in the upper atmosphere, which protects us from ultraviolet radiation (UV).

Skin cancer and sunburn are merely two consequences of excessive UV exposure. We need small amounts of UV light. By reacting with steroids in the skin, such light produces vitamin D, indispensable for strong bone development. But a blast of UV during a magnetic reversal would create an excess of vitamin D, which can be lethal. Those who live near the equator, whose darker pigmentation screens out some of the UV, would probably survive better than those with much lighter skins. Kopper thinks that such a scenario might explain why the Neanderthals died off so quickly in the north, but managed to survive longer in Africa.

Yet extinctions could have been caused by a reduction of the magnetic field itself. All living tissue is sensitive to magnetic fields. Molecules found in the adrenal cortex, which controls the body's salt balance, are thrown out of alignment when they're put in artificial magnetic fields. Even our so-called biological clock, which sets the timing of hormone secretions, may be controlled by the magnetic field. The earth, stripped of its magnetic field, could make this biological timepiece go haywire.

The coming reversal may be even more alarming, according to two anatomists at Hahnemann Medical College, in Philadelphia. John van Dyke and Myron Halpern found that mice living since birth in a low-magnetic-field environment had a shorter life span and were also infertile. If the same effect applies to us, humankind might suffer mass sterility by 3181. ∞



Magnetic fields (above) and their reversals may cause anthropologists to revise their theories

LIFE

By Dr Bernard Dixon

Hemophilia and sickle-cell anemia are clear-cut examples of genetic disorders but what about duodenal ulcers, fibrositis or skin cancer? As our concept of exactly what constitutes a hereditary disorder broadens genetic counseling will no longer be limited to those who are concerned about their offspring having a birth defect In the future, six-month old babies will routinely have their white blood cells analyzed, and parents will be presented with an outline of specific diseases the infant will be susceptible to over the entire course of his or her life

Such information leads to obvious practical action Parents of a child who is vulnerable to skin cancer for example may decide to leave sunny California and make their home amid a less beneficent climate on the East Coast An adolescent who is likely to fall victim to painful fibrositis in middle age may decide *not* to pursue an athletic career that would only aggravate the condition Ulcer proneness may influence an individual's choice of diet or even his or her livelihood

The idea of being able to assess disease susceptibility later in life is a startling one Knowing *what* they might get and *when* could lead to radical changes in people's careers life-styles and expectations

No standardized method of plotting a personal index of probabilities has yet been adopted but one approach hinges on the discovery of HLA antigens These first came to light because they affect the acceptance or rejection of tissue grafts Just as blood groups determine the types of blood that can be transfused from one person to another so HLA antigens must be matched if a kidney or other organ is to be successfully transplanted These antigens occur on white blood cells and tissues and their myriad subdivisions constitute a chemical fingerprint

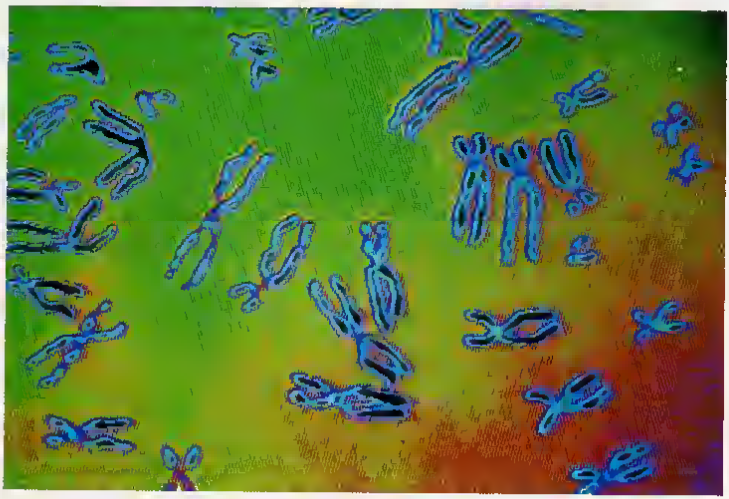
As immunologists began analyzing HLA antigens it was soon apparent that antigen patterns provided telltale signs of our predisposition to different diseases Rheumatoid arthritis multiple sclerosis psoriasis, and coeliac disease are among the conditions known to be influenced by them And the list is growing steadily HLA antigens might radically transform genetic counseling as we now know it

The profession's rapid advancement is also due to parallel findings that have emerged from a closely related field While one group of researchers have focused on HLA antigens or cell-surface markers, still others have probed inside the cell to study chromosome abnormalities Such a technique is used by cytologists to disqualify female Olympic athletes whose cells show signs of illicit intersexing, but its greatest potential may be to highlight disease proneness One example appears in the recently published annual report of the U K Medical Research Council It raises the prospect of distinguishing between tobacco smokers who are vulnerable to lung cancer and those who are comparatively resistant

The research is being done by Professor H J Evans at the Clinical and Population Cytogenetics Unit in Edinburgh So far he has shown that some cigarette smokers have significantly more chromosome defects in one sort of white cell compared with nonsmokers Moreover a particular chemical in smoke even in vanishingly tiny amounts, causes these cells to mutate Studies are now under way to compare the response of cells from lung-tumor patients and those from healthy controls Evans's next step is to learn whether this approach can be extended to identify sensitive individuals

There are further indications that such an exercise may be rewarding Already one cell detect—the so-called Philadelphia chromosome in some types of leukemia—has been linked unambiguously with cancer More recent reports suggest that subtle chromosome abnormalities are also associated with kidney carcinoma and with several other forms of leukemia

The impact of these converging fields of research is immediately apparent Tomorrow's medics will be able to give us uncannily precise information about our future medical profile Whether we will take heed of that advice is, of course an entirely different question



Chromosome abnormalities may reveal our susceptibility to lung cancer and other diseases

BEYOND THE SHUTTLE

SPACE

By Theodore R Simpson

While we await the space shuttle's first orbital flight test NASA is busily planning the next stages of our manned space program This blueprint for tomorrow bears a marked resemblance to a plan outlined by Wernher von Braun in an essay that appeared in the book *Across the Space Frontier* almost 30 years ago

Von Braun knew then that to make spaceflight as inexpensive as possible we must develop reusable rocket ships permanent space stations and reusable lunar spaceships The space shuttle is NASA's first step in this effort The shuttle can stay in low Earth orbit for about a week at a time and can haul a payload of 29 000 kilograms—the weight of five elephants—into an orbit 400 kilometers above the earth Later in the Eighties NASA hopes to launch one flight a week

Spacelab now being developed by the European Space Agency for early shuttle flights offers a base for short-term experiments It combines both a pressurized laboratory, where astronauts can work in a shirt sleeve atmosphere and an adjacent platform for tests in open space Materials-processing experiments aboard *Spacelab* will determine the commercial feasibility of space manufacturing The crew of six astronauts will perform approximately 40 experiments while in orbit

The first shuttle/*Spacelab* flight is a seven-day mission scheduled for June 1983 By the mid-1980s there will be six to eight *Spacelab* flights a year with a maximum of seven astronauts aboard Supplementary power sources may lengthen some flights to 20 days *Spacelab* s flight time actually could be extended to 60 days but this would divert the shuttle from its primary aim to launch new payloads

More permanently manned facilities will be built in the 1990s for longer missions which brings us to Von Braun s second premise—a space station for both civilian and military missions

Since *Skylab*, NASA has studied several space-station concepts The latest idea the Space Operations Center (SOC) has seven major parts two service modules two habitation modules, a logistics module a flight-support facility and a construction facility It would take ten shuttle launches to assemble the SOC With an initial crew of eight astronauts, the SOC would occupy an orbit almost 480 kilometers above Earth To prevent any imaginable malfunction the SOC has replacement parts for all its major life-sustaining elements The station and its crew could survive comfortably for 90 days without help from Earth or the shuttle

The service modules and their connecting tunnel form the SOC s central spine the other modules and all equipment are linked with them Large solar panels mounted on long booms provide at least 35 kilowatts of electrical power which compares with the horsepower of early Volkswagens The booms are attached to a six-meter-long tunnel that connects the service modules

Each habitation module is about 12 meters long and 4 meters in diameter and contains a command center that can control the SOC Much research must be done before choosing a final design but plans call for sleeping quarters a kitchen a lavatory/shower an exercise/recreation area a medical clinic and a small experimental laboratory

The proposed life-support system uses hydrazine and recycled water to create the SOC s oxygen and nitrogen The same unit makes the crew s drinking water from hydrazine, recycled wastewater carbon dioxide and water vapor The logistics module contains enough food and hydrazine to sustain the crew for 90 days a shuttle replaces the module with an identical one when supplies run out The habitation modules store an additional 90 days worth of supplies for emergencies

The SOC also carries a flight-support facility and a construction facility The flight-support center will assemble and launch multistage spacecraft and will service the reusable orbital-transfer vehicles (OTV) The construction facility maintains a beam builder that fabricates triangular trusses that can be used in large structures in the 1990s (see "Industry Goes to Space," April 1979)

CONTINUED ON PAGE 130

Able to service satellites in orbit the shuttle will make permanent space stations practical

HIGH-TECH ANXIETY

mind

By Denise Collier

One Saturday afternoon a friend of mine entered the housewares section of a large department store and was dazzled by a carnival of lights, dials, and switches. She found herself in a fully automated kitchen overloaded with blinking diode displays and atonal alarms that signal when the goose is cooked. Stunned by all this futuristic gadgetry, my friend immediately bought an electric juicer, a food processor, and a coffee maker whose digital timer would brew coffee and turn on kitchen lights at a preset hour. She left the store feeling up to the minute and awesomely capable. When she got home with her booty, she realized this machinery was more than she felt ready to master.

My friend suffers from an insidious twenty-first-century technophobia that I call high-tech anxiety. Brought on by our increasingly automated life-style, it is fueled by a sensory and informational glut that creates a confused internal debate over who is in control, man or machine.

This argument is as old as the wheel but takes on a new dimension as technology offers us not just tools for the future but the promise of electronic surrogates. With the lines of dominance blurred, objects grow ominous. We either are intimidated by the pervasiveness of high technology or become dependent upon it and fear its removal from our lives.

Think about it. High-tech anxiety has probably struck you. Did you ever rush to your bank's cash machine at 8 o'clock on a Sunday morning, miraculously find the thing working, and then have the machine spit out your card with no explanation? Did your four-function pocket calculator go dead in the middle of a complicated mathematical reckoning, making you realize that your fuzzy recollection of long division wouldn't win any sympathy from the men at IRS? Did you ever purchase a watch with buttons to push for the date, your pulse rate, your biorhythm, your appointments for the day, and the birthdays of your three closest friends only to discover that you were unable to figure out which button-pushing sequence would tell you the time?

Many people are overwhelmed when tasks that once required mental effort and manual dexterity are preempted by bleeping, blinking push-button machines. To the dyed-in-the-wool technophobe, the word *technology* recalls an image of Charlie Chaplin grappling with enormous gears in *Modern Times*. Or the classic Lucille Ball routine in which Lucy stands at a conveyor belt, lining up freshly dipped chocolates. As the belt speeds up, she dips the candies faster and faster, finally stuffing them into her mouth in a frantic effort to keep pace with the machine.

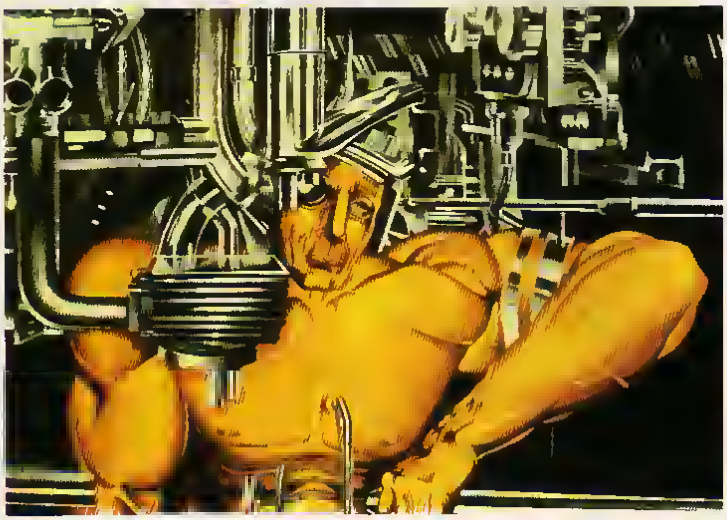
Women who confront high-tech in home and office often feel intense anxiety about the gadgets that are supposedly designed to help them. Often they would rather avoid the whole situation. One feminist writer said, "I wouldn't mind having a Cuisinart in the house, providing it came with a slave to run it for me. I can only assimilate a certain amount of information, and with my work, figuring out what's on TV tonight, and knowing two languages, I figure that's enough. I can't be bothered with learning to harness a Cuisinart. It's less trouble to do the slicing and dicing myself."

A female government official said, "I live in a modern apartment just outside the city. The entire building is electric powered. This is touted as a cleaner, more efficient way to live, but I think the electrical features in the apartment weren't created with people in mind. You can't control the stove or the thermostat. They're always too hot or too cold. It's funny. By living in this modern, convenience-filled building, I have forfeited control over my environment."

It can be argued that since men have grown accustomed to being the "fixers" in our society, the transition from mechanical gadgetry to electronics might be more natural for them than for women. Surprisingly, this is not the case. During the course of one interview I watched a normally laid-back journalist drive a four-inch nail through his calculator after the machine repeatedly produced different solutions to the same problem.

A New York actor who routinely does commercials for a top electronics firm

CONTINUED ON PAGE 130



THE ARTS

By Jeff Rovin

In 1957 Scott Carey boated through a mysterious glistening haze and became the Incredible Shrinking Man. He was metaphorically all of humankind passing into the new somewhat frightening age of space satellites and nuclear energy. Though our fears are different today, the need to exorcise them through film remains. And these modern day concerns are well represented in *The Incredible Shrinking Woman*, a fresh and ingenious retelling of the science-fiction classic.

Apart from the switch in gender, the most significant change is less what the film *shows* than what it *is*. Though the megrims of the Fifties were dealt with in a somber heroic way, the remake is a comedy. "It's not a *parody*," star Lily Tomlin observes. "I wouldn't have been satisfied with that. It's deeper. It's a moving comedic look at advertising, consumerism and fame. It's black, tender, satirical, visually saturated with pastel colors. It's a contemporary fairy tale, really."

The film opens on strong, satiric legs as the Pinto-driving Pat Kramer passes hastily through a succession of current ills: an exploding aerosol can, junk food exhaust fumes from a van, a new kind of cosmetic, and product samples that are affixed to the door of her southern California home or are brought from work by her advertising executive husband. The cumulative impact of these things is to cause the sweet, blameless housewife to shrink—like Carey, ultimately diminishing to subatomic size. However, the message expressed in the original film, as in the seminal Richard Matheson novel, is no longer the hopeful "To nature, there is no zero. It is the cautionary "To today's society everyone is zero."

The Incredible Shrinking Woman is Tomlin's fifth motion picture, though the first to feature the popular stage and TV personae she's been enacting professionally for nearly 20 years. In the film she plays not only the naive Pat but also her sage next-door neighbor Mrs. Beasley, the shopping bag woman Tess, and the five-year-old philosopher Edith Ann, among others. "I had so many different kinds of scenes that were funny and delightful that I was always just euphoric about the movie," Tomlin says. "The crew was strong and supportive, and everybody knew we had the chance to make a *special* picture. I even said to our director Joel Schumacher that we should all take off a year and travel around the world with the movie, to see at first hand if here and in Japan and all over they find it as uplifting and unifying and exciting a movie as we do."

Regardless of how people react when viewing the film, the comedienne describes the making of the $13 million fantasy as one of the most difficult undertakings of her career. "Pat was not a complex character to reach. She is cute and somewhat clever, but ordinary. I don't mean that in a demeaning way, because we wanted her to be microcosmic.

"But she changes during the course of the film, matures because of events that are really kind of extraordinary. That was where the part became an emotional and intellectual exercise, keeping the character credible in the face of these incredible and frightening events. It required a great deal of forethought and soul-searching for me to shrink along with her."

In the first part of the film, the challenge for Lily—as for Pat—was to come to grips with the shrinking. "I started preparing for it in a general way by thinking of it as a terminal disease and drawing on the clinically observed patterns that people go through—denial, bargaining, anger, all of that. I did long improvisations by myself and with other people, almost as if I were Pat Kramer at her analyst's. It wasn't really tough to get into a frame of mind for that initial shrinking, because it's only a couple of inches."

By the time Pat reaches one foot in height, and continues to condense, Tomlin came to recognize that size was no longer the cornerstone of the characterization. "I learned from the early improvisations that no matter how tall Pat is, she's still the same person. As she herself says, 'My ideas are just as big as they were before—maybe even bigger.' Even though she is only eighteen inches tall, Pat even becomes confident enough to go on the *Mike Douglas Show* to tell the world about

CONTINUED ON PAGE 138

Lily Tomlin and simian pal in The Incredible Shrinking Woman—*both victims of human insensitivity*

THE ARTS

By Janel Bladow

When Rudi Stern dreams he dreams in neon "I have plans for neon pavements, neon highways, neon tunnels, neon on bridges, underwater, outlining trees in parks Instead of twinkling little light bulbs that burn out every two weeks, I intend to outline bridges with neon ropes I see neon in elevators, water fountains -- many, many projects."

When Stern speaks of neon he speaks like a poet quoting perfect iambic pentameters He speaks proudly, fatherly, with the enthusiasm of an explorer As author of *Let There Be Neon*, published last year by Harry Abrams, Stern has revived—more than that, has revolutionized—neon as a form of art and as a form of communication

"The more I get into neon, the more I want to know!" exclaims Stern, who eight years ago opened New York's first art gallery exhibiting neon exclusively in the city's SoHo district "Neon is drawing with light and space You can wrap walls with neon, go around the equator There's no limit to neon's uses It can do anything a line can do, and it can do it in the dark."

Stern is energized by neon He notes that inside every glass tube there is a dance of electricity charging through inert gas and transforming one electron into a positive ion 60 times a second Stern pictures himself as a navigator guiding the good ship *Neon* into new worlds His goal is to take neon beyond the realm of advertising, where it has been pigeonholed for the last 60 years His prime occupation, he says with a visionary sparkle in his electric-blue eyes, is to find new uses for a medium previously shackled by rigid one-track thinking

Since Stern started working with neon in the late Sixties, he has taken the luminous tube into the worlds of art and environment Architects now find new ways to use neon as a source of light and as ornamentation Businesses that never dreamed of making use of neon 20 years ago have changed their thinking and now incorporate it into their building plans "I'm talking now with a city agency about using neon's directional, linear elements in an urban setting," Stern says

Sculptor Rudi Stern "Neon can do anything a line can do, and it can do it in the dark."

When his imagination was first fired by neon, it was a dying art Craft unions, hell-bent on running a closed shop, excluded anyone daring to bend glass in designs other than the 26 letters of the alphabet The plastics surge in the Fifties labeled as old-fashioned the glowing streamlined shapes so popular 10 to 20 years earlier Neon was relegated to serving as background illumination behind plastic marquees And the lighting industry itself was working to kill the fire in the luminous tube Major manufacturers of fluorescent and incandescent bulbs had never welcomed this medium By the time Stern was beginning to experiment, the number of shops making neon signs had dropped from 2,500 to around 250

Stern quickly found that learning the ways of the gases and fashioning pieces was not going to be easy No one volunteered information "The unions and the electric-sign industry resented us," he says "When my first sculpture was commissioned in 1967, I wanted to watch it being made But they told me to pay my money and leave."

Stern eventually gained entrance into neon's small universe when he researched his book For six years he traveled through the United States and to neon capitals of the world such as Tokyo and prerevolutionary Tehran He collected over 750 hours of interviews—the ammunition needed to recharge the industry Since then he has spearheaded neon workshops for more than 300 students and realized artworks for hundreds of businesses and individuals

Stern's arguments for neon over other man-made light sources sound almost too good to be true But, remarkably, neon is everything Stern says it is Consider for a moment a neon sign, such as those in so many barroom windows, outside motels, or in front of doughnut shops Its glow is warm and soothing Unlike fluorescents with their sterile supermarket garishness, unlike the blinding spotlight of incandescents, neon can be looked at directly And it is flexible: the tubing can be shaped in an almost infinite number of shapes and designs

CONTINUED ON PAGE 127

CONTINUUM

Edited by Dick Teresi

USELESS ANIMAL SLAUGHTER

Since Erasistratus starved a sparrow to "note the decrease in weight" billions of animals have been starved, suffocated, shocked, shot, boiled, baked, frozen, thawed, refrozen, force-fed, crucified, crashed, crushed, asphyxiated, irradiated, poisoned and laser beamed—all in the name of Science.

Notwithstanding the countless medical breakthroughs from animal experimentation, animals are far from the ideal research tool. Pharmacology textbooks cite endless examples of wonder drugs that never would have been marketed because of misleading effects on animals. Penicillin *kills* guinea pigs, morphine *excites* cats, digitalis *raises* the blood pressure of dogs. Yet most scientists insist there is no better way to study human disease.

But a revolution is brewing in the research community. It a faction of Space Age biologists wins out, the pet-shop atmosphere of the medical lab may give way to test tubes, agar plates, and computer graphics. It is now possible to devise far more accurate models of human diseases. In fact, medical research is retarded by an overreliance on animal experimentation, which often leads to unnecessary *human* experimentation.

Since the National Cancer Institute's quest for a magic bullet began in 1955, for example, millions of malignant mice have been injected with every conceivable substance, including war gas derivatives, bacterial enzymes, pesticides, guinea pig blood, and fungi from Japanese coal mines. Though none of these substances have proved as effective as ten that were discovered before organized cancer research even began, the institute's main strategy is still random screening on mice.

But many scientists ever since the program began have predicted its ultimate doom. There isn't any animal tumor that accurately mimics the common cancers of human beings. The result? Drug after drug has cured mouse cancer only to fail miserably in clinical trials. A drug called BCNU turned out to be a morbid pun. While it annihilates mouse tumors, the drug proved of limited effectiveness in treating human cancer and was occasionally so toxic that it killed the patient. BCNU became Be Seein' You!

Although a few persistent researchers have landed grants to pioneer testing methods that more closely replicate human responses—like the use of test-tube grown human tumor cells—it is virtually impossible to gain federal support for theoretical techniques. Mathematical models derived from data on actual human patients, for example, would ultimately allow researchers to predict a patient's response to many unproven treatments far more accurately than traditional animal systems. Government scientists say however, that we don't have enough data on biological systems to anticipate their response.

The notorious animal researcher Claude Bernard was saying the exact same thing more than 100 years ago. Mathematical biologists insist that our medical libraries are overflowing with information on how various chemical structures affect human cancer. They desperately want to derive equations that clarify how and why some drugs are useless while others cure rare cancers. Cancer equations might allow scientists to fine-tune a molecular probe that would seek and destroy malignant cells in the same way that NASA scientists used Newton's equations to calculate the thrust, timing, and trajectory of the moon shot.

But is it really possible to predict a human being's response without experimentation? Unbelievably, two biostatisticians at Roswell Park Memorial Institute, in Buffalo, New York, could have saved millions of dollars and prevented thousands of women from undergoing unnecessary radical mastectomies, but no one would listen. In 1971, having heard that the National Cancer Institute was about to begin operating on breast cancer patients to determine whether radical mastectomies are any better than simple mastectomies, Drs. Leslie Blumenson and Irwin Bross applied to NCI for a mere $20,000 grant to try to predict the answer with a mathematical model of breast cancer. Despite rejection, they made a computer prediction anyway and reached the same conclusion that NCI did after five years of human experiments, namely that radical mastectomies are unnecessary.

Evidently Bernard's philosophical dictum "Why think when you can experiment?" still pervades the research establishment. "The review committees are stacked with experimentalists," says Dr. William Dunn, of the University of Illinois Medical Center. "Since they're too busy in the clinic or the lab to get down to the nitty-gritty of *why* human beings respond in a certain way to a treatment, they're convinced that you *can't* use reason!"

The revolution Erasistratus started was critical. But, after 2,000 years, are animals still the most effective models? It is time for the next biomedical revolution. —*BRANDON KUKER-REINES*

CONTINUUM

AFGHAN SLAUGHTER

Freedom and Afghan natives have not been the only casualties of the Soviet Union's invasion of Afghanistan. The invaders and their supporters slaughtered numerous rare and endangered wildlife species and carted them off to market, according to the National Wildlife Federation, the largest environmental group in the non-Communist world.

A herd of 70 feral yaks, the product of years of conservation work, was reduced to 26. Snow leopards, flamingos, Siberian cranes, Bactrian deer, sand foxes and goitered gazelles were among other species that were slain. "One of the most promising conservation programs in the Third World has been wiped out," the federation said.

In addition, two of the six conservationists assigned by the United Nations to Afghanistan were killed. Three others either were fired or fled. Only one remains. One who fled, Jeffrey Sayer, said that "Russian soldiers gunned down priceless waterfowl and ordered Afghan guards to retrieve them from the lake. He saw a dozen skins of the very rare snow leopard on sale in a Kabul market shortly after. Marco Polo sheep and ibex apparently were also killed, he said, along with what was probably the only wild population of Bactrian deer outside of the Soviet Union.

Ironically, the world's largest environmental group is in Russia. Called the Nature Protection Society, it is sponsored by the government, and all Soviet citizens are automatic members.

Officials at the Soviet embassy in Washington could not be reached for comment.

—Stuart Diamond

Snow leopards are among the victims of the Soviet invasion of Afghanistan, along with flamingos, Siberian cranes and yaks.

HERPES CURE

Adenosine monophosphate, or AMP, a drug prescribed for years to ease joint inflammation and skin itch, has now been revealed as a potential cure for herpes virus.

Dr. Harvey Sklar of Englewood Hospital, New Jersey, for the past five years has been giving first-time herpes sufferers injections of AMP while characteristic herpes sores are still visible. The drug usually vanquishes the virus, whether it has just attacked the mouth, as herpes 1, or the genital area, as herpes 2. Dr. Sklar's five-year follow-up studies of AMP-treated patients show almost no recurrences of treated primary herpes—an extraordinary feat since conventional treatments give no promise of a cure.

Getting rid of herpes is not always possible once viruses have begun keeping house within their favorite hiding place in the nerve cells. But AMP injections given every other day over a period of several weeks following an attack dry out sores and suppress the severity and frequency of other attacks of recurrent herpes.

Dr. Harvey Sklar examines one of his smaller patients.

AMP is also effective against shingles, or herpes zoster, which is the third most common strain of the virus that attacks humans. If injections are started within three days after one contracts the disease, Sklar claims, symptoms will disappear within two or three weeks with no postherpetic neuralgia (pain).

Because AMP is a natural cellular metabolite of nerve cells, it is a highly safe drug with no side effects, Sklar says. Research has found that herpes reproduces and attacks when someone is under stress. Then the AMP level is lowered by the infection. When a substantial amount of AMP is injected into the body, the affected nerve cells have a chance to recoup and overcome their invaders.

Although the Food and Drug Administration is well aware of Sklar's work, it is not ready to pronounce the drug a certain cure for herpes until animal and more detailed human trials have been completed. Sklar told *Omni*: "I've been having exceptionally good results with human beings for the past five years, and now we are ready for a randomized, controlled study for shingles."

For more information write to Dr. Harvey Sklar, Englewood Hospital, Englewood, NJ 07631. —Caroline Rob

NINE-EYED ROBOT

A nine-eyed robot that can think—and maneuver—its way through a crowded room has been successfully 'let loose' by its thirty one year-old creator Hans Moravec of Carnegie-Mellon's Robotics Institute, in Pittsburgh, Pennsylvania.

'The Cart, as we call it,' Moravec says, 'is an evolutionary step on the road to intellectual development in machines.'

The robot is about the size of a card table and is controlled through a radio link. What distinguishes it, however, is its ability to interpret and act upon the images it receives via a TV camera.

The Cart's nine eyes are actually the nine different locations where the camera stops on its horizontal track and relays images to the robot's computer brain. Moravec conceived the idea for this type of vision from watching lizards catch flies. "Before a pounce," he explains, "a lizard would fix an eye on its victim and sway its head slowly from side to side. I realized this was an effective way to determine distances."

The Cart has been programmed to drive through cluttered spaces, but it moves slowly, only one meter every 10 or 15 minutes. After rolling a meter, Moravec says, it stops, takes some pictures, and thinks about them for a long time. Then it plans a new path, executes a little of it, and pauses again.

"It works slowly," he continues, "because computers are at their worst in trying to do the things most natural to humans, like seeing and common-sense reasoning."

Moravec considers his robot 'a modest attempt at endowing a mild-mannered machine with a few of the attributes of higher animals,' and foresees its most probable application to be a remote-controlled planetary rover, perhaps for Mars.

Hans Moravec and the Cart. Like a lizard with its prey.

As for a future filled with autonomous mechanical beings, Moravec believes it won't happen until computers are able to process as many data as human neural centers. He adds, however, that experiments similar to the Cart in the early vertebrates wound up evolving into creatures that walk upright and twiddle their opposable thumbs.

—Jane Bosveld

'Give peace a chance'
—John Lennon

PREGAME WARM-UP

It is a subject as old as sports. Does sexual activity diminish athletic performance? An authority on sports medicine gives this professional opinion: "Scoring before the big game does not take away from scoring during the game."

Donald L. Cooper, director of Oklahoma State University Hospital and team physician for the Big Eight college athletic conference, says he has found no specific correlation between normal sexual activity and athletic performance.

The idea that sex robs athletes of vigor "is one of the many sports myths that have been around so long they are widely accepted as truth," said Cooper, who headed an American Medical Association committee studying the question. He said the myth's most ardent proponents are the managers of prizefighters. "Even today managers try to keep their boxers away from their wives or girlfriends for months at a time."

If forced celibacy is maintained over an extended period, Cooper points out, it might produce the opposite effect: diminished performance—especially if the athletes' normal life-style included sex at regular intervals. He notes that the Pittsburgh Steelers, who spent the night before Superbowl X with their wives, beat the Minnesota Vikings 16–6. The Vikings had been separated from their wives for a few days just before the big game.

Cooper also said that one professional baseball player told him his sinker ball worked best after sex. The physician tells of a famous opera singer who would not appear on stage unless she had had sex before the performance. —Stuart Diamond

The Pittsburgh Steelers spent the night before Superbowl X with their wives. The Minnesota Vikings did not. The Vikings lost, 16–6.

CONTINUUM

CANCER IN PETS

For humans hospitals keep tumor registries to record types and sites of cancers and the success or failure of various treatments

Now professors at Purdue University's School of Veterinary Medicine, in Lafayette Indiana have started a similar registry for dogs and cats with cooperation from vets throughout the state

It's a rare kind of program directed toward the welfare of the animals themselves according to Dr Gordon Coppoc The knowledge gained may benefit the animal patients and also produce clues to causes of human cancers since dogs and cats share their owners environment and their exposure to various cancer-causing agents Cancers showing up in the shorter-lived pets might give early warning about the risks that humans are facing

—Alton Blakeslee

Charting the cancers of dogs and cats may eventually help people

TOUCH-TONE SHOPPING

Having computers serve as salesmen is now a reality at one of Canada's largest retail outlets Simpson-Sears in Toronto has been experimenting for five years with an electronic shopping system Roughly 20 percent of the store's customers are hooked in to this computer pilot project

Toronto area shoppers with Touch Tone phones can register with the store to take advantage of the system Once registered they place their orders out of the Sears catalog through a simple push-button code They dial a special number that connects them to a voice-response computer which in turn, takes down such basic data as the customer's name and address method of delivery and color size, and quantity of purchase In the IBM 3033 voice-response computer there is a total inventory of the store's goods which is constantly updated The order goes directly to the warehouse, where clerks prepare the purchase for delivery

Leading retailers everywhere have been watching this electronic-shopping pilot project with great interest Meanwhile research is going on to develop a voice-recognition computer that will work on the same fundamental principle as the Touch-Tone system except that the computer would identify the customer and record the order by analyzing voice patterns —Timothy Bay

LASER AIRPLANES

Passenger airliners powered by lasers beamed down from space? Dr Abraham Hertzberg head of the University of Washington's Aerospace and Energetics Research Program in Seattle thinks it will work and that its time is near

Hertzberg's scheme would work like this

The jet would take off and land with regular kerosene-powered engines But at cruising altitude laser power would take over An infrared laser beam from a solar-power satellite in a low polar, sun-synchronous orbit would flow through a relay satellite and into a special receiver atop the plane The receiver would focus the beam into a heat exchanger heating the inflowing air to more than 1 100°K The kerosene fuel would be turned off and the laser heated air streaming out of the engines would provide necessary thrust

If the laser wandered off target Hertzberg says 'a feedback system would instantly cut the kerosene engines on The plane would carry enough reserve fuel for a cruising range of nine hundred thirty kilometers

Major plane-building companies look askance at his scheme Hertzberg says because they don't want to look like fools "

But he may have the last laugh The laser-powered airliner is within reach of present-day technology And the rising cost of jet fuel may make it positively economical within the next ten years —Joel Davis

'Till now man has been up against Nature from now on he will be up against his own nature '

—Dennis Gabor

'The Buddha the Godhead, resides quite as comfortably in the circuits of a digital computer or the gears of a cycle transmission as he does at the top of a mountain or in the petals of a flower

—Robert Pirsig

Laser planes would save fuel

VOLCANIC PAYOFF

Although not every dark cloud has a silver lining, one of this century s largest black clouds— the Mount St Helens volcano eruption — has rained a little glitter down on the surrounding countryside with all those tons of mud and ash

For one thing though 240 square miles of woodland was obliterated the devastation is expected to be a boon for the mountain bluebird, which is attracted to snagged and gnarled trees

And while 26 lakes were destroyed and 14 million fish and other wildlife were wiped out the volcanic ash will enrich the soil causing some new plant species to appear as the vegetation grows back

The 26 000 miles of impassable highways and $200 million of damage to roads and bridges will certainly create plenty of jobs for contractors and road workers

The $2 5 billion in total damage and the death or disappearance of 70 people saddened the local Washington State residents but thousands of tourists are helping to remove some of the sting Sales of canned volcanic ash are brisk in some places although it's a little like buying water at Niagara Falls

But the biggest benefactors of the disaster appear to be scientists The series of eruptions that began in March 1980 is being called a once-in-a-lifetime chance for geologists to study fresh samples from the earth s interior scattered in abundance over a wide area They hope to find out how metals such as gold, copper and— of course— silver are formed And they will be able to study how the earth regenerates itself, as plants and animals begin to reclaim the lifeless land

They expect the complete regeneration to take less than two centuries— a mere second in geologic time In the meantime the volcano is teaching some immediate lessons They are, one geologist said "how to plan ahead how to cope with ash what to do with plugged-up waterways"

— Stuart Diamond

Winner. The mountain bluebird

"We don t know what time is, let alone how it shall be divided for us

— J B Priestley

CRUMBLING MONUMENTS

From Athens to Rome, from Milan to Washington urban noise and air pollution are destroying some of the world s greatest monuments In Greece acid rain has done more damage to the Acropolis in the past 40 years than all the natural elements did in the previous 25 centuries

In Rome traffic vibration and pollution are causing marble sculptures to crumble so quickly that most of the carvings on the city s monuments will disappear within 20 years unless protective measures are taken

In Milan Leonardo da Vinci s *Last Supper* is slowly crumbling from traffic vibration Its colors are fading because of smog And in Washington D C gargoyles on the National Cathedral are flaking into dust

The sculptured record of human civilization, fashioned from sandstone and limestone, is no match for the sulfuric acid produced by traffic fumes or for the continual rumbling of trucks

But scientists and planners recently have teamed up to try to preserve what is left The Greek government has closed industry and banned parking near the Acropolis In Milan historians are trying to find money for air purifiers near Da Vinci s work and are installing equipment that absorbs sound waves Scientists both at the National Bureau of Standards and at Brookhaven National Laboratory are trying to develop clear durable stone preservatives that can be sprayed on the artifacts

One promising substance is a plastic polymer which penetrates the stone and coats the surface The technique has worked with sculptures from the Brooklyn Museum, in New York City

— Stuart Diamond

The Porch of the Maidens on the Acropolis is deteriorating fast

CONTINUUM

THIN HORMONES

If you admire the svelte ness of long distance run ners *Vogue* models and ballerinas but can t keep to a diet take heart Womanli- ness new research shows owes a good deal to fat

We know that mature women have between 26 and 28 percent body fat which can be regarded as stored energy for reproduc tion and lactation Rose E Frisch of the Harvard School of Public Health s Center for Population Studies writes "If a wom an s body lacks the neces sary energy for adequate nourishment of the unborn child and for lactation the brain apparently shuts everything off

Female athletes bal lerinas, and women who diet injudiciously Frisch says are likely to fall be- neath the critical fat/lean ratio necessary for ma - ing normal menstrual c - A woman five feet five - tall for example mus - at least 108 pounds to mee nature s reproduct ve s and ards according to Fr s fat index

We were surprised at - how sharp the thresho d s Frisch reports Some peo ple can turn cycles on or off with a three pound weigh change

Why? The female hormone estrogen is manufactured in fat she explains And plump women make the most potent form of estrogen — estradiol Meanwhile their leaner sisters may even make a kind of antiestrogen called catechol estrogen according to Rockefeller University researcher Jack Fishman

You don t exactly have to be lissome to impa - te oroductive cycles either Female discus throwers who replace fat with muscle may also stop ovulating accord ng to Frisch

O! that this too too solid flesh would melt Hamlet cried Not such a good idea for Ophelia — Judith Hooper

The svelte figures of ballet dancers have long been envied by young women Now we know too little weight can turn hormones off

Men occasionally stumble over the truth but most of them pick themselves up and hurry off as if nothing had happened
— Winston Churchill

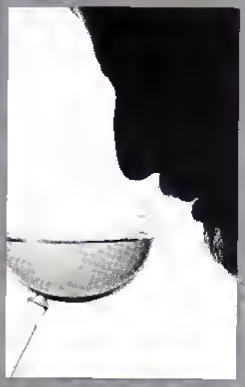
REMEMBRANCES OF THINGS PAST

Take note Marcel Proust The taste of crumpets may do it for some but it is our sense of smell that is the real hot line to the remembrance of things past Or so reports Brown University psychologist Trygg Engen

His studies show that al though we humans may distinguish between two dif ferent smells with only 70 percent accuracy we remember those smells with that same 70 percent accuracy whether the second whiff comes our way 30 seconds or 30 days later Even ter a year — when sights and sounds are long forgotten — our odor memory accuracy dips to only 65 percent

Why is our odor memory so persistent? Pierre Gloor a Montreal Neurological Institute researcher suggests that our olfactory sense is directly plugged into the brain s limbic system the headquarters of emotion And this intimate connection between smell and emotion had strategic evolutionary value for our prehuman ancestors

As primitive creatures evolved Gloor observes they learned to make decisions based on past experi ence instead of relying on simple instinct Odor may have been the essential clue he says "that allowed them to call on pertinent past experience in dealing with dangers or opportunities permitting them to react more flexibly and thus to survive"



Our noses remember better than our eyes or ears

So when the smell of new-mown hay revives a dormant memory you re enjoying a sensation that stems from the very core of our evolution — Tom Summer

Positive being mistaken at the top of one s voice
— Ambrose Bierce

"We haven't the time to take our time '
— Eugène Ionesco

PANTYHOSE FOR SALMON

Gary Duker puts body stockings on salmon

A graduate student at the University of Washington s College of Fisheries In Seattle Duker is trying to determine how body coloration affects the mating habits of the salmon that spawn in Washington s streams and rivers

When salmon are maturing in the open sea the different species look almost identical Duker says "But when they return to fresh water streams to spawn the five species—Chinook chub coho pink and sockeye—not only change body shape but also change their coloration '

Duker has demonstrated that female salmon of one species either attack or simply ignore the male salmon of another species though the reverse does not happen 'Male salmon are pretty indiscriminate in courtship behavior he says

Now he s putting colored body stockings on male salmon Danskins to boot (' My wife buys them for me) He clothes them from behind the gills to the tail with slits for the fins Duker wants to see whether changing a male salmon s color throws off female salmon of the same species

Results to date are mixed and it s still too early in the experiments to draw any conclusions In one case though a male chub disguised with a red body stocking as a sockeye was spurned by a female chub

Duker admits that putting body stockings on salmon mostly falls in the realm of basic research However his work might help determine whether the mixing of salmon species in spawning streams helps or hurts the production of new fish

—Joel Davis

Salmon with body stocking To see whether changing a male salmon s color throws females off during the mating period

BOXING SAFETY

A professor in Canada is now at work on an electronic instrument designed to save boxers from brain damage

Installed in standard protective headgear the device would flash telltale light signals every time a fighter was hit on the head a green light if the punch registers as fairly mild a red light to warn against serious injury

We d like to base boxing on skill rather than on brute power says Dr Sean Egan professor of sport psychology and boxing coach at the University of Ottawa and a former light-heavyweight fighter himself

An inflatable tube inserted in the cushioning of the headgear that shields the forehead would record the pressure created by the punches and would relay the findings to a microtransducer mounted near the scalp The mechanism would then convert an electrical signal into flashing lights—green or red—which the referee would monitor

Brain damage in boxing is caused by concussion—often a blow to the head so violent that the brain itself actually smashes against the opposite side of the skull Dr Egan cites studies by a German anatomist who observed that skulls with smooth interiors seem more prone to brain damage than those with bumpy surfaces Operating on this theory Egan believes brain X rays might identify which boxers face the most risk Ringside doctors could set the instrument to take into account precisely how much punishment an individual fighter seems likely to withstand safely

Since 1945 330 U S fighters—amateur and professional—have died from ring injuries

—Robert Brody

Rocky Marciano demonstrates the danger of hitting someone in the head during his 1952 championship bout with Jersey Joe Walcott

CONTINUUM

SPANISH FLY

Scientists in California have invented a synthetic version of the legendary aphrodisiac Spanish fly They did it not to improve anyone's sexual appetite but to cure warts

"The natural source Spanish beetles has basically disappeared" said William Dauben an organic chemist at the University of California at Berkeley "What we did was to synthesize the active ingredient in Spanish fly

That active ingredient, cantharidin, is an irritant that causes blistering on the skin It has been used for years as an alternative to liquid nitrogen by some dermatologists to burn off warts, particularly around mucous membranes

Traditionally the white crystalline substance—which looks like sugar—was obtained by crushing the wing covers of *Lytta vesicatoria* the bright green or bluish Spanish beetle But the beetles have all but disappeared So Dauben and his associates made a synthetic version by combining a number of organic chemicals under great pressure —15 000 atmospheres

Dauben said the new substance for which a patent is pending, might be sold at commercially competitive prices Scientists note that cantharides, in pure form are rather poisonous if taken internally In Spanish fly the cantharidin is not present in pure form since the entire beetle is ground up

Researchers also say there is no experimental evidence that Spanish fly enhances sexual appetite Dauben did muse however, that 200 years of folklore and off-color jokes must have got started for some reason "—Stuart Diamond

'The future is beyond knowing but the present is beyond belief '

— William Irwin Thompson

MAY DAY IN SPACE

Oceangoing ships collide despite the vastness of the seas And you can expect collisions of satellites in the even vaster reaches of space, an aerospace engineer predicts In fact, by 1995 the probability of collision could be on the order of 50 percent for a 50 meter-radius spacecraft in a 1,000-day circular-orbit, low-altitude (500 to 1 500 kilometers) mission says Vladimir A Chobotov of the Aerospace Corporation, in El Segundo California

Spanish fly, dropped secretly in your girlfriend's drink, may not make her more receptive but it could help get rid of her warts

Collisions and explosions in space normally occur only in science fiction but one expert warns they could become commonplace

Right now in Earth orbit are 'an estimated radar trackable population of some 5,000 objects from nearly 2 000 space launches, with the number still growing Chobotov writes in *Astronautics and Aeronautics* magazine Chobotov also notes that more than 50 explosions of spacecraft or rocket stages have been tracked

Some explosions were accidental—with leftover propellant blowing up—and some were intentional, as in the Soviet Union's antisatellite tests Chobotov told *Omni* He said he could not amplify because much information is classified

Some spacecraft and rocket stages and miscellaneous debris in slightly eccentric and inclined orbits close to the geosynchronous drift relative to 'fixed' satellites and thus present a potential collision hazard '

Chobotov suggests that "planet Earth needs a space-object management policy seeking means of limiting the chance of collisions or minimizing the damage if they occur

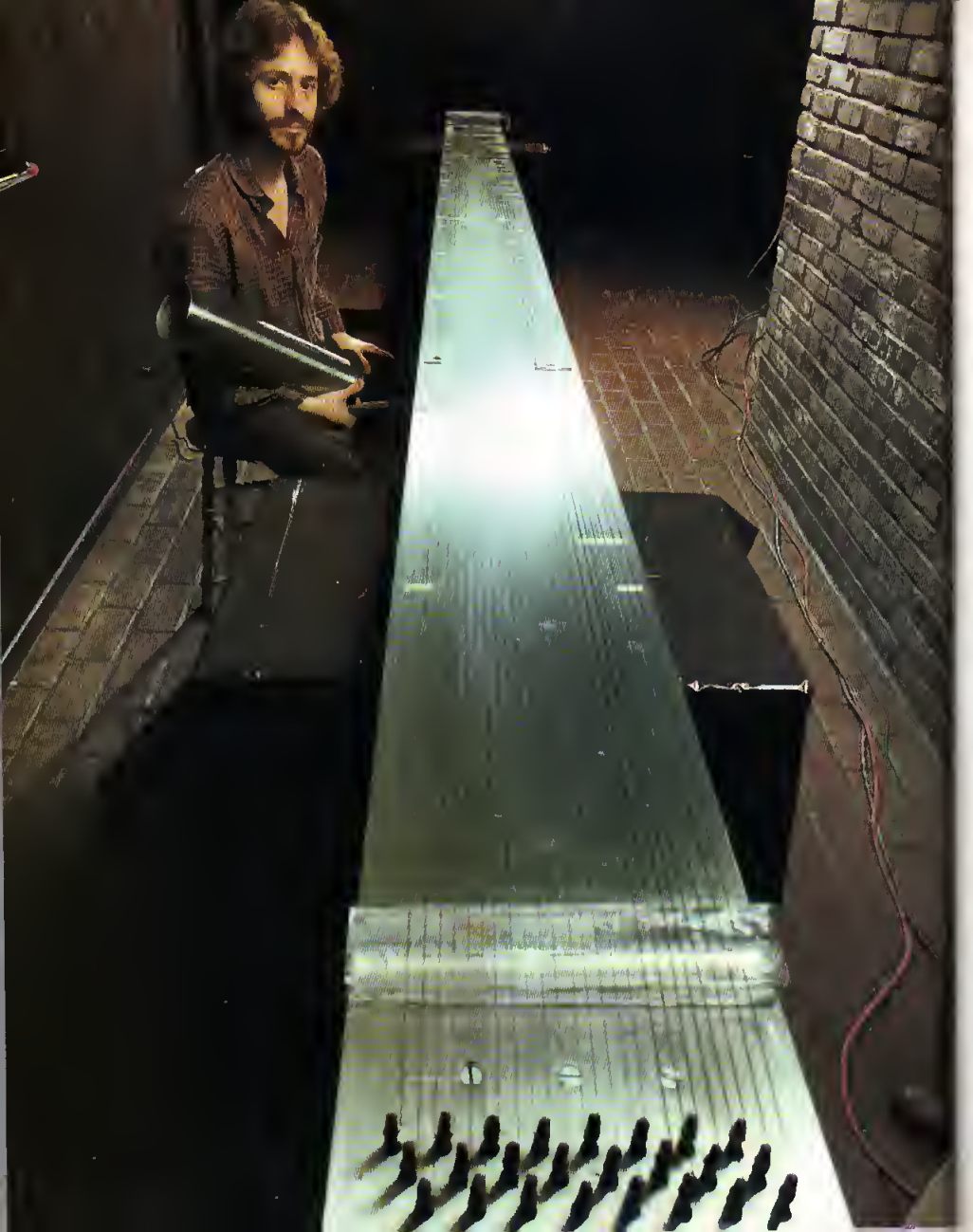
—Alton Blakeslee

'All elevated thinking ends in a sigh '

— Paul Valéry

If you are out to describe the truth, leave elegance to the tailor

— Albert Einstein



THE ENDLESS SCALE

Computer composers and microtonalists expand musical experience

BY DOUG GARR

At first glance Laurie Spiegel might seem like an IBM programmer tinkering on her day off. Her Lower Manhattan loft is a miasma of electronic high technology. There are tape recorders, a projection television screen, an Apple II computer with a video display and a workbench littered with solder, wire, voltmeters, oscilloscopes, transistors and circuit boards.

But Spiegel doesn't belong to the button-down-collar crowd. She is a composer, schooled at Juilliard, who uses computers and a polyphonic synthesizer to create something that is simultaneously music and art. Her compositions are contained in magnetic discs of binary computer coding. She slips one of them into her Apple and flips some switches.

From the stereo emerges a series of simplistic, repetitive musical phrases, while the room's TV screens display an analogous pattern of thin, fleeting colored lines. Gradually the music grows richer and more dense, the pace and variety of sound expand. On the screens the images intensify in color and movement. Soon the loft resounds in a riot of visual harmonics, images flashing in unison to the composer's creative musical desires.

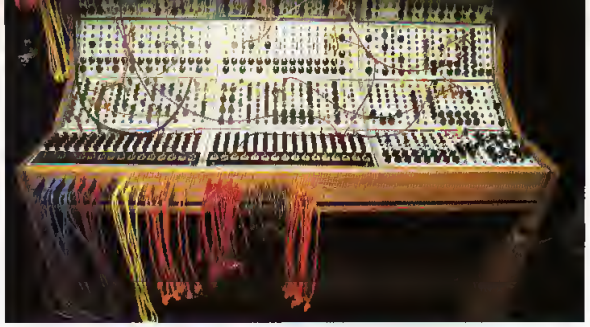
In a stark, windowless California room Craig Hundley builds unique instruments that explore pitches and timbres he couldn't experience in his formal music training. One of them is a 17-foot steel beam with 24 brass and bronze strings stretched along its length. It looks like the world's largest and strangest steel guitar. Hundley slides a shining steel cylinder along the strings. Eerie bass moans ricochet off the cold walls. He replaces the bar with a pair of fat mallets, and the room rumbles like the heart of thunder.

Young composers like Spiegel and Hundley personify a musical renaissance that promises to change the way we hear, think about and compose music in years to come. The computer is central to this expansion of aural awareness, but the rebirth encompasses many other elements. For instance:

- Several West Coast composers known as microtonalists are using rediscovered mathematical ratios to invent new scales with many

Craig Hundley (left) and his Blaster, an instrument that creates an ocean of rumbling bass microtones

PHOTOGRAPHS BY NORMAN SEEFF



more tones and musical options than the traditional 12-note octave

• A host of new music-making machines, including fine-sculptured stringed instruments, resonating aluminum beams, and primitive ensembles made entirely from junk, have emerged. These unusual instruments can play sounds infinitely more varied and dynamic than any we have ever heard before.

• Exotic performance concepts are blending music into the landscape, broadening the definition of something called sound sculpture. Music is even generated underwater by the brain's alpha waves and by the movements of dancers.

Throughout music's 6,000-year history, every available substance in the natural world has been used to produce new sounds. Today the computer stands at the forefront of musical progress, because it can produce an infinity of sounds beyond the realm of the real world.

Computers have successfully broken music and vocalization into their component parts and reassembled them as new, hybrid sounds. Voices have been transformed into emotionless tonal instruments, and trumpet and trombone sounds have been converted into speech. Before your ears, a clarinet playing a single note can metamorphose into a percussion instrument. Computers even have the potential to write their own music. Cyber-composers may not be Beethoven, but they might be truly creative. "I don't hold out any great hope for a computer to write a masterpiece," says Douglas Hofstadter, an Indiana University computer expert and Pulitzer Prize-winning author, "but for someone to say that all a computer can do is produce Muzak, you've got to ask, What is Muzak?"

Spiegel uses her computer for a variety of musical tasks: composing, improvising or overdubbing (the machine can play melodies while she plays bass, or vice versa), and a wide range of experimentation. "It is an incredible labor-saving device," she says. "I can compose in computer memory and have the final score printed out. The computer can also play the music as I'm composing, in case I want to change something right away. With traditional composition, you have to hear all the elements of the works in your head."

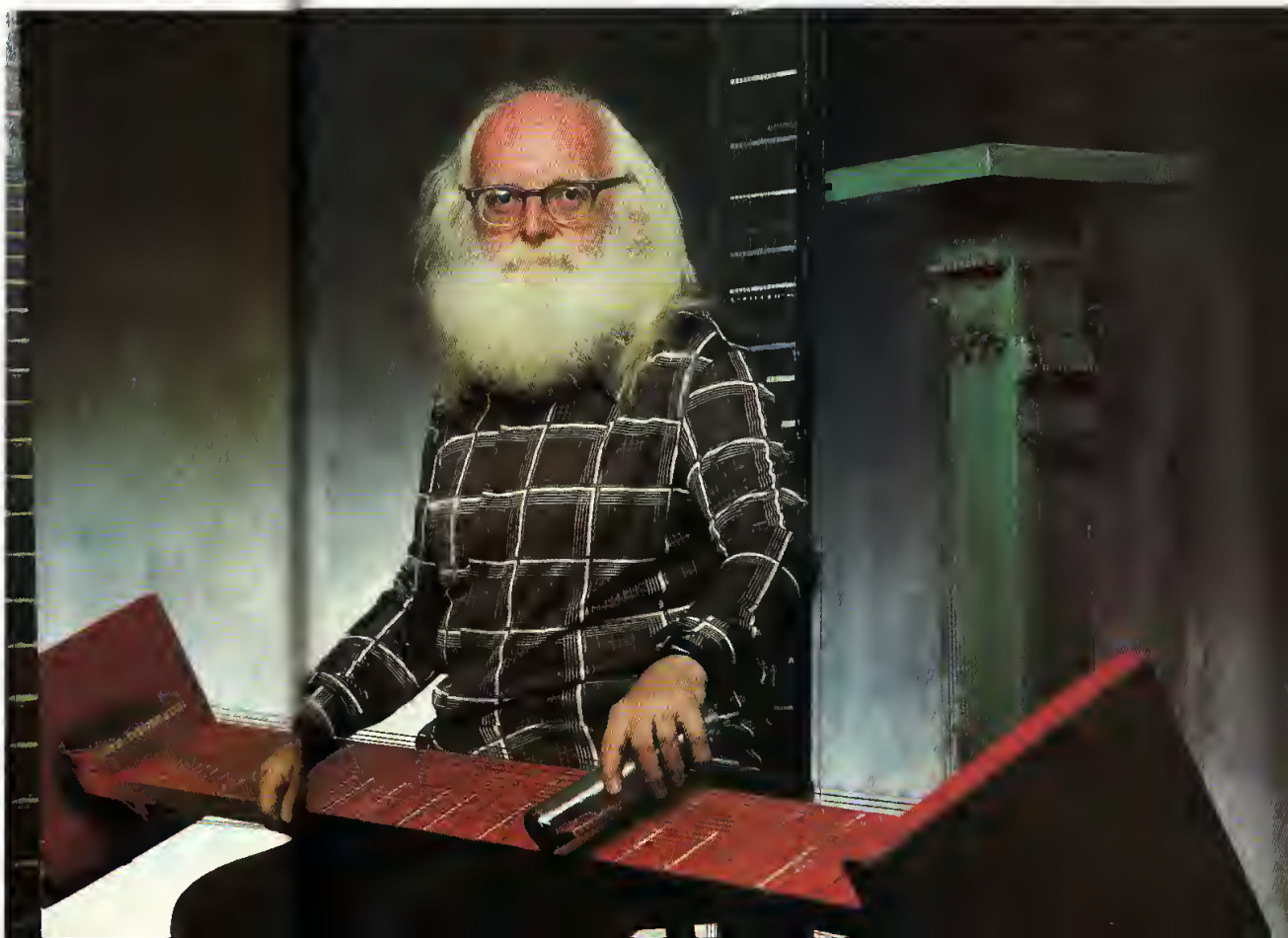
But you don't need Laurie Spiegel's knowledge of theory to play a computer. Someone who is all thumbs can do it without hitting a wrong note. "You use your intelligence, not your reflexes," Spiegel says. "It's like one-finger typing. You can hit three hundred notes with one push of the button. As a musical tool, the computer will parallel the invention of musical notation."

Most musical experimentation today centers on the collaboration between computer and musician. Dr. Max Mathews, thought by many to be the father of computer music [see *Omni*, May 1980], first wrote a program to synthesize music in the late 1950s. He played his composition, entitled *Music I*, on an IBM 707, a room-sized behemoth that would befuddle today's microchip composers. Mathews recalls that musicians at first used the computer purely as a storage device, packing their complete score into the memory banks, then blithely pushing a button while the computer simply played by rote. This is now changing. Musicians are looking more ambitiously at the computer as a tool. "What we need is some way of having the performer interact with the intelligence of the instrument, as if the instrument were another performer."

This attitude inspired Mathews's invention of such computer-instrument combinations as the sequential drum, a rectangular piece of plastic that resembles a small, tightly stretched trampoline. Beneath the skin, three sensors initiate commands to the computer. One sensor controls a note's volume: much as in an ordinary drum, the harder you hit, the louder the note sounds. The two other sensors control timbre (sound quality) and sound decay (the duration of a note or musical phrase). A preprogrammed musical pattern is stored in the computer memory. Mathews activates the pattern and strikes the drum to add flavor.

Ivor Darreg (right), patriarch of microtonalists, splits the octave in ways never before imagined. The confluence of computers and new scales can be seen in the futuristic synthesizer (above).

"When I play old music, I am gathering wood in the forest; with new music, I am planting seeds of the future."



and nuance to the overall rhythm.

"I tend to play a Bach sonata accompanied by a violin," he says, "but it can sound like anything I want." He is currently developing a sequential violin.

Programming music through a computer does not require keyboard pyrotechnics or one of Mathews's digital analogs. Joseph Pinzarrone, director of electronic music at Northern Illinois University, transforms dancers into musical instruments. First he devised a "movement-sensitive costume" with 64 mercury switches attached to various spots on the arms, hands, legs and feet. These switches are fed through a computer to a synthesizer. During a performance, Pinzarrone sits at the computer console and works with the dancer whose body movements open and close circuits that control the synthesizer sounds.

While the future of musical performance will undoubtedly owe a huge debt to the computer, which will always be around to play and compose upon, it may be equally dependent upon a school of musicians, composers, and instrument builders who are reshaping the mathematical concepts of scales and notes—microtonalists. They ignore the musical notation that has been accepted for centuries by Western culture in favor of a new, more scientific approach to sound.

The bulk of our familiar melodies stem from a 12-tone octave—the seven white natural and five black sharp/flat keys found on the piano. The microtonalists, however, have learned how to play between the cracks of the keys. For example, C-sharp and D-flat actually have slightly different frequencies, despite common belief, they are not the same note. By distinguishing between sharps and flats, and by adding F-flat and C-flat (where there are no black keys on the piano), the microtonalists designed a 19-tone scale. And that was just the beginning. Using slide rules and calculators to find exact ratios and frequencies, microtonalists quickly discovered they could play musical scales with 31, 43, or even 55 notes in the octave.

Cris Forster, a young microtonal composer in San Diego, began his musical career as a piano scholar, hoping to become a traditional musician. Then he grew interested in exploring new sounds. On his own, he augmented his musical knowledge with mathematical theory, and today he'll usually have a slide rule or a pocket calculator within reach while he writes music.

"Our twelve-tone scale was firmly established by Johann Sebastian Bach over two hundred years ago when the old man was considered a revolutionary," Forster says. "And since I cannot walk into a music store and buy instruments for an exploration outside of this scale, I must build them myself."

So Forster began building instruments. The Chrysalis has 82 strings stretched like spokes around a hub. He plays it by rotating the strings past his fingers. Then there's the Harmonic Melodic Canon, a grooved sound board that resembles a drafting table with 48 strings each one meter long running across it, which Forster strums standing up. Another instrument, the Diamond Marimba, has a series of glass tubes suspended from its bars. The tubes serve as sound chambers for vibrations made by striking the bars with mallets. Forster is working on a glass harmonica, which will contain a rotating wheel and produce continuous sounds like those of an organ.

He is resigned to playing the somewhat martyrlike role of musical carpenter to the new age. "As instrument builder I am becoming a resident of the land of dirty hands and hardware stores," Forster says without a trace of bitterness. "I have sacrificed a possible career as pianist, teacher, and historian in an attempt to bring opposites like lumberyards and music calculators and Indonesian scales together."

The grand old man of the microtonalists is Ivor Darreg, a composer, instrument builder, and piano tuner who lives in Glendale, California. The former child prodigy, now sixty-three, is a leading authority on musical life beyond the 12-tone scale.

> *"From the stereo emerges a series of simple musical phrases, while TV screens display an analogous array of fleeting colored lines. The experience is music and art combined."*

"I've tuned organs, pianos, and harpsichords for forty years," Darreg says. "I've always wanted to escape the music establishment's squirrel cage. Think of what it's like to be a concert pianist and practice the same old scales day after day. Those horrible exercises were so boring."

In 1936, when he realized he wasn't using his ears to hear efficiently, Darreg constructed his first instrument, one electronic musicians would envy for its prescience. He found an old accordion keyboard in a music shop in San Francisco and, adding parts from a shortwave radio, created an electronic keyboard oboe. A musician with a conventional background could play it, but Darreg added several buttons that produced pitches not heard on the ordinary 12-tone scale. They were to an extent new notes.

Since then, Darreg has built five contrabass steel instruments, ranging from six to eight feet long, which he calls Megalyras. He has also modified and refretted many guitars, so musicians can play in 19, 22, or 31 tones per octave.

"It changes the mood profoundly by adding four or five new musical moods to the vocabulary," Darreg says of the Megalyras. "There are certain chords and combinations of sounds that are impossible in an ordinary twelve-tone system. Until the guitar took over from the piano as our main instrument, it was financially and mechanically impractical to increase the number of tones. It's been attempted for two or three centuries, but it simply costs too much."

Perhaps the piano has been supplanted by the guitar, but other microtonalists dreaming of new sounds have succeeded in modifying the keyboard. The most successful designs use a series of oval-shaped buttons to accommodate 19 tones. Composers call this the generalized keyboard, and there are very few of them in this country for precisely the reason Darreg mentioned: cost.

Ervin Wilson and Scott Hackleman applied the generalized keyboard to a clavichord they codesigned, and Motorola produced a microtonalist organ called the Scalatron. There are only two existing Scalatrons, one used by George Secor in California and another at Queens College where Professor Joel Mandelbaum uses it as a composing and teaching aid.

The Scalatron is an amazingly versatile instrument with five octaves of 50 keys each and 31 programmed pitches. It looks as if only an octopus could find its way around the keyboard, but once you learn the color coding, Mandelbaum says, the instrument is almost as easy to play as a piano. The white keys are the naturals, the blacks are the sharps, the reds are the flats, the greens are the half-sharps, and the blues are the half-flats.

As a serious composer who spends more of his time in the musical mainstream, Mandelbaum is still discovering the Scalatron. "There's an awful lot on that instrument I haven't heard, or if I've heard it, I haven't yet internalized it," he says. Yet he is optimistic about the legacy the microtonal school will leave. "When I'm writing nonmicrotonal music, I feel like I'm gathering wood in the forest," he says. "When I'm writing microtonal music, I feel like I'm planting the seeds of the future."

Those musical seeds are also being nurtured by researchers who are expanding the computer's ability to generate truly radical sounds. Charles Dodge, the dedicated young composer who runs Brooklyn College's four-year-old research-minded computer music department, is quietly pushing the computer's musical abilities to their full potential.

Dodge's work focuses on vocoding, a complex method of musicalizing the human voice. Following an apprenticeship with Mathews at Bell Labs, Dodge carted an ancient, discarded Bell Labs Honeywell computer with him to Brooklyn. The electronic beast befits the atmosphere of Dodge's lab—a throwback to a 1950s recording studio—where he puts the old-fashioned unit to work creating never-

before-conceived aural sensations

The process is painstaking and slow A spoken voice, if first digitized at 15 000 samples per second and an analysis program reduce the speech data to a more manageable 120 frames per second Each frame can then be altered according to desired pitch amplitude time and several filter coefficients that take into account the sound generated by windpipe, tongue jaw, mouth glottis and vocal-cord movements

The tape of Dodge's composition "In Celebration" a rendition of the Mark Strand poem contains words that are often inaudible, but the musical range is enough to make an opera singer envious From simple melody to complex eerie harmonies the musical breadth is as if the Andrews Sisters had suddenly become baritones

The Brooklyn College team says the computer makes it possible to run the pitch and amplitude from one voice through the vocal track of another voice The result is a sort of musicalized speech grafting "It's like taking one person's vocal cords and putting them in someone else's mouth" says music professor Tom Jerse laughing at the possibilities "It means you can mix Mick Jagger and say Luciano Pavarotti into one voice track a literal if somewhat bizarre form of rock opera"

Three thousand miles from Brooklyn in Stanford University's music department computer experts are charting the first paths along different musical frontiers combining computer analyses of various instruments with the human voice They can for example mix the sound produced by a trumpet mouthpiece with the voice of a singer into one mode of expression

Stanford calls this process cross synthesis Researcher John Serawn says the resulting harmonics are quite spooky "You can get a flute that sounds as if it were talking" he says

Serious composers will probably not latch on to cross synthesis for writing orchestral symphonies but there is unlimited appeal for those scoring music for science-fiction movies "In the 1980s and 1990s you will hear sounds of instruments playing voices, probably in *Star Wars*-like movies one noted Stanford computer-music researcher predicts

The sounds of the future whether generated by computers or microtonal composers may be presented to us in forms being created by artists who are exploring the aural sensations of sound sculptures or sound environments

Max Neuhaus a percussionist who has played with famed experimental conductor Pierre Boulez is one of the leading practitioners of the theory that sound creation has absolutely no boundary Neuhaus once made a structure called Water Whistle A series of rubber pressure hoses, with whistles attached whipping around underwater in a pool created music that existed only in the water You had to listen with your ears submerged Since then he has constructed Times Square a set of resonating

CONTINUED ON PAGE 102

For a beautiful full color lithograph print 18" x 19" of Ken Davies famous Flying Wild Turkey painting supervised by the artist, send $5.00 to Box 929 OM N Y NY 10268.

TOTO, I'VE A FEELING WE'RE NOT IN KANSAS ANYMORE...

We're not. We're in the world of the future, a world no longer contained—or containable—on one planet.

Today we are concerned with the worlds within and the worlds beyond, because we know that this is where we'll find answers to some of the questions that haunt our curiosity. We look far into black, depthless space for definition of life and clues to its origin. We look further and further into the human psyche to try to fathom that secret universe. We look everywhere. The new pioneers are the scientists, astronomers, geologists, oceanographers, psychiatrists, chemists, physicists, and the rest, and the new frontiers they cross seem as uncrossable and improbable as America must have seemed before Columbus and space travel before the Wright brothers.

This is what OMNI magazine is all about. It was created in the spirit of this adventure. In its award-winning articles it has covered, and continues to follow, the entire science spectrum, including bionics, space travel, cloning, robotics, and even the timeless pursuit of the yeti.

OMNI publishes and interviews the greatest writers, scientists, and thinkers of our time—B. F. Skinner, Pohl, Asimov, Sagan, Toffler, Fuller, Heinlein. Regular columns on space, the arts, UFOs, and Earth keep fingers on pulses whose count is always subject to drastic change. And OMNI is the first major magazine to afford paranormal phenomena the simple dignity of a proper scientific inquiry.

There has never been a magazine like OMNI before, because there has never been an age like this one before. OMNI is on sale everywhere. But if you'd like to guarantee seeing all 12 issues for a year and save $6 from the newsstand price, then fill in the coupon below, enclose $18, and we'll start your subscription immediately.

OMNI. The magazine of tomorrow. But subscribe today because tomorrow is closer than you think.

OMNI Subscription Dept.
P. O. Box 908, Farmingdale, N.Y. 11737

☐ YES! Send me one year of OMNI (12 issues) for only $18 (that's a savings of $6 off the newsstand price).

☐ Increase my savings by sending me 2 years of OMNI (24 issues) for only $32 (that's a saving of $16 off the newsstand price).

(For United Kingdom subscriptions, send payment of £11 for one year to: 2 Aramber Rd., London, W14.)

Name _____

Address _____

City _____ State _____ Zip _____

☐ Please extend or renew my current subscription at the same low rate

☐ Check or money order enclosed

☐ American Express ☐ Mastercard

☐ VISA (BankAmericard)

Acct # ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Exp. Date _____

Interbank # ☐☐☐☐ (Mastercard only)

Signature _____

Print clearly please. Rates for U.S., APO, FPO, and U.K. only. Canada and elsewhere add $6 to the U.S. subscription rate. Payment must accompany order. Allow 8-9 weeks for delivery of first issue. Offer void after 9 81 00361

FICTION

Hunted without mercy, the great metallic herds were nearing extinction

BY ROGER ZELAZNY

Spinning through the dream of time and dust they came beneath a lake-cold lake-blue lake-deep sky, the sun a crashed and burning wreck above the western mountains, the wind a whipper of turning sand devils, chill turquoise wind out of the west taking wind. They ran on bald tires, they listed on broken springs, their bodies creased, paint faded, windows cracked, exhaust tails black and gray and white, streaming behind them into the northern quarter whence they had been driven this day. And now the pursuing line of vehicles, fingers of fire curving, hooking, above, before them. And they came, stragglers and breakdowns being blasted from bloom to wilt, flash to smolder, ignored by their fleeing fellows.

Murdock lay upon his belly atop the ridge, regarding the advancing herd through powerful field glasses. In the arroyo to his rear the Angel of Death—all cream and chrome and bulletproof glass, sporting a laser cannon and two banks of armor-piercing rockets—stood like an exiled mirage, glistening in the sun, vibrating, tugging against reality.

It was a country of hills, long ridges, deep canyons toward which they were being driven. Soon they would be faced with a choice. They could pass into the canyon below or enter the one farther to the east. They could also split and take both passages. The results would be the same. Other armed observers were mounted atop other ridges, waiting.

As he watched to see what the choice would be, Murdock's mind roamed back over the previous fifteen years, since the destruction of the Devil Car at the graveyard of the autos. He had, for twenty-five years, devoted his life to the pursuit of the wild ones. In that time he had become the world's foremost authority on the car herds—their habitats, their psychology, their means of maintenance and fueling—learning virtually everything concerning

LAST OF THE WILD ONES

PAINTING BY DON EDDY

their ways save for the precise nature of the initial flaw that one fatal year which had led to the aberrant radio-communicable program that spread like a virus among the computerized vehicles. Some but not all were susceptible to it, tightening the disease analogy by another twist of the wrench. And some recovered to be found returned to the garage or parked before the house one morning battered but back in service, reluctant to recite their doings of days past. For the wild ones killed and raided, turning service stations into fortresses, dealerships into armed camps. The black Caddy had even borne within it the remains of the driver it had mooned long ago.

Murdock could feel the vibrations beneath him. He lowered the glasses, no longer needing them, and stared through the blue wind. After a few moments more he could hear the sound, as well as feel it—over a thousand engines roaring, gears grinding, sounds of scraping and crashing—as the last wild herd rushed to its doom. For a quarter of a century he had sought this day, ever since his brother's death had set him upon the trail. How many cars had he used up? He could no longer remember. And now...

He recalled his days of tracking, stalking, observing, and recording. The patience, the self-control it had required, exercising restraint when what he most desired was the immediate destruction of his quarry. But there had been a benefit in the postponement—this day was the reward, in that it would see the passing of the last of them. Yet the things he remembered had left strange tracks upon the path he had traveled.

As he watched their advance, he recalled the fights for supremacy he had witnessed within the herds he had followed. Often the defeated car would withdraw after it was clear that it was beaten, grill smashed, trunk sprung, lights shattered, body crumpled and leaking. The new leader would then run in wide circles, horn blaring, signal of its victory, its mastery. The defeated one, denied repair from the herd supply, would sometimes trail after the pack, an outcast. Occasionally it would be taken back in if it located something worth raiding. More often, however, it wandered across the Plains, never to be seen mobile again. He had tracked one once, wondering whether it had made its way to some new graveyard of the autos. He was startled to see it suddenly appear atop a mesa, turn toward the face that rose above a deep gorge, grind its gears, rev its engine, and rush forward, to plunge over the edge, crashing, rolling, and burning below.

But he recalled one occasion when the winner would not settle for less than a total victory. The blue sedan had approached the beige one where it sat on a low hillock with four or five parked sports cars. Spinning its wheels, it blared its challenge at several hundred meters' distance, then turned, cutting through a half circle, and began its approach. The beige began a series of similar maneuvers, wheeling and honking, circling as it answered the challenge. The sports cars hastily withdrew to the sidelines.

They circled each other as they drew nearer, the circle quickly growing smaller. Finally the beige struck, smashing into the blue vehicle's left front fender, both of them spinning and sliding, their engines racing. Then they were apart again, feinting—advancing a brief distance, braking, turning, backing, advancing.

The second engagement clipped off the blue vehicle's left rear taillight and tore loose its rear bumper. Yet it recovered rapidly, turned, and struck the beige' broadside, partly caving it in. Immediately it backed off and struck again before the other had completely recovered. The beige tore loose and spun away in reverse. It knew all the tricks, but the other kept rushing in, coming faster now, striking and withdrawing. Loud rattling noises were coming

● Murdock could feel the vibrations. He lowered the glasses, no longer needing them, staring through the blue wind. He could hear the sound... as the last wild herd rushed to its doom. ●

from the beige, but it continued its circling, its feinting, the sunlight through the risen dust giving it a burnished look, as of very old gold. Its next rush creased the right side of the blue vehicle. It sounded its horn as it pursued it and commenced an outward turn.

The blue car was already moving in that direction, however, gravel spewing from beneath its rear wheels, horn blasting steadily. It leaped forward and again struck the beige upon the same side. As it backed off, the beige turned to flee, its horn suddenly silent.

The blue car hesitated only a moment, then sped after it, crashing into its rear end. The beige pulled away, leaking oil, doors rattling. But the blue car pursued it and struck again. It moved on, but the blue swerved, ran through a small arc, and hit it yet again upon the same side it had earlier. This time the beige was halted by the blow, steam emerging from beneath its hood; this time, as the blue car drew back, it was unable to flee. Rushing forward, the blue struck it once more upon the badly damaged left side. The impact lifted it from the ground, turning it over onto the slope falling away sharply to its right. It rolled sideways, tumbling and bouncing, to be brought up with a crash upon its side. Moments later its fuel tank exploded.

The blue car had halted, facing downhill. It ran up an antenna from which halt a dozen spinning sensors unfurled, a fairy totem pole shimmering in the fume-filled air. After a time it retracted the sensors and withdrew the aerial. It gave one loud blare of the horn then and moved away to round up the sports cars.

Murdock remembered. He put his glasses in their case as the herd neared the turning point. He could distinguish individual members now, unassisted. They were a sorry-looking lot. Seeing them, he recalled the points of the best that he had come across over the years. When their supplies of parts had been larger they had used their external manipulators to modify themselves into some magnificent and lethal forms. Kilo for kilo, the wild ones had become superior to anything turned out in the normal course of production.

All of the car scouts, of course, went armed, and in the early days a number of them had experimented. Coming upon a small herd, they would cut out a number of the better ones, blasting the rest. Disconnecting the think boxes, they would have their partners drive them back. But attempts at rehabilitation had been something less than successful. Even a complete wipe, followed by reprogramming, did not render the susceptible individuals immune to relapse. Murdock even recalled one that had behaved normally for almost a year, until one day in the midst of a traffic jam it had mooned its driver and taken off for the hills. The only alternative was to discard the entire computational unit and replace it with a new one—which was hardly worthwhile, since its value was far greater than that of the rest of the vehicle.

No, there had been no answer in that direction. Or any other but the course that he had followed: track and attack, the systematic destruction of the herds. Over the years his respect for the cunning and daring of the herd leaders had grown. As the wild ones had dwindled in number, their ferocity and guile had reached the level of legend. There had been nights, as he lay sleeping, that he dreamed of himself as a wild car, armed, racing across the Plains, leader of a herd. Then there was only one other car, a red one.

The herd began its turn. Murdock saw, with a sudden pang of regret, that it was heading into the far eastern canyon. He tugged at his white-streaked beard and cursed as he reached for his stick and began to rise. True, there would still be plenty of time to get over to the next canyon for the kill, but—

No! Some of them were splitting off, heading this way!

Smiling, he drew himself upright and limped rapidly down the hill to where the Angel of Death waited for him. He heard the exploding mines as he climbed into

the vehicle. Its motor began to hum.

"There are a few in the next canyon," came the soft, well modulated, masculine voice of his machine. "I have been monitoring all bands."

"I know," he answered, stowing his stick. "Let's head over that way. Some will make it through."

Safety restraints snapped into place around him as they began to move.

"Wait!"

The white vehicle halted.

"What is it that you wish?"

"You are heading north."

"We must to exit here and enter the next canyon with the others."

"There are some connecting side canyons to the south. Go that way. I want to beat the others in."

"There will be some risk involved."

Murdock laughed.

"I've lived with risk for a quarter of a century waiting for this day. I want to be there first for the end. Go south!"

The car swung through a turn and headed southward.

As they cruised along the arroyo bottom's sand, Murdock asked, "Hear anything?"

"Yes," came the reply. "The sounds of those who were blasted by the mines, the cries of those who made it through."

"I knew some would make it! How many? What are they doing now?"

"They continue their flight southward. Perhaps several dozen. Perhaps many more. It is difficult to estimate from the transmissions."

Murdock chuckled.

"They've no way out. They'll have to turn sooner or later, and we'll be waiting."

"I am not certain that I could deal with a mass attack by that many—even if most lack special armaments."

"I know what I'm doing," Murdock said. "I've chosen the battleground."

He listened to the muffled thuds of the distant explosions.

"Prime the weapons systems," he announced. "Some of them could have located the sideway we'll be taking."

A twin band of yellow lights winked out on the dashboard and were replaced by a double row of green ones. Almost immediately these faded and were succeeded by two lines of steady red points.

"Ready on rockets," came the voice of the Angel.

Murdock reached out and threw a switch.

A larger light had also come on—orange and pulsing faintly.

"Cannon ready."

Murdock threw a larger switch beside a pistol grip set in the dash below it.

"I'll keep this one on manual for now."

"Is that wise?"

Murdock did not answer. For a moment he watched the bands of red and yellow strata to his left, a veil of shadow being drawn slowly upward over them.

"Slow now. The sideway will be coming up shortly. It should be up there on the left."

His car began to slow.

"I believe that I detect it ahead."

"Not the next one. It's blind. There's one right after it, though. It goes through."

They continued to slow as they passed the mouth of the first opening to the left. It was dark and angled off sharply.

"I've become aware of the next one."

"Very slowly now. Blast anything that moves."

Murdock reached forward and took hold of the pistol grip.

Angel braked and made the turn, advancing into a narrow pass.

"Dim the ready lights. No transmissions of any sort. Keep it dark and quiet."

They moved through an alley of shadow, the distant explosions having become a pulsing more felt than heard, now. Stony walls towered on either hand. Their way wound to the right and then to the left.

Another right-hand twisting, and there was a bit of brightness and a long line of sight.

"Stop about three meters before it opens out," Murdock said, not realizing until moments later that he had whispered.

They crept ahead and came to a halt.

"Keep the engine running."

"Yes."

Murdock leaned forward, peering into the larger canyon running at right angles to their own. Dust hung in the air—dark, murky below, sparkling higher above where the sun's rays could still reach.

"They've already passed," he reflected, "and soon they should realize they're in a box—a big one, but still a box. Then they'll turn and come back, and we'll open up on

them" Murdock looked to the left "Good place right over there for some more of our people to lay up and wait for them I'd better get in touch and let them know Use a fresh scrambler this time"

"How do you know they'll be coming back? Perhaps they'll lay up in there and make you come in after them"

"No" Murdock said "I know them too well They'll run for it"

"Are you sure there aren't any other sideways?"

"None going west There may be a few heading east but if they take them they'll wind up in the other trap Either way they lose"

"What if some of those others cut down this way?"

"The more the merrier Get me that line And see what you can pick up on the herd while I'm talking"

Shortly after that he was in touch with the commander of the southern wing of the pursuers requesting a squad of armed and armored vehicles to be laid up at the point he designated He learned that they were already on their way to the western canyon in search of those vehicles observed entering there The commander relayed Murdock's message to them and told him that they would be along in a matter of minutes Murdock could still feel the shock waves from the many explosions in the eastern canyon

"Good" he said and he ended the transmission

"They've reached the end" the Angel announced a little later "and are circling I hear their broadcasts They are beginning to suspect that there is no way out"

Murdock smiled He was looking to his left where the first of the pursuing vehicles had just come into sight He raised the microphone and began giving directions

As he waited he realized that at no time had he relaxed his hold on the pistol grip He withdrew his hand, wiped his palm on his trousers, and returned it

"They are coming now" the Angel said "They have turned and are headed back this way"

Murdock turned his head to the right and waited The destruction had been going on for nearly a month and today's should be the last of it He suddenly realized just how tired he was A feeling of depression began to come over him He stared at the small red lights and the larger pulsing orange one

"You will be able to see them in a moment"

"Can you tell how many there are?"

"Thirty-two No hold it thirty-one They are picking up speed Their conversations indicate that they anticipate an interception"

"Did any come through from the eastern canyon?"

"Yes There were several"

The sound of their engines came to him Hidden there in the neck of the ravine he saw the first of them—a dark sedan dented and swaying half of its roof and the nearest fender torn away—come around the canyon's bend He held his fire as it approached, and soon the others followed—rattling steaming leaking covered with dents and rust spots windows broken hoods missing doors loose A strange feeling came into his breast as he thought about the more magnificent specimens of the great herds he had followed over the years

Still he held his fire even as the first in line drew abreast of him, and his thoughts went back to the black and shining Devil Car and to Jenny the Scarlet Lady with whom he had hunted it

The first of the pack reached the place where the ambushers waited

"Now?" the Angel asked just as the first rocket flared off to the left

"Yes"

They opened up and the destruction began cars braking and swerving into one another the canyon suddenly illuminated

"The destruction had been going on for nearly a month, and today's should be the last of it He suddenly realized how tired he was A feeling of depression began to come over him"

by half a dozen blazing wrecks—a dozen—two

One after another they were halted burned Three of the ambushers were destroyed by direct crashes Murdock used all of his rockets and played the laser over the heaped remains As the last wreck burst into flame he knew that though they weren't much compared with the great ones he had known, he would never forget how they had made their final run on bald tires broken springs leaking transmissions, and hate

Suddenly he swiveled the laser and fired it back along the canyon

"What is it?" the Angel asked him

"There's another one back there Don't you pick it up?

"I'm checking now but I don't detect anything"

"Go that way"

They moved forward and turned to the right Immediately the radio crackled

"Murdock where are you going?" This came from one of the ambushers to the rear

"I thought I saw something I'm going ahead to check it out"

"I can't give you an escort till we clear some of these wrecks"

"That's all right"

"How many rockets have you got?"

He glanced again at the dash where the only light that burned was orange and pulsing steadily

"Enough"

"Why don't you wait?"

Murdock chuckled "Do you really think any of those clunkers could touch something like the Angel? I won't be long"

They moved toward the bend and turned The last of the sunlight was striking the highest points of the eastern rim overhead

Nothing

"Picking anything up?" he asked

"No Do you want a light?"

"No"

Farther to the east the sounds of firing were diminishing The Angel slowed as they neared a wide slice of darkness to the left

"This ravine may go through Do we turn here or continue on?"

"Can you detect anything within it?"

"No"

"Then keep going"

His hand still upon the grip Murdock moved the big gun slightly with each turn that they took covering the most likely areas of opposition rather than the point directly ahead

"This is no good" he finally announced "I've got to have a light Give me the overhead spot"

Instantly the prospect before him was brightly illuminated dark rocks orange stands of stone striped walls—almost a coral seascape through waves of settling dust

"I think somebody's been by here more recently than those we burned"

"Don't tired people sometimes see things that are not really there?"

Murdock sighed

"Yes and I am tired That may be it Take the next bend anyway"

They continued on making the turn

Murdock swiveled the weapon and triggered it blasting rock and clay at the corner of the next turning

"There!" he cried "You must have picked that up!"

"No I detected nothing"

"I can't be cracking up at this point! I saw it! Check your sensors Something must be off"

"Negative All detection systems report in good order"

Murdock slammed his fist against the dash

"Keep going Something's there"

The ground was churned before them There were too many tracks to tell a simple tale

"Slowly now" he said as they approached the next bend "Could one of them have some kind of equipment or something to block you I wonder Or am I really seeing ghosts? I don't see how—"

"Gully to the left. Another to the right."

"Slower! Run the spotlight up them as we pass."

They moved by the first one, and Murdock turned the weapon to follow the light. There were two side passages going off the ravine before it turned.

'Could be something up there," he mused. "No way of telling without going in. Let's take a look at the next one."

They rolled on. The light turned again, and so did the gun. The second opening appeared to be too narrow to accommodate a car. It ran straight back without branching, and there was nothing unusual in sight anywhere within it.

Murdock sighed again.

"I don't know," he said, "but the end is just around the next bend—a big box of a canyon. Go straight on in. And be ready for evasive action."

The radio crackled.

"You all right?" came a voice from the ambush squad.

"Still checking," he said. "Nothing so far. Just a little more to see."

He broke it off.

"You didn't mention—"

"I know. Be ready to move very fast."

They entered the canyon, sweeping it with the light. It was an oval-shaped place, its major axis perhaps a hundred meters in length. Several large rocks lay near its center. There were a number of dark openings about its periphery. The talus lay heavy at the foot of the walls.

"Go right. We'll circle it. Those rocks and the openings are the places to watch."

They were about a quarter of the way around when he heard the high, singing sound of another engine revving. Murdock turned his head and looked fifteen years into the past.

A low, red Swinger sedan had entered the canyon and was turning in his direction.

"Run!" he said. "She's armed! Get the rocks between us!"

"Who? Where?"

Murdock snapped the control switch to manual, seized the wheel, and stomped on the gas. The Angel leaped ahead, turning, as fifty caliber machine guns blazed beneath the darkened headlights of the other vehicle.

"Now do you see it?" he asked as the rear window was starred and he felt the thudding impact of hits somewhere toward the back of the vehicle.

"Not entirely. There is some sort of screen, but I can estimate based on that. Give me back the controls."

"No. Estimates aren't good enough with her," Murdock replied, turning sharply to place the rocks between himself and the other.

The red car came fast, however, though it had stopped firing as he entered the turn.

The radio crackled. Then a voice he had thought he would never hear again came over it. "That's you, isn't it, Sam? I heard you back there. And that's the sort of car the Archengineer of Geeyem would have built

CONTINUED ON PAGE 110

OMNI PROFILE

By bringing humor to the lab's rigid domain, a maverick psychologist bucks the scientific establishment

I woke to find myself in a totally different room. On the wall facing me were two doors—one pure white, the other jet-black. I didn't like the looks of the situation. Apparently I had to choose which of the doors was open and led to food. The other would be locked. If I jumped at the wrong door and found it locked, I'd fall into the water. I needed a bath, but I didn't relish getting it this way.

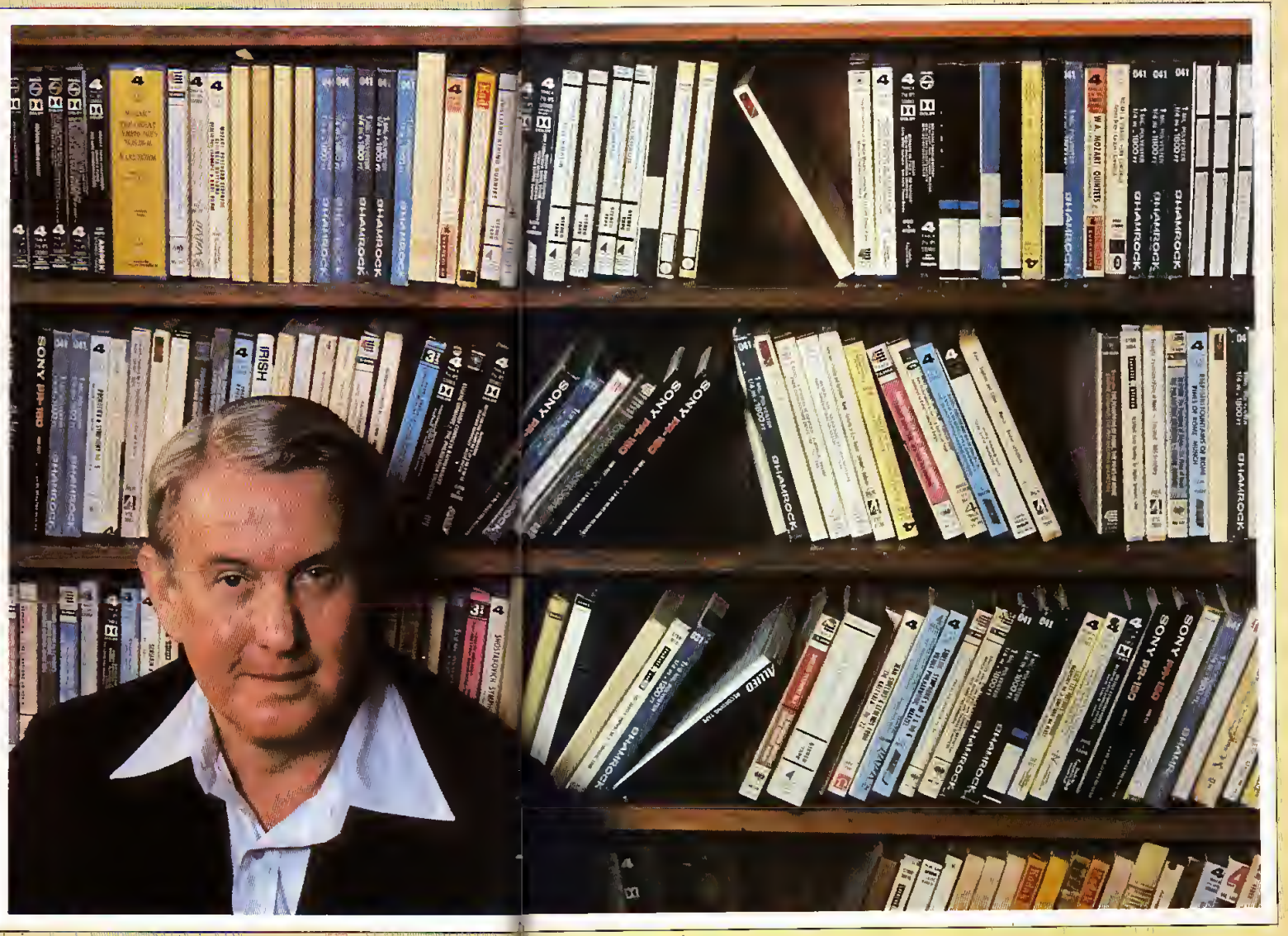
The ultimate behaviorist's nightmare. He wakes up as a "White Rote" trapped in an extraterrestrial psychologist's operant chamber. The rest of this little scientific hallucination can be found on page 395 of *Understanding Human Behavior* (Third Edition), one of the most successful college psychology texts of all time. Its author, James V. McConnell, is a hero to a generation of psych students, as well as to his publishers, for whom he makes tons of money. Each chapter of *UHB-3*, as McConnell calls it, begins with the first half of an appropriate vignette. To find out how the story ends, you're supposed to read the chapter of hard science. The conclusion appears after the facts.

There are many stories. "On the Other Hand" introduces a chapter on the split brain with a Kafkaesque fable about a dissident neurophysiologist. Before

PHOTOGRAPH BY
DAN McCOY/RAINBOW

KING OF THE WORM RUNNERS

BY KATHLEEN STEIN



being dragged off by the secret police he buries his treasured formula in the "silent" right hemisphere of a patient. Later friendly doctors decode the message by encouraging the patient to draw on the right side of the brain. In "Riddle of Rage" (for a chapter on brain-function localization) a scouting party of sentient microchips fly in for a closer look when they spy CARs, the rudiments of intelligent metallic life on the third planet around a distant star. Other titles include "How to Build a Better Robot," "Black Boxes and Womb Tanks," "It's All in Your Mind," and "I'm Crazy—You're Crazy."

By sandwiching the linear information between two slices of Gestalt, McConnell appeals to both sides of the brain—the no-nonsense left hemisphere and the poetic shape maker on the right. It works like behavior mod," says McConnell, a tall, tortyish man with a sort of wide-angle, bigger-than-life face. One might encounter this visage close-up in a Stanley Kubrick movie offering you a smoking glass of ye olde ultragiggle. "Behavior mod outlines the pattern for you, arranges the material so that your right hemisphere perceives while your left learns by rote. That's what my stories are supposed to do: help the right perceive patterns and become emotionally involved while presenting the material in a form easily memorized by the left."

Although it makes sense and seems to work, one still wonders what kind of guy would use a comic book story to ruminate on the mind/body/soul question in the middle of an introductory psych text. But McConnell is a scientist with a reputation for being less than orthodox in his research and methodology. Worse, he has been accused of being a humorist, which, to paraphrase Arthur Koestler, has unleashed "the hostility of the gray birds in the groves of academe against this bird with the too-hilarious voice."

McConnell personifies a select minority of scientists who openly—too openly—employ humor as a *modus operandi*. His irrepressible desire to have a good laugh has gotten him into some deep and piranha-filled water. So we posed the question: Can science and humor exist on the same plane?

"I hope so," the psychologist says with an air of elegant melancholia that often hangs like a little cloud over the head of our best humorists. "But I remind you, most people with political power don't have a good sense of humor—in any field. New endeavors need humor because you're trying to unify a group you're fighting for your existence or fighting an establishment. Humor doesn't go over well; humor has too much intellect in it."

Our story—really a tragicomedy—begins in 1953 at the University of Texas, where two psychology grad students, McConnell and Robert Thompson, are conditioning freshwater flatworms to contract, or scrunch up, each time a mild shock is delivered through the water in their trough. Just before the shock, an electric light is turned on above the trough. Could the worms be taught to scrunch when they see the light—sans shock? McConnell and Thompson thought so.

The flatworm, or planarian, sometimes described as a "gliding patch of slimy skin," is a fabulous creature able to divide into scores of pieces, each of which regenerates into a new worm. As the lowest organism on the phylogenic scale, it has a primitive brain and synaptic nervous system. Planaria present an elemental model on which to study learning and memory.

The two young worm runners' results indicating that planarians can be taught to scrunch up on cue made no waves. McConnell went on to teach at the University of Michigan, where he took the experiment one scrunch further. He cut the worms in half, and when the tail halves had regenerated, they remembered as much about how to behave in the spotlight as the head did, and sometimes more.

This bit of news raised eyebrows, especially when McConnell conjectured publicly that some chemical conditioning may take place during training that could be transmitted to succeeding generations of worms. "If this should prove true for men and women as well as worms," he told *Newsweek* in 1959, "then memory and learning would appear to have a chemical, inherited basis." With statements like this, smacking ever so faintly of Lamarckian Heresy, the atmosphere surrounding McConnell's lab began to heat up. But there was more to come, much more.

"If I had to do it over, I would have qualified all my statements with 'ifs' and 'perhapses,' appeared dead serious, and never smiled at anything. And I would have gone mad."

By now McConnell was an established researcher receiving grants. "At that time we began classically training a bunch of victim planarians," McConnell recalls, guiding us down Memory Lane. "Then we chopped them up and fed the pieces to untrained cannibalistic planarians. We also fed untrained victims to a control group. After we had given both groups a couple of days to digest their meal, we trained both groups. To our delight, the planarians that had eaten educated victims responded more often than did the worms that had consumed their untrained brethren. We seemed to have transferred a memory engram from one animal to another!"

Food for thought indeed. If you are what you eat, there's a feast of philosophy, arts, and science awaiting us all. We have only to grind up our poets and thinkers and serve them as hors d'oeuvres at cocktail parties. And so on. McConnell began having a terrible time with the lay press, trying to explain that it didn't work that way—for the same reason you don't become piggish merely from consuming a ham sandwich. The information that might be encoded in the animal protein is destroyed by the digestive system in mammals before assimilation takes place.

Some scientists were finding all this hard to swallow. At first the issue was mainly whether the worms could learn in the first place, rather than the more dramatic possibility that learning could be transferred. But McConnell ignored the former issue, concentrating on the suggestion that memory formation is somehow involved with the creation of new chemical molecules and that ribonucleic acid in the brain plays a role in the process. The startling outlines of a new hypothesis were beginning to form. Learning, especially memory acquisition, might function by means of a rich interplay of chemicals. Even more startling: There might be a chemical code for learning—even as DNA is for genetics.

By the mid-Sixties many research groups reported success in memory transfer—using higher organisms. Brains of educated rats were ground up and injected into naive rats. The newly sophisticated rats behaved in a manner that indicated they had learned by hard experience. Paying Your Dues could become obsolete, at least for rats. Maybe not just for rats.

Other experiments indicated that injections of smart rat brain could raise the I.Q.'s of hamsters, suggesting that RNA contains chemical components of memory and intelligence that span whole species! If rats to hamsters, why not hamsters to man and man to rats, and so on?

Distinguished biochemist Georges Ungar went so far as to isolate, characterize, and synthesize a specific transferred memory, "scotophobin," or fear of the dark. Ungar would actually make up batches of scotophobin, a complex polypeptide 15 to 16 amino acids long, and send it to you in a bottle. He also had a whole bunch of other phobins. But this tantalizing research went "the way of the worm" when Ungar died in 1977.

To date there have been thousands of successful memory-transfer experiments reported in the literature. But the subject of the "chemical code for learning" still can elicit violent negative responses from otherwise cool men of science. One leading (and normally laid-back) artificial-intelligence honcho exploded at a lunch table recently when the 15-year-old transfer work was brought up. "Sophomoric! Ridiculous! A stage many people in neurophysiology seem to go through, and then reject quickly," he retorted.

Yet if the results were valid one British expert admitted they had revolutionary implications for the understanding of how learning takes place in the brain

The battle was waged in the periodicals and at the meetings According to scientific historian David Travis in his paper on McConnell 'Constructing Creativity The Memory Transfer and the Importance of Being Earnest the transfer results were rejected as sloppy science or unconscious experimenter bias or mass hysteria One peer review angrily denounced the work as either the biggest finding or the biggest hoax in psychology in years and probably the latter Another esteemed researcher called a memory-transfer article in *Science* a bunch of crap

The one recurring complaint, Travis says was the suspicion of subversive flippancy The McConnell group over the years had allowed an aura of schoolboy humor to surround their investigation And the reaction of the scientific community to this mirthful attitude was swift and vengeful McConnell calls it 'autistic hostility

What brought all this offending research and its frivolous attitude to a head was a unique and irregularly published journal It was born when McConnell s planarian experiments became known throughout the scientific and popular press and he subsequently was inundated with requests for information about the care and feeding of flatworms and for ideas on how to set up the experiments His Michigan group produced a set of mimeographed instructions and dubbed it *The Worm Runner s Digest* Vol 1 No 1 The cover was complete with heraldic device a two-headed worm rampant a coronet of connected nerve cells the S/R of Dr Pavlov s stimulus response and the legend *Ignotum per Ignotius* which Koestler translates as "When I get through explaining this to you you ll know even less than when I started "

Some of the recipients of that first issue took the joke at face value and sent back their experiments—real and farcical—and the *WRD* was on its way With the exception of *The Journal of Irreproducible Results* McConnell says, "*The Worm Runner s Digest* is the only scientific journal that *knowingly* publishes satire

During its first year the *Digest* s format mixed serious articles on physiological psychology with such twisted pieces as 'Operant Conditioning in the Domestic Darning Needle (*Spina ferrica*)' and 'How to Make Use of the Self-Fulfilling Prophecy Without Hall Trying,' or such sublime pictorials as 'A Child s Garden of Vectors' Each issue was shot through with cartoons of worms engaged in Socratic dialogue

McConnell s editorial 'Worms & Things' always let the reader in on the latest theory "How old are worms?" he writes in one issue "If a worm be hatched from an egg, grow to maturity in two months then fission into halves spontaneously and regrow into two mature worms in one month how old are the latter individuals? And if this keeps up for an extended period of time what can one say about age?

In later issues straight articles were separated from spoofs because scientists complained they could not tell them apart The serious and the satirical were printed from opposite covers after that Yes there were some works of genius in the *Digest* he mused Some of it s obviously crud But to quote Ted Sturgeon and his marvelous law 'Ninety percent of everything is crud ' And the *Digest* was read by simply everybody in the scientific community

The August 1963 issue featured A Christmas Caramel perhaps the only extant proof that famed behaviorist B F Skinner had ever cracked a joke This departure from Skinner s renowned sober voice—a skill he wrote for a Harvard Christmas party—takes place in the office of one Dr Skinnybox who is interrupted from his reading of *Esquire* magazine by Barrelbottom a student inquiring about graduate work in psychology By means of a series of electrical shocks to Barrelbottom s bottom—followed by rewards of peanuts—Skinnybox convinces Barrelbottom to study behaviorism As the curtain falls Skinnybox has attached a rubber hose from the peanut machine to Barrelbottom s mouth Skinner s stage directions

Barrelbottom now starts to type first rather hesitantly Occasionally he bounces off the chair occasionally he stops to chew peanuts Professor Skinnybox goes back to reading his Esquire

The *Digest* was important in three respects Travis says It provided McConnell with an editorial forum it carried bibliographies of all research relevant to the running of worms and the wider memory transfer confroversy and it was often sent gratis to those who might be interested

But in the minds of many influential scientists especially those in funding capacities the already-outrageous transfer studies were further damned by their physical proximity to the *Digest*'s satire and laughter The ambiguity of humor 'acted like an amplifier on McConnell s already-controversial research By the end of the Sixties he was severed from funding and was subjected to intense derision and prejudicial treatment at meetings and elsewhere

"Let s put it this way McConnell explained as he wheeled around the Ann Arbor campus in his Mercedes with its BE HAVE license plate 'If my overriding goal was to get the transfer material accepted and win the Nobel Prize and become famous in that sort of way I certainly would never have started the *Digest* Obviously subconsciously or whatever that wasn t one of my goals

"I went through an angry period in the Seventies I had fought for four years to get grants But I m a person who believes in cutting my losses In retrospect, the lack of funds forced me to go off and do other things I never would have written *UHB* if Uncle Sam had continued to give me lots of cash And the textbook has been verrry lucrative and *that* means freedom "

You can straighten a worm but the crook is in him and only waiting
—Mark Twain

Aside from indulging in satire and parody McConnell broke other sacred taboos He disclosed certain mechanical and human failures in the lab He once admitted for instance that his air conditioner had gone on the blink and heated up some animals Then there was the incident involving RNA McConnell admitted publicly that some had fallen on the floor and he had scooped it up and stuffed it back into its container Accidents will happen but not to scientists "Reporting that we dropped the first RNA on the floor McConnell commented, "is like admitting that one has farted in church

At the time though McConnell had no idea he had so soundly violated the canons of respectability "Although I certainly did violate them At the same time I thought many of my attackers were not all that intelligent and that those who were bright were blinded by prejudice and emotionality Now, however I would probably view them as defending their egos We did rather rip apart some deeply felt almost religious beliefs about the mind

Most neurophysiologists in the Fifties and Sixties spent their lives studying the brain with electrical probes thinking chemical events to be derivative "The memory-transfer research contradicted not one, but at least a dozen of the acts of faith on which neurophysiology had been founded he said We might as well have presented the pope with evidence that Mary was a whore Jesus was a homosexual and God was a black woman living in South Dakota For we had really pulled the props out from under most scientists who thought they knew what the mind was And the soul

"I suspect that if the response to our work had been more logical and less emotional the *Digest* would never have been born and my own image as a humorist would have been confined to classroom iconoclasms

Bernard Agranoff and Roger Sperry are only two of the eminent neuroscientists who told McConnell that if he were right all of their life s work was for naught Sir John Eccles went further As a devout Catholic he worked out the mind/body/soul problem in a personal way According to McConnell Eccles believes in free will yet he apparently had early difficulties resolving this concept with mechanistic physiology So he put God at the synapse as a sort of Brownian movement of molecules 'He [Eccles] once told me," McConnell remembered he couldn t believe in my

CONTINUED ON PAGE 108

FICTION

SERPENTS' TEETH

BY SPIDER ROBINSON

LOOKOVER LOUNGE
HOUSE RULES – AGES SIXTEEN AND UP
IF THERE'S A BEEF, IT'S YOUR FAULT IF YOU BREAK IT, YOU PAY FOR IT, PLUS SALES TAX AND INSTALLATION NO RESTRICTED DRUGS IF YOU ATTEMPT TO REMOVE ANY PERSON OR PERSONS FROM THESE PREMISES INVOLUNTARILY BY FORCE OR COERCION AS DEFINED BY THE HOUSE, YOU WILL BE SURRENDERED TO THE POLICE IN DAMAGED CONDITION THE DECISIONS OF YOUR BARTENDER ARE FINAL, AND THE MANAGEMENT DOESN'T WANT TO KNOW YOU THE FIRST ONE'S ON THE HOUSE, HAVE A GOOD TIME

Teddy and Freddy had certainly been highlighted when the door first slid open, but by the time their eyes had adjusted to the dimmer light inside the lounge, no one seemed to be looking at them (Was that a good or a bad sign? Neither was sure.)

Teddy entered first, Freddy at her heels. They strove to move synchronously, complementarily, as if they were old dance partners or old cop partners, as if they were married long enough to be telepathic. In fact, they were all of these things, but you could never have convinced anyone watching them now.

Teddy's first impression was that the lounge was just what she had been expecting. The crowd was sizable for this time of night, perhaps four or five dozen souls, almost evenly divided between hunters and hunted. While the general mood seemed hearty and cheerful, quiet desperation could be seen in any direction, invariably on the faces of the hunters. She frowned at a processor group, which was working the lower register, leaving the higher frequencies free for conversation.

Teddy located the bar and went over to it. The bartender was a grizzled old man whose hair had been red and whose eyes had been innocent—perhaps a century before. He displayed teeth half that age. "Welcome to the Big Apple, folks."

PAINTING BY KENT G. BELLOWS

Freddy's eyebrows rose. "How did you know we're from out of town?"

"I'm awake at the moment. What'll it be?"

Teddy and Freddy told him what they wanted. The old man took his time, poured with one finger, brought their drinks to them with his pinkies extended. As they accepted the drinks he leaned forward confidentially. "None o' my business, but you might could do all right here tonight. There's good ones in just now, one or two anyways. Don't push is the thing. Don't try quite so hard. Get me?"

They stared at him. "Thanks, uh—"

"Pop, everybody calls me. Let them do the talking."

"We will," Freddy said, tasting his drink. "Thank you, Pop."

"Whups! Scuse me." He spun and darted off at surprising speed toward the other end of the bar.

Teddy found them a table near one of the circulators, with a good view of the rest of the room. "Freddy, for God's sake, quit staring. You heard what the old fogy said. Lighten up."

"Teddy!"

"I like him, too. I was trying to get your attention. Try to look like there isn't muck on your shoes, will you?"

"How about that one?"

"Where?"

"There."

In the *blue and red*? Teddy composed her features with a visible effort. "Look, my love. Apparently we have HICK written across our faces in big, black letters. All right. Let's not make it DUMB HICK, all right? Look at her arms, for God's sake."

"Oh." Freddy's candidate was brazenly wearing a sleeveless shirt, and a cop should not miss track marks.

"I'm telling you, slow down. Look, let's make an agreement. We're not going to hit on *any*body for the first hour, all right? We're just out for an evening of quiet conversation—that's all."

"I see. We spent three hundred and sixty-seven Newdollars to come to New York and have a few drinks."

Teddy smiled as if Freddy had said something touching and funny and murmured, "*God damn it, Freddy. You promised. Don't say another word.*"

"All right, but I think these people can spot a phony a klick away. The one in pink and yellow, on your left."

"I'm not saying we should be phony. I'm—" Teddy made an elaborate hair-adjusting gesture, sneaked a look, then frankly stared. "Wow. That's more like it. Dancing with the brunette, right?"

"Yeah."

Their choice was golden-haired and heartbreakingly beautiful, dressed daringly by their standards, but not shockingly. Ribs showed, and pathetically slender arms, and long, smooth legs. Intelligence showed in the eyes; lips were slightly curled in boredom. No tattoos, facial or otherwise.

"Too good to be true," Teddy said sadly. "All those regulars here, and we walk into this place our very first night and score that?"

"I *like* wishful thinking. You shoot for the moon, once in a while you get it."

"And end up wishing you'd settled for a space station. I'd settle for that redhead in the corner with the ventilated shoes."

Freddy followed her glance, winced, and made a small sound of pity. "Don't mock the funny-looking."

"Me? I grew *up* funny-looking. I worked four summers pushing greaseburgers for this chin and nose. I'll settle for anyone halfway pleasant."

"I love your chin and nose. I don't like him anyway. He looks like the secretive type."

"And aren't you? This drink is terrible." The music had come to a halt.

"So's this—"

The voice was startlingly close. "Hey! You're in my seat. Atlas."

It was the stunning, golden-haired youngman. Alone.

Freddy began to move and speak at the same time, but Teddy kicked him hard in the shin, and he subsided.

"No, we're not," she said firmly.

There was nothing especially grudging about the respect that came into the youngman's eyes, but there was nothing especially submissive about it either. "I always sit by a circulator. I don't like breathing garbage." He made no move to go.

Teddy refused her eyes permission to drop from his. "We would be pleased if you'd join us."

"I accept."

Before Teddy could stop him, Freddy was up after a chair. He placed it beside the youth who moved it slightly to give himself a better view of the room than of them. The youngman sat without saying thanks.

"You're welcome," Freddy said quietly but quite audibly, slouching down in his own chair and Teddy suppressed a grin. When she led firmly, her husband always followed well. For the first time Teddy became aware that she was enjoying herself.

The youngman glanced sharply at Freddy. "Thanks," he said belatedly.

"Buy you a drink?" Teddy asked.

"Sure. Beer."

"Their choice was golden-haired and beautiful. Ribs showed, and pathetically slender arms, and long, smooth legs. Lips were slightly curled in boredom. No tattoos, facial or otherwise."

Teddy signaled a waiter. "Tell Pop we'd like a couple of horses over here," she said, watching the youngman. Dos Equis had become quite expensive since the rationalization of Mexico, but his expression did not change. Teddy glanced down at her own glass. "In fact, make it three pair."

"Tab?" asked the waiter.

"Richards. Richards, Ted Fred."

When the waiter had left, the blond said, "You people always seem to know how to do that. Signal waiters. What is that, a size thing or an age thing?"

"Neither one," Freddy answered seriously. "I think you could—"

"Which one of you is which?"

"I'm Freddy."

"Oh, Christ, and you're Teddy, huh?" He sighed. "I hope I die before I get cute. I'm Davy Pangborn."

Teddy wondered whether it was his legal name, but she did not ask. It would not have been polite; he had not asked them. "Hello, Davy."

"How long've you been in the city?"

Teddy grinned broadly, annoyed. "Is there hay in my hair or something? Honest to God, I feel like there's a fly unzipped on my forehead."

"There is," Davy said briefly and turned his attention to the room.

Teddy and Freddy exchanged a glance. Teddy shrugged.

"How old are you, Davy?" Freddy asked.

Davy turned very slowly, then looked Freddy over with insolent thoroughness. "How many times a week do you folks do the hump?" he asked.

Teddy kept her voice even with some effort. "See here, we're willing to swap data, but if you get to ask questions that personal, so do we."

"You just did."

Teddy considered that. "Okay," she said finally. "I guess I understand. We're new at this, though."

"Is that so?" Davy said disgustedly and turned back to face the room at large.

"We make love about three times a week," Freddy said.

"I'm nine," Davy said without turning.

The beer arrived, along with a plate of soy crunchies garnished with real peanuts. "Compliments of the house," the waiter said, and left.

Teddy glanced up, craned her head until she could see through the crowd to the bar. Pop's eyes were waiting for hers; he shook his head slightly, winked, and turned away. Total elapsed time was less than a second; she was not sure she had not imagined it.

She examined Davy more carefully. He was obviously bright and quick; his vocabulary and grammar were excellent; his education could not have been too badly neglected. He was clean. His clothes were exotic but neat and well kept. He didn't look like a welfare type; she would have given long odds that he had some kind of job, perhaps even a legal one. He was insolent, but she decided that in his position he

could hardly be otherwise He was fearfully beautiful, and must know it She was sure he was not and had never been a prostitute, he didn't have that chickie look that went with the profession.

Her well-developed cop sense told her that Davy had potential.

Did Pop know something she didn't? How honest was Davy? How many scars were drawn how deep across his soul? How much garbage had modern civilization poured into his subconscious? Would he grow up to be Maker, Taker, or Faker? Everyone in this room was walking wounded how severe were Davy's wounds?

"How long have you been single, Davy?"

He still watched the roomful of hunters and hunted, face impassive. "How long since *your* kid divorced *you*?"

"Why do you assume we're divorced?"

Davy drank deeply from his beer turned to face her. "Okay, let's run it down. You're not sterile or if you are it was postnatal complications. You've had it before. I can see it in your eyes. Maybe you worked in a power plant, or maybe Freddy here got the measles, but once someone called you Mommy it's unmistakable. And you're here. So the kid walked out on you."

"Or died," she suggested. "Or got sent up, or institutionalized."

"No." He shook his head. "You're hurting, but you're not hurting that bad."

She smiled. "All right. We've been divorced a year as of last week. And what about you?"

"Three years."

Teddy blinked, hiding her surprise. If Davy was telling the truth—and a lie seemed pointless—he had opted out the moment he could and was in no hurry to remarry. Well, with his advantages he could afford to be independent.

On the other hand, Teddy looked around the room herself, studying only the hunters, the adults, and saw no one who made her feel inferior. *He never met a couple like us before*, she told herself, and she made herself promise not to offer him their notarized résumé sheets unless and until he had offered them his.

"What was your kid like, Atlas?" Davy sipped beer and watched her over the rim of the glass.

"Why do you call us that?" Freddy asked.

Teddy frowned. "It's pretty obvious, darling. Atlas was a giant."

Davy grinned through his glass. "Only half the answer. The least important half. Tell me about your kid—your ex-kid—and I'll tell you the other half."

Teddy nodded. "Done. Well, his name is Eddie, and he's—"

"*Eddie!*" the youngman exclaimed. "Oh, my God, you people are too much!" He began to laugh. "If it'd been a girl, it would've been Hedy, right?"

Teddy reddened but held her temper. She waited until he was done laughing, and then two seconds more, and continued, "And he's got dark brown hair and hazel

eyes He s short for his age and he ll probably turn out stocky He has beautiful hands He s got my temper and Freddy s hands And he s bright like you He ll go far About the divorce Teddy paused She and Freddy had rehearsed this next part for so long that they could make it sound unrehearsed But Davy had a Built-in Crap Detector of high sensitivity Mentally Teddy discarded her lines and just let the words come We I guess we were slow in getting our consciousness raised Faster than some slower than most We we just didn t realize how misguided our own conditioning had been until it was too late Until we had our noses rubbed in it " She sipped her beer without tasting it

Although he had not been fed proper cues Freddy picked it up I guess we had our attention on other things I don t mean that we fell into parenting We thought it through—we thought we thought it through—before we decided to conceive But some of our axioms were wrong We

He paused blushed and blurted it out We had plans for Eddie "

"Don t say another word Davy ordered

Freddy looked puzzled Teddy frowned And they both waited

Davy finished his beer in one long slow draft stretching the silence He set the glass down put both hands on the table and smiled The smile shocked Teddy to her core She had never not in the worst of the divorce not in the worst of her work in the streets seen such naked malice on so young a face She ordered her own face to be inscrutable And she took hold of Freddy s hand under the table

"Let me finish It ll save time Davy said And I ll still tell you why you re an Atlas He looked them both up and down with care "Let s see You re hicks Some kind of civil service or social work or both—both of you Very committed very concerned I can tell you what grounds Eddie cited at the hearing Want to hear me?

You re doing okay so far Teddy said tightly

On the decree absolute it says Conceptual Conditioning Restraint of Personality and Authoritarianism Guaranteed sure as God made little green grasshoppers But it won t have the main reason on it "Delusions of Ownership

They had not quite visibly flinched at the first three charges but it was obvious that the fourth one got to them both Davy grinned wickedly

"Now the key word for both of you the word that unlocks you both is the word *future* I can even sort of see why Both of you are the kind that wants to change things to make a better world You figure like this The past is gone unchangeable The present is here *right now* and it s too late So the only part you can change is the future You re both heavy into politics am I right? Right He paused for a minute

He knew that he was getting to them both his grin got bigger Teddy and Freddy were rigid in their chairs

So one day the youngman went on softly "it dawned on you that the best way to change the future is to colonize it With little xeroxes of yourselves Of course one of the first concerns of a colonizing country is to properly *condition* the colonists To ensure their loyalty Because a colonist is supposed to give you the things *you* want to have in exchange for the things *you* want *him* to have and for this golden opportunity he is supposed to be properly grateful It wouldn t do for him to get any treasonous ideas about his own destiny his own goals Davy popped a handful of soy crunchies into his mouth "In your case the world needed saving and Eddie was elected Like it or not He chewed the mouthful "Let me see Don t tell me now I see the basic program this way first a solid grounding in math history and languages—I d guess Japanese Immersion followed by French Then by high school begin working toward law maybe with a minor in Biz Ecch Then some military service police probably and then law school if he survived all that With any luck at all old Eddie could have been mayor of wherever the hell you live—one of the Dakotas isn t it?—by the time he was thirty-five Then senator by forty

Jesus Teddy croaked

"I even know what Eddie wants to be instead A musician And not even a respectable musician piano or electric guitar or something cubical like that right? He wants to play that flash stuff that isn t even proper music He wants to be in a processor group right? I saw the way you looked at the band when you came in There are probably very few things on Earth that are of as little use to the future as flash It doesn t even get recorded It s not supposed to be It s for the *present* I wonder if Eddie s any good

What are you trying to do to us?

"Now about why you re Atlases Atlas isn t just a giant He s the worst kind of giant the one to avoid at all costs because he s got the weight of the whole world on his shoulders And he wants you to take it over for him as soon as you re big enough Sooner if possible Suddenly finally the grin was gone replaced by a snarl "Well screw you Atlas! You re not even cured *yet* are you? You re still looking for a Nice Young Kid Who Wants to Make Something of Himself You want a goddamn volunteer! You re suddenly childless and you re so goddamn lonely you tell each other you ll settle for anything just to have a kid around the house again But in your secret hearts you can t help hoping you ll find one with *ambition* Can you?

He sat back He was done "Well he said in a different voice already knowing the answer "how d I do? And he began eating the peanuts from the bowl

Teddy and Freddy were speechless for a long time The blood had drained from both

CONTINUED ON PAGE 112

Tempted by visions of megabucks and facing little risk of capture, a growing number of light-fingered computer experts are writing their own

PROGRAMS FOR PLUNDER

BY ROGER RAPOPORT

"If I had been a traditional embezzler," says Malcolm Senn, "they probably would have arrested me within six months. But with the computer I never had to touch the cashbox. Being controller made it easy. First I set up fourteen phony suppliers. Then I programmed the unit to pay automatically for nonexistent goods and services from my dummy companies. That way I could be skiing in the Alps while my California employer mailed checks to these fronts.

"The system earned me a million dollars over six years. By then I was ready to quit and start enjoying the

PAINTING BY RICHARD COHEN

houses planes and boats I'd accumulated. I knew if I just left my successor eventually would figure out what I'd done. Since I can't stand suspense, I began leaving clues to help the auditors catch me. I wanted to have my day in court, serve a brief sentence at a country-club prison, and then live off the money I'd stashed in Switzerland. But the auditors were impossibly slow. Finally, in desperation, I started bouncing checks. It still took them another three months to catch up with me."

Like most of the 800 other people whose computer crimes have been uncovered in recent years, Senn set up his automated theft with no previous lawbreaking experience. Until he began bilking his employer, Senn had never shoplifted so much as a chocolate bar.

Sitting in the living room of his rented Mediterranean-style home on the California coast, he discusses his lucrative data-processing heist with the insight of a business administration professor. On the coffee table is the latest issue of *Fortune*. In his right hand is a frosty glass of white wine that sloshes over the rim every time he gestures to emphasize his pearls of wisdom. Thanks to his pseudonym, Senn will have a talk tomorrow morning with Big Board companies anxious to secure their electronic data-processing (EDP) facilities.

The prospect of hiring a San Quentin alumnus to give advice on tighting computer crime might not appeal to every corporation. However, after losing over $2.1 billion to electronic thieves during the past 20 years, industry waits in line for the services of men like Senn.

And these documented electronic frauds represent only about 15 percent of the total, because 85 percent of such incidents are never reported to police. "Companies are afraid publicity will stimulate more ripofts like this," Senn explains. "In many cases they prefer to quietly discharge larcenous employees. Some even receive severance."

More than ever before, computer crime pays. While the average American embezzler takes home $19,000, computer bank frauds average $450,000. Safer than armed robbery and quicker than a mugging, electronic heists can usually be accomplished during banker's hours. Just a few minutes at the right terminal can sometimes net a year's income. Unlike mobsters, data-processing cons don't have to bother with smuggling, shakedowns or enforcers. There are no middlemen, burns or deadbeats. And law enforcement agencies frequently don't understand fully the complexities of EDP fraud, and they can't crack it.

Since 1958, when a computer caught a stockbroker working for New York's Walston & Co. who had stolen $277,607, no industry or agency of government owning EDP equipment has escaped the attention of high-tech con artists. Biscuit manufacturers, insurance companies, hospitals, colleges and the U.S. Army have all been victimized. One disillusioned employee at a San Jose, California, computerized billing firm decided to get back at his colleagues by walking out with the entire program inventory. Caught without spare copies of missing bills, the marketing manager committed suicide and the company filed for bankruptcy.

Who are the EDP swindlers? Donn Parker, a consultant with SRI International who is considered the Sherlock Holmes of computer crime, has met more of them than anyone else. Sitting beside a five-inch-thick printout he maintains on electronic theft at his office in Menlo Park, California, he says, "Most perpetrators are young, eighteen to thirty years old. They tend to be amateurs with no prior criminal record. They love to play computer games and are fascinated by the challenge of trying to beat the system."

Many of the convicted thieves Parker has met began their life of crime after taking college computer-science courses.

"At Caltech, 26 students used a computer to print 1.2 million entries to a contest run by McDonald's and won a Datsun and many other prizes. Burger King was delighted."

Teachers like to show students how to crash the computer, Parker says. "Ostensibly this is done to familiarize them with the system's inner workings. But things inevitably get out of hand. A couple of years ago, eight seniors at my son's high school broke into the district unit and gave all their classmates straight-A report cards. The seniors at a rival school across town got nothing but F's.

"Instead of discouraging this sort of behavior, many colleges let their students form crash clubs. They actually compete to discover better ways to compromise equipment. The result is that universities are turning out a whole new generation of computer criminals."

Institutions hit include Stanford, the University of Toronto, Georgia Tech and the University of Wisconsin. At Queens College in New York City, a student moved up the grade point averages of a dozen friends by tinkering with the school's IBM computer. He also improved enough of his own marks to win a Phi Beta Kappa key.

Twenty-six Caltech students once used the campus EDP unit to print out 1.2 million McDonald's contest entry blanks by using a simple Fortran program. Since they had a third of the entries, it was no surprise when the group won a Datsun station wagon, a year's free groceries, and a slew of $5 gift certificates. McDonald's, chagrined by the whole affair, staged another drawing, excluding computer-written entries. Executives of Burger King were so delighted that they set up a $3,000 Caltech scholarship in the name of the senior who orchestrated the winning effort.

Even without crash clubs, schools breed "hackers," who spend most of their working lives close to data terminals. "Wherever computer centers have become established," says MIT Professor Joseph Weizenbaum, "disheveled young men with sunken, glowing eyes can be seen sitting at computer consoles, their arms tensed and waiting to fire their fingers, already poised to strike at the keys, their attention riveted like a gambler's on the rolling dice. They work until they nearly drop, twenty, thirty hours at a time. Their food, if they can arrange it, is brought to them: coffee, Cokes, sandwiches. If possible, they sleep on cots near the computer. But only for a few hours. Then back to the console or the printouts."

What makes these hackers good criminals is their ability to exploit automation. As machines replace humans in such routine business activities as accounting, payroll, ordering and shipping, new ripoff opportunities develop. Access to EDP units is easy. Give a bright fifteen-year-old computer buff seven hundred fifty dollars, send him down to Radio Shack, and he can create a system that will get him into just about any company computer in town," says Oakland electronic-security consultant Robert Abbott. "It may take him a little while, but he'll do it."

And once these bright young fellows obtain access, they can compete with the multinationals. Jerry Schneider while working his way through UCLA with a small intercom-installation firm named Los Angeles Telephone and Telegraph Company succumbed to the lure of a quick strike. Eager to start selling communications equipment but hopelessly undercapitalized, he studied the phone company's computerized ordering system and, posing as a Bell worker, obtained all the codes he needed for ordering supplies.

For six months Schneider regularly ordered phone equipment, which he resold to customers of LAT&T. By offering some of the best prices in town on these hot items, he attracted big business. Even Western Electric's local office went to him when it ran short of a particular control unit. Schneider promptly sold Western Electric a hot piece of its own equipment, without the identifying marks.

Only after stealing $1 million worth of phone equipment was Schneider turned in by an employee who had been denied a raise. The judge sentenced Schneider to 60 days at a Malibu work camp; the phone company seized $100,000 worth of equip-

ment and settled a $250,000 lawsuit for $8,500. Expenses, legal fees, and bad debts left Schneider with only $42,000 in his account. Unfortunately, by the time he got out of jail an accountant had disappeared with the entire sum.

Schneider decided to rehabilitate himself by opening a security consulting service in Beverly Hills, California. Sitting in the lobby of the Century Plaza Hotel, he says, "Even after I had been caught, one of the phone company's employees was using a method similar to mine. The company is still doing things the same old way, although the system is a little more secure physically. I'd suggest they check employee-ordering codes to see whether they're being abused, stop using a line anyone can call in on, and change the computer's phone number every week. Hell, they're still using the same number that I used to call."

Schneider's theft was one of the more sophisticated assaults on a computer. Data-processing skill, however, is not a prerequisite for success. Many outsiders have scored with just a few days' work. One man who helped himself to deposit slips at bank tables in New York, Washington, and Boston put his own account number on the bottom of the slips and replaced them on the tables. Hundreds of people unwittingly contributed to his account. He disappeared after cleaning $750,000 out of the three banks. And the police still haven't been able to find him.

A common technique is to recruit the employees who control million-dollar EDP units but earn only modest salaries. In one of the better efforts, a South Korean gang penetrated the U.S. Army's inventory-control computer at Taegu. They stole more than $17 million worth of food, uniforms, car parts, bulldozer track, gasoline, and other commodities and fenced their loot to Korean contractors, soldiers, and politicians.

At a Pompano Beach, Florida, harness track, clerks working with bettors programmed the computer to accept conditional wagers. On losing bets, the employees simply canceled the bet. On winners, they printed up the valuable ticket. The system netted two professional gamblers $90,000 before it was broken by racing officials, who revoked the licenses of three employees implicated in the swindle.

It took Florida authorities considerably more time to quash a similar operation at Flagler dog track. Six track employees made over $1 million from a five-year trifecta scheme. After each race they held up calculation of the winning values and punched out extra tickets for the right combination. Then they fixed the computer records that showed the actual number of winning bets. An obliging friend cashed in their tickets.

Another gambler, Roswell Steffen, embezzled $1.5 million from his employers at Union Dime Savings Bank, in New York City, to support his $30,000-a-day life-style. "I would go through the computer tapes at the end of the day and see whether any new large-balance accounts were open," he recalls. "Then I would use the system's override and make a correction for about half of the account's balance—fifty thousand dollars, for example—and use that money for gambling."

Whenever a discrepancy was uncovered, Stetten adds, "I would fake a call to the data-processing department and reassure the teller it was a simple error, which I could correct. Then I would have to use the correction feature to take fifty thousand dollars from another account and deposit it in the first one."

Steffen finished far ahead of colleagues who limited themselves to occasional dips into customers' Christmas Club accounts. But the $275-a-month employee was undone when a raid on a bookie's "boiler room" revealed his betting slips. Steffen was sentenced to 20 months.

While some experts believe screening can weed out risks like Steffen, IBM's principal architect of computer security dis-

"A South Korean gang used the U.S. Army's inventory-control computer at Taegu to steal $17 million worth of food, uniforms, and car parts and fenced them to local politicians."

agrees. "I don't believe personal integrity is a continuing characteristic of an individual," says digital-equipment manufacturer Robert Courtney. "We're all subject to temptation, and we can't gauge what someone might do under stress. Suppose that you hire a person because you're impressed by his integrity. Then his mother-in-law needs an operation she can't afford. His sense of personal responsibility induces this otherwise honest worker to embezzle. So the very thing that led you to hire him is what prompts him to rip you off."

Sometimes even experts like Donn Parker, who has interviewed digital cons from San Quentin to Rikers Island, find it hard to spot a potential thief. "In this business you never really know whom you're dealing with," Parker says. "Not long ago I was on a Los Angeles computer-security panel with a local consultant named Stanley Mark Rifkin. A few months later I picked up a newspaper and read that he had stolen over ten million dollars from Security Pacific Bank."

Rifkin, a thirty-two-year-old computer consultant, worked for a firm servicing the EDP unit at the bank's downtown headquarters. After learning the secret financial-wire-transfer code, Rifkin called Security Pacific and moved $10.2 million to his account in New York City. Then he promptly shifted the funds to a Zurich account, flew to Switzerland, and purchased $8.1 million worth of diamonds from Russalmaz, the Soviet state diamond agency.

Because confirmation lags behind transfer orders on the federally supervised financial wire, it took the bank nearly a week to discover the theft. Rifkin was arrested five days later at an apartment in Carlsbad, California. He had on him $12,000 in cash from one sale he'd negotiated with a Rochester, New York, jeweler and 19 pounds of diamonds worth $13 million at retail. He pled guilty to two counts of wire fraud and was sentenced to eight years in a penitentiary.

Why didn't Security Pacific insist on extra confirmation when Rifkin asked for such a large transfer? "You don't have a signature, because wire-transfer systems aren't capable of signing things," a security officer explained. "So you use the code. Many transfers originate by telephone, and if the man calling has the right personal identification code and the right daily code, you automatically transfer the funds."

Even armed guards, passkeys, and secret codes can't prevent some executives from using their computer to victimize customers. In the $2 billion Equity Funding case, believed to be the largest known automated fraud, high-speed computers spit out fictitious insurance policies.

"The computer was the key to the fraud," California Insurance Commissioner Gleeson Payne explained. "Under the old, hard-copy methods of keeping insurance records, you couldn't build up bogus policies in this kind of volume."

The FBI has trained more than 400 agents to combat these cybernetic felons. Most of these agents have accounting backgrounds, necessary to gather evidence. But some recent investigations have shown the difficulties of putting together a case in the computer crime field.

A further complication is that today's laws don't adequately define EDP crime. Since computer time itself is a commodity, any programmer who uses the system to print up a Snoopy calendar is technically dipping into corporate assets.

Over drinks at a restaurant in the technological heartland of California's Santa Clara Valley, a programmer sketches some of the problems. "Several years back, my computer-service company was going after a competitor's contract with a Sacramento aerospace manufacturer. I worked up a program that was equal in all respects to the one provided by their vendor. But my boss wanted to be sure our offering had everything the customer was already getting. The potential customer had already given us a copy of his existing program. Unfortunately, a colleague had locked it in his desk and left for the day. In a hurry, I called our competitor's computer and had

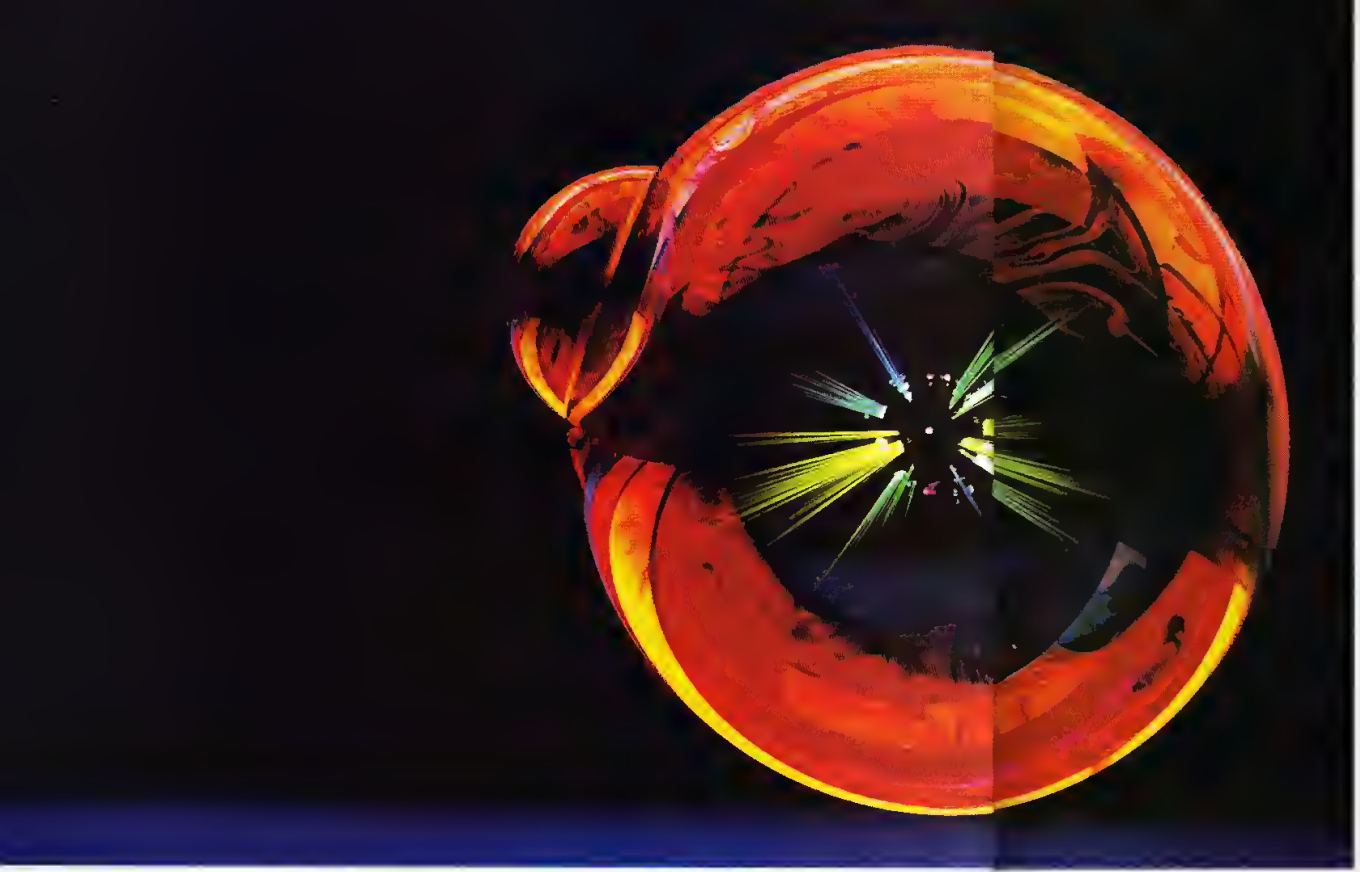
CONTINUED ON PAGE 114

PLAINS OF FOREVER

A futuristic trip through the lens of a master photographer

BY ROBERT SHECKLEY

Pete Turner s studio is a great white cube with polished wood floors It is an appropriate place for the highly sophisticated advertising photography for which Turner is famous Tall and thin, wearing denims and boots, Turner manipulates images on a white screen "There are a lot of possible places to begin, but I chose Stonehenge It's a symbol of man pulling himself out of neolithic unconsciousness building something never before imagined And the road is my symbol for the human journey Roads go on forever, and this is just a road, moving straight out to infinity" I notice the shapes to the right of the road, out of scale, ominous What are they? "Something concrete, but unknowable They are the mystery—the reason we keep on traveling down the road"

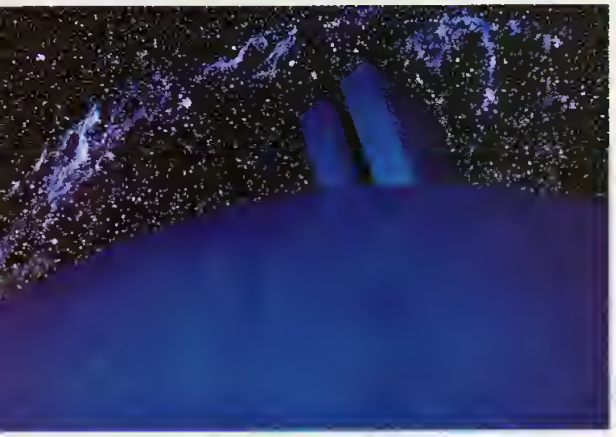


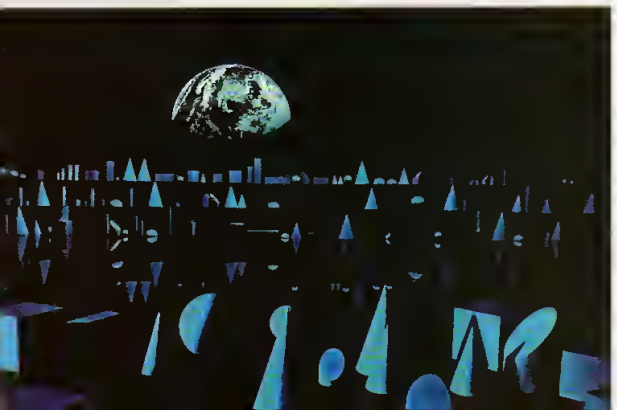
"The bubble is what's called a minimum structure, stabilized by pressure. I injected a very spacy object inside it. And I used a very intense light source. It's almost coherent light. I put the two objects together and ask myself whether it's too complex. There are unlimited options in this. It becomes an alien vision ... a sort of magic."

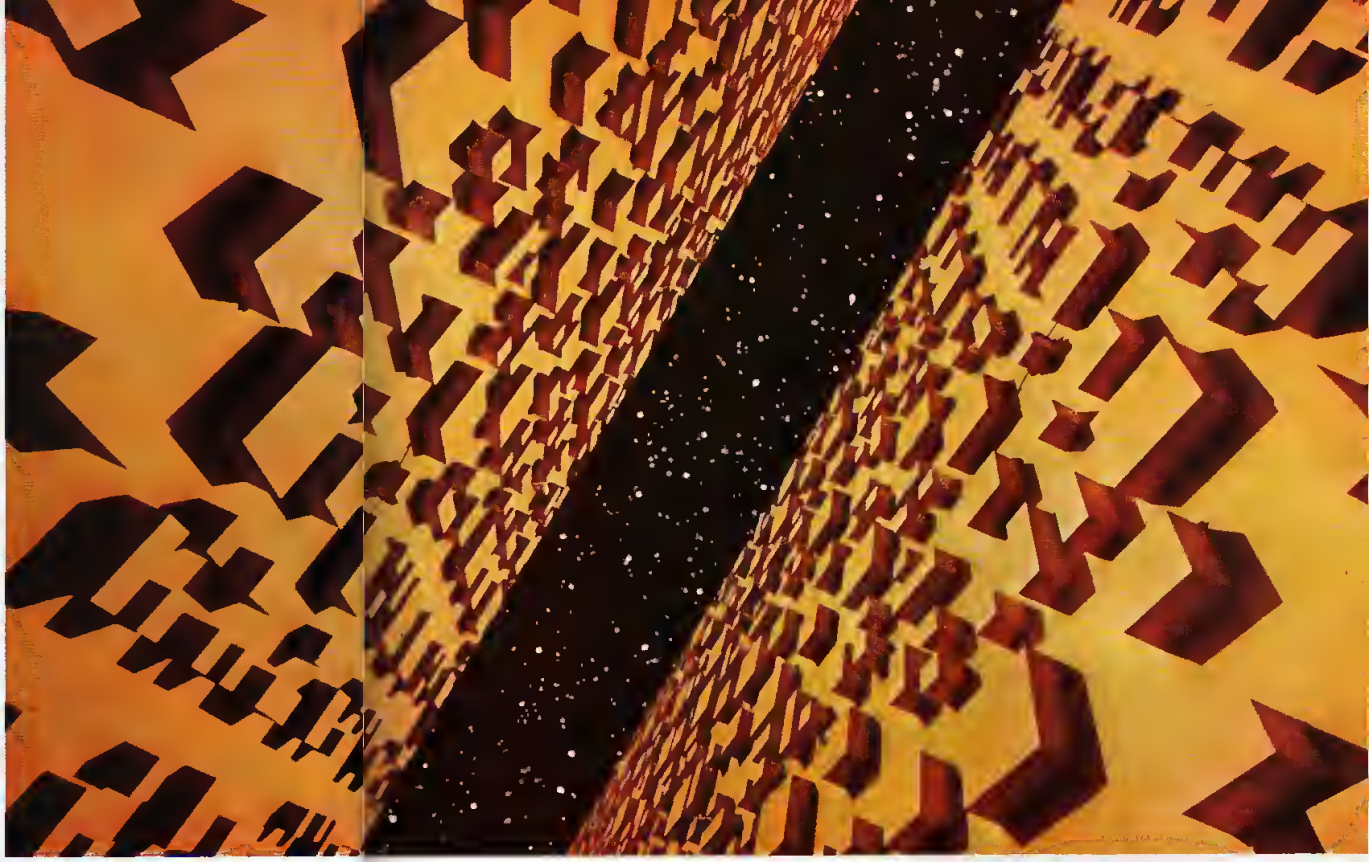
Turner is not at ease with words. He is suspicious of them: a maker of images rather than a teller of tales. He shapes his thoughts with long, thin fingers, trying to make them palpable, hoping they will fit the wordless matters he has photographed. "And here we have light, transparency: the bubble of consciousness. Transparent bubbles with coherent light at the core—that's us. We are simultaneously the light source and the thing illuminated. Our lives are spent seeing what there is to be seen by our own light. And what we see, no other species on Earth has ever seen before." Any sentient creature can see the sky, but only man, only a Turner, can see the window in the sky and pass through it, even though it isn't there, to the beyond that lies within us. Turner nods. "That's it. We see through ourselves into the universe."

"Transparent bubbles with coherent light at the core—that's who we really are."

'You've got to switch thinking. It's important to be able to play with these things. This city is really Brasilia. It's been retouched, and the windows have been removed so they don't read as lights. The only lights are in the sky. The image has been manipulated. That side of the building is the museum. It's been flopped over to create this incredible perspective."







The images symbolize states of mind as well as future actualities. Here's the present, and here's what it leads to. "It's something the ancient world never knew: geometric sterility, the possibility of a world entirely divorced from nature. It scares me, the way those walls rise up toward the stars, and there's nothing inside them or outside them." The image is even more frightening, because it has no indication of scale. But if man were there, he would be an insect, an insignificant ink spot marring the mindless regularity of those perfect walls. "Yes, and this is the final city, perched upon the barren earth, its slab-sided buildings naked to the stars. And there's the final graveyard, where the only monuments to our long history are cones and spheres, signifying nothing."

"It's new, this geometric sterility, the possibility of a world divorced from nature."

"These aliens are real, but indefinable. I think they are what we are going to become"

Turner is an optimist; his images are cautionary rather than predictive. "When you work with these forms, you have to feel what they mean rather than tell it literally. Here is an ultimate landscape, crystalline in its purity." What about those shapes above the plain, those entities coming through the foreground? "It's the aliens, of course. They're ambiguous—visually definite, verbally indefinable. And they're more than just aliens. I think they're also us in our next stage of development. I think we can escape from the trap we're building for ourselves, escape from our fatal geometricity. I think we transform ourselves." Into what? Turner doesn't know, since the caterpillar can't imagine the butterfly it will become. The process of transformation can only be hinted at. ∞

"I called it Moon's Moon. I wanted to symbolize what would happen toward the end... nothing apocalyptic, just old age looming closer, the moon's orbit decaying. Arthur C. Clarke once wrote that for every human who has walked the face of the earth, there is a star in the universe. The old transforms into the new. It's the end, but also the beginning."

Meeting human needs with limited resources takes a new kind of engineering

MACRO

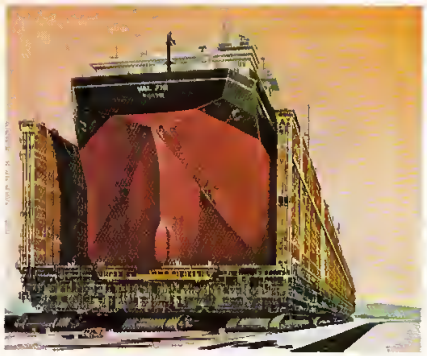
BY DAN ROSS AND ARTHUR J. MAHER

After a hard day at work, you are whizzed home in the hydrofoil. Downstream your destination looms larger: a curtained, blue island of steel and glass, floating on immense concrete pillars, far from the overcrowded mainland. Once again it hits you just how spectacular—and lovely—your new city is.

On your way out to sea you pass floating industries, thermal-energy plants, waste-disposal facilities, and desalination plants. Finally you land on the largest island of all: a floating "downtown." The people-mover takes you past parks, shops, and offices and deposits you at one of the apartment buildings that house as many as 20,000 people each. Home again.

Fantasy? For now, at least. There's a good chance that neither you nor your children will ever dwell in such a city. Not because it can't—or shouldn't—be built. Listen to John P. Craven, the imaginative but hardly wild-eyed dean of marine programs at the University of Hawaii. "Technologically we can build it right now."

But technology is not what's standing in the way of floating cities, supersonic subways, solar-power satellites, and other mighty endeavors that many planners say could raise the standard of living all over the world. It is simply a matter of priorities.



PAINTINGS BY WAYNE McLOUGHLIN

Modern technology has far outstripped our ability to carry out every project on the drawing board. And because of this, a new discipline called macroengineering says we must completely rethink how we choose and plan our projects.

Macroengineering is the study of the management of macroprojects: engineering projects so massive they pose special problems through sheer size. Large-scale projects can now transform our environment so completely that we can no longer afford to build them helter-skelter, macroengineers say. But even in this present era of limits, they insist, much of what we consider science fiction should be turned into reality and can be—if only we learn to shrewdly marshal our resources and consolidate our will.

Still skeptical? Then consider the real obstacles to that floating city in our opening scene. Let's assume the Japanese government commissioned a standard city. It could mass-produce and tow to Japan's western river mouths to relieve overpopulation in the east. It might well happen in the next decade.

Just as final approval is due, fishermen complain that their customary fishing grounds will be destroyed. Then political representatives in the Diet ask where displaced villagers will be relocated. Japanese generals point out that floating cities are vulnerable to attack or sabotage. Word comes from New York that the banking community doubts their profitability. The Soviet Union delivers a formal note protesting the undisguised anti-Soviet aggression in transplanting large populations to Japan's west coast facing Vladivostok. As the last straw, a government minister concedes: "Maybe Tokyo isn't so crowded."

Get the message? Disciples of macroengineering tend to put it this way: "To build a great engineering project, the engineers should be the last people to come into it."

The godfather of this new discipline is Frank P. Davidson, an MIT research associate with an Anthony Eden mustache and contagious enthusiasm. "Engineering is too important to be left to engineers," he says. "What it needs are modern-day Renaissance men."

Davidson comes close to fitting that bill himself. In his busy career he has founded the Institute for the Future, advised governments and corporations on macroprojects, and pioneered in teaching macroengineering at MIT. But his formal education was not in engineering. Davidson began as an international lawyer. He was introduced to the problems of macroprojects the hard way. It is Frank Davidson who revived the dream of a tunnel under the English Channel and who may soon see it through to completion.

The rebirth of the "Chunnel" began when Davidson and his wife took a stormy ferry ride from Calais to Dover. Not long afterward, Davidson recounted the rocky crossing to a friend, who recalled reading in his childhood about a plan to tunnel under the Channel. The idea dates to the mid-eighteenth century, when a French geologist conceived a "dry-shod" connection between the two countries. It was nearly carried out in the 1880s—geological surveys were completed and test tunnels were dug—but the British War Office ruled it out as "a permanent threat to England's security." England and France had been opponents in various wars for as long as anyone could remember.

But in 1957 military objections were "obvious nonsense," according to the usually judicious *Economist*. That's when Davidson formed a corporation of bankers, diplomats, and lawyers called Technical Studies, Inc. Four months later, Technical Studies became the American partner of a three-nation Channel Tunnel Study Group which, for 23 years, has been planning the construction of this underwater link.

The intervening years provide a case study in the problems of macroengineering. "Innovative financial and legal thinking were just as important as engineering," Davidson says. "Fortunately, the bankers and international lawyers were present from the outset."

> *"MIT developed trains that could fly at thousands of miles per hour, but America moved on to other projects. Now the Japanese intend to install them on their Tokyo-to-Osaka line."*

Simply organizing the Chunnel was a macroproject in itself. More than 20 public and private corporations were eventually brought into the study group. It took 16 years of planning before the two governments agreed on a $2 billion twin-tube railroad tunnel to be financed by government bonds. Treaties were signed in 1973, and boring was started, but then Prime Minister Harold Wilson's Labor government got cold feet in 1975 and withdrew.

After five years' delay, the light at the end of the Chunnel may finally be in sight. Early last year the French and British railroads agreed on a bargain-basement model: a single-tube rail link with a smaller, parallel service tunnel. Alternating shifts in each direction could accommodate 70 trains a day carrying freight and some 6 million passengers a year with plenty of room for future growth. Even allowing for inflation, the price tag will fall well short of the earlier $2 billion. This time support is expected from the entire European Economic Community. The scaled-down Chunnel could open as early as 1989.

"You can't work on something as far-out as the Channel Tunnel without coming up with a parcel of wider ideas," Davidson says, commenting on his shift from law to macroengineering. His two interests coincided in 1968, when a group of California scientists asked him to incorporate them as a nonprofit Institute for the Future. In proper scientific manner they named their lawyer president and asked him to contribute to their new journal, *Futures*. Davidson used the article as a forum for his ideas on the problems of large-scale projects in it he coined the term *macroengineering*.

The article caught the eye of professors at MIT's school of engineering, who invited Davidson to lecture on his ideas. Two years later he had moved to Cambridge and was working full time as the first macroengineer. He now holds two appointments at MIT: as chairman of the management school's System Dynamics Steering Committee and as joint program coordinator (with C. Laurence Meador, his former student) of the Macro-Engineering Research Group at the school of engineering.

Meanwhile, the realization that macroprojects have special problems has been catching on in both academia and the outside world. The last three annual meetings of the American Association for the Advancement of Science have included symposia on macroengineering. Engineering societies from London to Tokyo have explored the idea in conferences of their own. And last June MIT sponsored what Davidson describes as "the most intensive series of macroengineering seminars ever held on this planet."

Macroengineering as a discipline may be new, but macroprojects are as old as civilization. The pyramids, China's Great Wall, the Mayan canals discovered by radar in the Guatemalan jungle early in 1980, the remarkable network of dikes in the Netherlands, and the Panama Canal—all were equally "macro" for their day.

In fact, the definition of a macroproject depends on the civilization building it. A macroproject is an engineering project at the cutting edge of technology and social organization. A wall that a modern contractor could build in a single afternoon would have been incredible 10 000 years ago. The fabled wall of Jericho is often cited as the world's first macroproject.

THE MACRO EXPLOSION

Times have changed since then. In 1976 the White House science adviser commissioned a study to identify neglected scientific problems that might grow into "major societal crises." Obstacles hindering macroprojects were named as one of them. In its report the following year, the National Science Foundation warned that it would soon become increasingly difficult to initiate large-scale technological projects, or carry them through to completion. Ironically, this comes at a time when the techni

CONTINUED ON PAGE 118

Photograph by Doug Kirkland

An infuriating conversation with the master of macho anthropology, where men are men, and women had better have pretty, young skin

INTERVIEW

DONALD SYMONS

Much more than women, men are predisposed to desire a variety of sex partners—for the sake of variety. Physical endowments, especially those associated with youth, are by far the most important determinants of women's sexual attractiveness, while political and economic prowess constitute sexiness in men.

Among all peoples, copulation is considered essentially a service or favor that women render to men.

Are these the musings of a club-bearing Neanderthal? An Archie Bunker manifesto on male-female relations?

Female readers may seem to detect Archie Bunker undertones in these dispassionate statements, but their author, anthropologist Donald Symons, is no Archie Bunker and no male supremacist. Siding with nature versus nurture, the work of this University of California at Santa Barbara associate professor has been hailed by such notables as E. O. Wilson, of *Sociobiology* fame.

A prevailing doctrine holds that John's yen for a redhead in every port and Mary's dream of a Rotary Club husband and a house full of Tupperware are learned behaviors, which can be eradicated by an upbringing of unisex toys and primers portraying Dick in an apron and a fearless, hammer-wielding Jane. Not so, says Symons. Men and women, he claims, possess strikingly different sexual psyches, not because of cultural brainwashing, but because of deep-seated biological roles that date back to our earliest hunter-gatherer rituals.

Symons's name tag does *not*, however, read sociobiologist. He prefers to call his territory Darwinian psychology, and it is enriched by a broad range of cross-cultural studies, primate research, and everything from feminist credos and novels to autobiographical allusions and Symons's own hunches.

Writer Claire Warga spoke with a besandaled Symons at his home in the lush, semitropical Santa Barbara hills, where he lives with his wife, his cat, and a refrigerator full of avocados from a backyard where he ponders the sexual proclivities of mankind.

Omni: You argue in your book *The Evolution of Human Sexuality* that men as a group inherently desire more sexual variety than women as a group. Is this correct?

Symons: Basically yes, though it's too complex an issue to substantiate in a brief discussion, and I refer readers to my book for a fuller explanation. The reproductive success of a male is determined by the number of eggs he fertilizes. Because males invest relatively little with each mating—they don't invest nine months' use of their bodies—they can potentially impregnate a female at almost no cost to themselves in time and energy. So it's reproductively advantageous to tie up as many female investments as they can. Among our earliest hunter-gatherer ancestors—from whom, I maintain, we haven't changed significantly with respect to our sexual natures—a male's reproductive success increased as a function of the number of women he could impregnate.

For his female counterpart, the realities were quite different. She could bear only four or five children during her lifetime, whether she copulated with one, ten or a thousand men. As a consequence, I believe, selection favored the basic male tendency to desire sexual variety—and to become sexually aroused by the sight of females. The strength of the arousal depends on a subjective evaluation of the reproductive value of the female.

Omni: Exactly what do you mean when you say "reproductive value"?

Symons: I'm referring to such qualities as youthfulness and, to certain visual health and age indicators—an unblemished or unwrinkled skin—which at some level were regarded as indicating the ability to bear healthy children who would stand a good chance of surviving.

I think that the general tendency among divergent cultures of finding healthy people and young women attractive is relatively innate, because these are universally associated with reproductive value. The females of other species of mammals generally provide clues as to whether or not they're fertile by the presence of estrus. Human females, however, are unique among mammals in that they don't externally advertise ovulation. Selection therefore favored male abilities to size up a female's reproductive value mainly through the next best available visual clues.

Omni: And do you see female sexual nature as having evolved innate rules for terreting out the highest-status male her reproductive value can buy?

Symons: Yes, rules that indirectly achieve that end, though not necessarily with an awareness that such rules are operating. Among species in which males compete for status, a high-rank mate will generally endow her offspring with some reproductive advantage, since high-status males are more likely than low-ranking males to produce offspring capable of surviving and reproducing themselves.

Indeed, studies of several cultures around the world support the generalization that the attractiveness of males depends mainly on their skills and prowess, rather than on physical appearance or youth, but for women physical beauty and youth are the most attractive factors.

Since women invest a good deal of energy and take serious risks by becoming pregnant, their reproductive success is affected considerably by the circumstances of impregnation. The basic female strategy therefore is to get the best possible husband, to be fertilized by the fittest available male. A high-status mate brings certain advantages to maximize the returns on the sexual favors she gives.

Omni: That's a cynical view of sexuality.

Symons: These impulses are part of human nature because they proved adaptive over millions of years. A woman who found maximal pleasure by mating randomly with an endless succession of men is extremely unlikely to be as reproductively successful—in a primitive environment—as a woman who gets the best husband she can and convinces him in every way that she is faithful so that he will provide for and protect her and the offspring that after all he can never be fully certain are really his. Uncertainty over paternity, incidentally, I believe, is the reason why men almost universally experience jealousy over their mates.

> *"Studies of cultures around the world show that the attractiveness of males depends on their skill and prowess, but for women, physical beauty and youth are the relevant factors."*

Omni: What do you mean?

Symons: Well, for a woman, there is never the possibility of her husband deceiving her and giving birth to a child that isn't really hers. But a man can be cuckolded and threatened with having his wife's reproductive capacity and his own paternal efforts deceptively tied up by another man's child. I don't mean to imply that males experience jealousy more strongly than females do on the occasions they do, but that females are more flexible on the issue of jealousy for the reason I've proposed. They can't be fooled as easily.

Omni: Are all aspects of the feelings of love colored by the two sexual strategies that you've proposed?

Symons: In my book I attempted to stick pretty close to discussion of sexual attraction, isolating it not only from love but from all other sorts of thoughts and feelings. That may be a fault of the book, but I had to restrict the range of the discussion to make it manageable.

Omni: Well, let's talk about sexual attraction. Do you think all feelings of sexual attraction are defined by the reproductively oriented motivations that you've ascribed to men and women?

Symons: Basically yes. I think you could create a human situation in which a particular trait or quality that had never before been perceived as attractive would become desirable because it's linked to status. So yes, over time women may change their definition of what is high status in a male, but I'm much less convinced you could create a situation between men and women where attraction wouldn't bear at all on status. Or where men would be most attracted by fifty-year-old instead of twenty-year-old skin. Of that I'm very dubious.

Omni: Your views on the sexual psyches of men and women will no doubt strike many as inflammatory. And you offer them at a time when society is attempting to minimize male/female differences. How have you come to see things this particular way?

Symons: Primarily through an application of what I call Darwinian psychology. As a student of evolution, I thought it odd that over a century after the discovery of the basic creative mechanism in nature—evolution by natural selection—the implications of the Darwinian revolution in biology simply had not been applied very systematically to understanding human psychology. Evolutionary theory is, after all, well established in its broad outline, though it's undergoing still further refinements. We humans presumably are products of the same process, at least insofar as our basic dimensions, senses and passions are concerned.

All the experience we have had with other animals suggested that there were likely to be sex differences in human sexuality too. By comparing male and female, we can better see evidence of selection at work, and therefore evidence of design.

My major interest has not been so much human sexuality per se, or sex differences, but rather, What is the nature of the human mind? How have the mind and the brain been shaped by natural selection? How the mind works with respect to sexuality is part of that. Since sexuality is closely tied to reproduction, I think that the neural and hormonal underpinnings of sexual feeling, thought and action are likely to have been very responsive to natural selection.

Evolutionary theory is first of all a theory to explain in a reasonable way the facts that we have. A Darwinian perspective focuses our attention on particular areas—examining evidence from the perspective of reproductive success (the number of surviving offspring that an individual produces). The greater the number of his or her genes an individual passes on to the future, the

more he or she influences the shape of future evolution. It's from this framework that I tried to make sense of the differences I see in male-female sexual behavior.

Omni: Some would argue that cultural conditioning accounts for many of the differences. Do you think that we are seeing mainly innate differences?

Symons: I believe, with respect to sexuality, that there are a female human nature and a male human nature and that these are extraordinarily different. Men and women diverge in their sexual psyches because throughout the extended hunting-and-gathering phase of human evolutionary history the sexual desires and dispositions that were adaptive for one sex were, for the other a ticket to reproductive oblivion. Because of the very different amounts of parental investment each sex makes in its offspring, two different strategies evolved.

Omni: By parental investment, do you mean only time?

Symons: Parental investment is any investment by a parent, whether in the form of time or energy or risk, that increases the offspring's chance of surviving. Mammalian females, you know, produce eggs that are large and carry a reserve of food for the embryo. Sperm cells are much smaller and don't have that food reserve. So females invest far more energy in an egg cell than males invest in a sperm cell.

It has been suggested, by the way, that the high initial female investment explains why females, rather than males, generally provide parental care among mammal species. Natural selection in most species has favored females who sequester and protect this investment. In fact, internal fertilization is thought to have evolved as a means of better ensuring this protection.

Omni: Let's get back to those inflammatory comments. In your book you've suggested that copulation is essentially a service that women provide to men and not the other way around. Why is this so?

Symons: For a number of reasons too long to give their full due here. But evidence from cross-cultural studies shows that among all peoples it's primarily the men who court, woo, proposition, seduce, employ love charms and love magic, give gifts in exchange for intercourse, and buy the services of prostitutes. And only men rape. Everywhere sex is understood to be something females have that males want.

Omni: Can you really speak about all peoples, since the anthropological record is far from complete—is, in fact, fairly spotty—when it comes to systematic studies of sexuality? And it's biased by the fact that most anthropologists have been men, who would be less likely to have access to the love charms and the means of seduction employed by the women in the culture they are studying.

Symons: Few anthropologists have sought to conduct primarily sexual research. So there *are* big gaps in the kinds of answers we have, and, yes, most an-

CONTINUED ON PAGE 116

POSTMARKS

BY MARC KAPLAN

Colorful commemoratives enable stamp collectors the world over to experience the conquest of space

From their launch-side seat in living rooms around the world, thousands of philatelists track the space achievements of China, France, West Germany, and Japan, as well as those of the United States and the USSR. By far the most requested issue on file with the U.S. Postal Service is the First Man on the Moon stamp. Its printing cylinder traveled to the moon and back aboard *Apollo 11*.

With 150 nations issuing space-topic stamps, Third World countries are awakening to the cosmic imperative. Telecommunication technology is proving that you needn't own a space program to benefit from one. NASA's Intelsat system, for example, routes information across the Atlantic Ocean to American allies in Europe, and the *Molniya* satellite system unites Soviet bloc nations into Interkosmos.

Ironically, stamps themselves may one day fall victim to the Space Age. Though still in the experimental stage, Intelpost, the mail of the future, will be beamed off satellites to receiving stations in the United States and seven foreign nations. It may eventually eliminate the need for the familiar corner rectangle altogether. ∞

endless scale

CONTINUED FROM PAGE 49

chambers under a subway grating at that location It produces a humming bass blended with a pleasant high-pitched sound when activated by the computer wind Most recently Neuhaus put 64 speakers in a greenhouse filled with shrubbery at the Walker Art Center s New Music America festival in Minneapolis Each speaker was connected to its own synthesizer producing an ever-shifting aural montage

Also at the Minneapolis fairground artist Left Brush suspended a grid of 200 speakers each with its own sound source (one even being the strings of a piano floating on a raft in a pond) among the trees at the art center s exhibit

Boston sound artist Christopher Janney crafted a musical instrument from a stairwell by attaching photoelectric cells to the steps Breaking an individual beam generates a series of computer-stored notes Though practicing scales might prove exhausting a group of people could actually play the stairs

In Vancouver Canada composer David Rosenboom has gone a step further creating a participatory sound environment that uses alpha waves generated by visitors brains Though it is nice to fantasize about the possibility of playing Haydn with electrodes hooked up to your head sound authorities say this kind of thing is a long way off

Surprisingly some of our newest sounds have been produced from scrap Skip LaPlante a Princeton University graduate who studied Mozart and Schönberg has made about 60 different percussion and wind instruments using thrown-away materials Raiding kitchens and farmhouses LaPlante drew unique sounds from huge cardboard rug tubes broiler pans cat-food cans even shards of glass You can get really clean pitches from cinder blocks broken into L shapes he says And cut-down wine jugs make excellent cloud-chamber bowls LaPlante hunts for battered and discarded wine jugs on the Bowery in New York City He has even created music by bouncing a Superball on a piece of glass In contrast to the computer and other slowly crafted homemade instruments LaPlante s sound generators rarely cost more than $25 to build

Indeed the homemade instrument appears to be more important than ever as young musicians strive to create new musical forms Hundley tor instance has had a certain rebelliousness implanted in him much like Spiegel and LaPlante Hundley is an eclectic musician with a restless ear who dallied in several genres before directing his attention to film scoring (*The Incredible Shrinking Woman* and *Roadie* among many) He was a prodigy on piano at thirteen and a self confessed burnout at seventeen Hundley has performed Tchaikovsky s First Piano Concerto as a guest soloist with the Milwaukee Symphony Orchestra and has been featured on four jazz albums He has vocoded disco tunes and played clavichord in the jazz movie *New York, New York*

Hundley s new project is a 53-tone synthesizer that will feature programmable tuning It will be one of the very few electronic instruments capable of generating microtonal music Perhaps it will allow more classically oriented microtonalists to step into the reverberating studios of electronic musicians It that is the path of the future then Hundley will surely be one of the very first to set out

Undoubtedly in the future greater economic access to new technology will make more of us musicians "When I went to music school which wasn t that long ago they didn t even have an analog synthesizer" Spiegel says "I think it s a shame that the general public has greater access to this stuff than the conservatory student who is told that it s really complicated and generally useless musically I ve had this computer for less than a year It s not that difficult to learn Before I got it I never heard a single orchestral score that I had written I never even heard my string quartets played live while I was at Juilliard Now with my computer I can get instant feedback on what I have written

Clearly computers mathematical explorations of new scales and composer made instruments won t wipe out disco or empty Carnegie Hall Popular music has enormous staying power and no electronic instrument can exactly duplicate the subtle nuances and rich tonalities of a finely tuned violin in a symphonic orchestra Even if one could it wouldn t necessarily be desirable Many people like the idea of variety spontaneity and human beings in musical performance

But the new music won t be merely the avant-garde affectation of a few snobby intellectuals Technology will certainly open up enough doors to make many kinds of music more accessible to all levels of creator player and listener

The music of tomorrow will not limit expression it will free it of virtually all restraints Our aural experience will be eclectic and electronic Stuart Diamond a composer who specializes in the lyricon an instrument something like an oboe wired to a synthesizer says The serious composer is usually condemned to write chamber music using just three or four instruments But composing on the lyricon gives me the power of a symphony orchestra Maybe not the subtlety but certainly the volume force and scope

Once any music is in a radio it s electronic anyway Even a Beethoven string quartet is electronic at this point It s been reduced to electrons and reconstructed back into acoustical wave shapes Electronic music is not some weird idea reserved for the distant future It s a *fait accompli* ◻◻

FICTION

ICONS

Complaints poured in. The public was outraged. Their toys continued to self-destruct, and life was no fun at all

BY BARRY N. MALZBERG

My Hemingway keeps mumbling about the ultimate nada," Smith said. "and the darkness and the light. It keeps trying to go upstairs to lock itself in the bathroom with my carbine. I have to shut off the power but one of these days I'm not going to be home when it happens."

Jones nodded glumly. "*My* Hemingway wants to go running with the bulls," he said, "calls it the ultimate quest and so on, but what it really wants is to be gored. It keeps on looking out the window staring at the pavement, and I have to pull it back inside."

I shrugged. There was no point in admitting that *my* Hemingway slipped off while I was at the slaughtering docks yesterday and put a hole in its Plexiglas head. I had the same warnings as Smith and Jones. No one to blame. "Not good," I said.

"It's always the same damned things," Jones said bitterly. "They send these things out glistening with their white beards and fiery eyes, and they're marvelously entertaining for a few weeks, typing and drinking away and speaking of the clean and the just, and next thing you know they're off in corners whispering about telescopic sights. I say it's disgusting."

"Design defect," Smith said knowingly. "built into the machines. Planned obsolescence. Self-destructing. Good turnover. A need for replacements all the time. It's all planned."

"Well, I won't take it anymore," Jones said. "You have to take a position, make a stand."

"That's the ticket," Smith said. "Draw the line. Fight for truth. Stand up to the bastards once and for all."

They looked at me expectantly. I have their trust. In a way I am the ringleader by unspoken consensus.

"Agreed, gentlemen," I said. "One must take a stand."

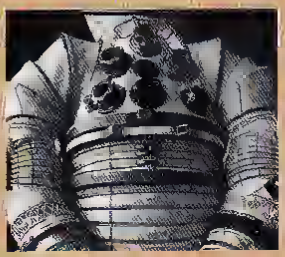
We left the Juicer and took the tramway to the central offices of Icons, Inc., located in the packing district. As soon as we arrived we could see the dimensions of the problem. The offices were ringed by thousands of demonstrators, chanting in an ugly way for justice. Barricades had been established, and the police were restraining the crowd. Many had brought their defective or imploded Hemingways to wave above their heads. The problem, as we had suspected, was quite widespread.

"Who would have known?" Smith said reverently. "There is still some spirit left in us—and outrage."

"There are limits," Jones agreed. "They cannot sell us defec-

PAINTING BY DON IVAN PUNCHATZ

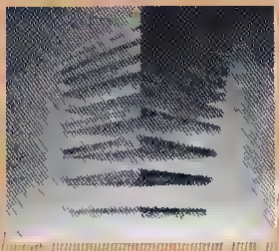
NEXT OMNI



SUITING UP

INTERVIEW

SPIES



FICTION

SILICON VALLEY SPIES—For the last ten years Soviet agents have been skulking about in California's Silicon Valley birthplace of the microcomputer technology that revolutionized Western military hardware. So far the KGB has spent over $100 million on devious projects that range from buying up local banks to shipping computer equipment out of the country in crates that are labeled "washing machines." *Omni* tells how they've done it—and why no one has been able to stop them.

CONSCIENCE FOR HIRE—When Richard McCormick speaks, researchers quake in their boots. This mild-mannered Jesuit scholar is a leader in the expanding field of scientific ethics, which attempts to determine whether experiments are not merely good science but good humanity. As scientific exploration creeps closer to the edge of life creation and mind control, ethical questions loom ever larger for researchers. In next month's *Omni* writer Douglas Colligan introduces you to the priests and teachers who seek to confront the moral implications of science.

SUITING UP—A new era in space begins when *Columbia* lifts off from pad 39A at Cape Canaveral sometime later this year. New conquests require appropriate threads, which is why NASA has completely revamped its space wardrobe for the first generation of shuttle voyagers. A tough, polymerized hard suit will give astronauts protection as they exit from the shuttle to perform experiments out in free space. Even the brand-new flight suits worn inside the ship differ substantially from the old *Apollo* gear. During the six years since we last boosted a human being into orbit a revolution has occurred in the design of space suits. Think you know *haute couture*? Don't answer until you've seen our exclusive pictorial next month in *Omni*.

INTERVIEW—In 1968 Peter Glaser stunned the uptight readers of *Science*, the nation's most erudite and perhaps most cautious, scientific journal, with his modestly titled article "Power from the Sun." In it Glaser proposed building gigantic satellites and placing them in orbit where they could absorb solar energy and beam it to Earth as microwaves. Today the solar-power satellite (SPS) remains one of the most inventive approaches to solving the energy crisis. In the April Interview Glaser, father of the SPS, defends his baby and destroys some myths about solar energy.

SCIENCE FICTION—Cynthia Morgan makes her debut in the April *Omni* with "The Hitmaker," a deceptively low-keyed story about the effects of live TV coverage on a small American town. In Warren Brown's "Last Waltz" a woman wronged tastes a very sweet revenge, and an unlucky airman is shot down and forced to come to grips with Paul J. Nahin's "The Infinite Plane." Good reading in the April *Omni*.

tive icons indefinitely. We can only take this stuff for so long."

We established positions at the rear and joined in the chant. Smith's face flushed with accomplishment. Jones seemed timorous; he lacks physical courage—a quality that he had hoped his Hemingway might have given him. More's the pity.

"New Hemingways!" we shouted. "Hemingways that live, not Hemingways that die!" Gunshots were heard as here and there in the crowd defective Hemingways found their masters' weapons and did away with themselves on the spot.

An employee of Icons, Inc., came out on a balcony. Even from this distance we could see him shaking. They usually assign a minor functionary to address rioters. "Be reasonable." The junior shouted. "Disperse! You are breaking the law."

"Justice!" we shouted. The police, with their weapons holstered, stood looking in the opposite direction. After all, many of them had Hemingways, too. "Go home!" the junior said, but he was pelted by debris. He recoiled under a hail of garbage.

"All right," he bellowed suddenly, "we'll make an adjustment."

"No adjustments!" we shouted, quite caught up in the moment. "Justice!" We knew that we would prevail. We always do in these confrontations. After all, Icons is dependent upon our goodwill. Remember the Monroe riots and their outcome.

"Very well," the junior said, "we accept return of all Hemingways. For full credit."

We cheered.

"And we will apply the full cost of each toward the purchase of a Kennedy. Only taxation differential will be due."

We cheered again. Everyone thinks of the Kennedy with anticipation. Rumors are that models had been in production for years but were being held back purposely to manipulate greater demand.

"A Kennedy for everyone!" the junior screamed. "Everyone *all* of you will know that they will fight any battle, share any cause in the struggle for freedom. Friend and foe alike will know that a new generation, forged from a hard and bitter peace—"

But he could no longer be heard, so great now were the cheers.

I can't wait for my Kennedy. He will put strength in my spine, sparkle in my eyes, purpose in each dreary day. It will be like the early days with the Hemingway, before the terrible design defect manifested itself.

Smith tears, however, that the Kennedy will also prove defective. "You can't trust these corporations," he points out. "They probably have an obsolescence factor in the Kennedy as well. But Icons is clever."

"What do you mean?" I ask.

"I mean, this time, when it breaks down, they'll have it arranged so it looks like *our* fault." Smith says bitterly. "Wait and see."

Jones and I, however, disgusted with Smith's pessimism, have threatened to do him damage if he doesn't shut up. If you can't trust a Kennedy, what then?

RUNNERS

(CONTINUED FROM PAGE 63)

work because it violated everything he knew about God. At the time I grew furious with him. I now wish I'd had better sense."

Today there is growing suspicion that thoughts and feelings may one day be traced to chemical events. Such thinking makes the transfer effect less dubious. Very little is known about what makes the brain tick. New neural connections are made, but no one has yet explained how.

"I think what we were doing was tapping into chemicals that are released from one neuron to another," McConnell explained, "putting into the system chemicals that caused neural growth to occur in a patterned way. This suggests that the proteins are actually 'brief revisions of the neural blueprint you were born with.' In the animal studies the injected RNA told the neurons what new synaptic connections to make for learning to occur. When these blueprints were transferred from one animal to another, they gave the creature the molecular pattern it would otherwise have had to build up through experience."

"But the field has gone by me," McConnell admits. "I wouldn't know a molecule if it jumped up and bit me. What must be done next will be done by biochemists and neurophysiologists, and the next breakthroughs will reveal what the hell does happen chemically in the brain."

What do researchers in the biological basis of behavior say? Most restrict themselves to investigations at the neurotransmitter level. New York University professor of neurology and physiology David Quartermain admits that he is skeptical of the transfer theory, but he is willing to grant that "there was some suggestion that *something* was transferred in those studies."

"I don't think they can be discounted as wrong," he says, "nor do I think McConnell and Ungar are charlatans. I think perhaps the *something* transferred might be a motivational factor, but given the structure of the mammalian nervous system—with all its exquisite detail—these complicated structural relationships suggest memory storage is more complex than we know now."

Nor does Quartermain, who is investigating protein-synthesis inhibition in the brain and looking for a way to ease memory disorders, discount the possibility that protein is a key element in memory. "There's got to be something to produce the change, if that change is durable. There have been some very elegant and informative experiments in which you train animals and see whether there are changes in the species of RNA or protein after training. Some of these experiments suggest that there is. I think this is an area that will be understood within the next ten, twenty or fifty years."

McConnell wryly points out that some RNA experiments have been done on humans—in organ-transplant recipients. "It's seldom talked about in literature, and I can't give you any data on it, but it will be confirmed by any doctor working in the field. About fifty to sixty percent of the transplant patients show temporary psychotic symptoms after transplant. In kidney transplants it's closer to ninety-five percent. No psychiatrist or physiologist measured them for possible memory shadows. I'm sure they're picking up memories or behavioral tendencies from the donor."

Never fearful of speculation, McConnell thoughtfully entertains some farfetched ideas—such as learning pills. He will imagine a time when drugstores might carry bottles of protein compounds or RNA to enhance learning of calculus, say, or tax accounting, or anything else. "Not every thing," he cautions. "What I would say is that we'll be able to specify what family of chemicals is involved, for example, in learning Chinese. Then we'd synthesize them and give you daily injections, enabling you to learn Chinese five to ten times faster than normal. And to remember it better."

Science is, to a far greater extent than most scientists realize, the behavior of human beings who suffer the same personality quirks and fits of temper that everyone else experiences.

The years of worm running are behind him. The *Digest* terminated after 20 years for lack of funds. ("The new director of the institute has no sense of humor.") McConnell now turns his attention increasingly to teaching, writing, and the formulation of a unified field theory of the brain, though he's too modest to call it that. This quest includes a decade-long wrestling match with the redoubtable Skinner over the existence of the mind.

When McConnell was a trembling grad student, Skinner told him that the mind is a theoretical concept that we are better off abandoning. McConnell went away to mull that one over for 20 years.

Today he says, "John Watson [the father of behaviorism] made the animal brain into an adding machine. Skinner turned it into a computer. But Skinner still won't look into the box. With our knowledge of the hemispheres, we can now go much further into the head than Skinner is willing to go."

"At one lecture I pointed out to him that he can't explain what *he* does when he trains a pigeon. He sets a goal for the bird. Then directs its movements toward achieving that goal. In the interim he rewards the animal until it attains the goal. The trouble is, the goal is in Skinner's mind. It does not exist anywhere else."

Skinner has never explained how an individual changes himself or modifies his *own* behavior, McConnell says. "I say the left hemisphere is the pigeon and the right is the Skinner that sets the goals, anticipates what the consequences of actions will be, selectively reinforces behaviors that are 'emitted'—Skinner's word—by the left hemisphere. So the right hemisphere's boss, really, though it's called the nondominant hemisphere. Skinner doesn't like that at all. Next serve, Dr. Skinner."

McConnell thinks back over all the weird battles he's somehow found himself in. "I suppose my only regret is that I still can't tie all of the memory-transfer data and hemisphere studies into one pretty package. But the thing I'm proudest of—even more than my so-called honesty—is the fact that I didn't push the transfer effect more than I did. If I have one talent, it's for propagandizing. Look at my textbook—it's a six-hundred-page commercial for my version of the scientific method. I flatter myself that I could have created a school, or at least a large set of disciples, had I chosen to play the guru's role. But at some deep level a little voice tells me that if the facts don't sell themselves, they may not be valid. Yet McConnell is one of a certain endangered subspecies of scientists, poets, inventors who feel the faint, nagging suspicion that they are born too soon. By just a few years. His whole theory will fit together in neat, interlocking pieces anytime now."

"Of course, had I understood ten years ago what I do now, much of the controversy would never have taken place. Having been shocked to the core by the Nobel laureates, I'm sure I defended my own ego by resorting to humor. Part of my wit was bitter attack. But part of it was little more than the same submission response that a young wolf shows to the pack leader when he bares his throat in self-defense. Better to be laughed at than crucified, if you know what I mean."

Would he do the whole thing over again?

"Yes, except I would have qualified all my earlier statements with theoretical garbage and a barrage of 'its' and 'perhapses.' I never would have used the term *memory transfer*. 'Transfer of response bias' is so delightfully neutral. I would have appeared dead serious and refused to smile at anything. And I would have gone mad."

Will James V. McConnell usher in the new order, construct the paradigm shift in psychology? Will this maverick be seen as a pioneer who helped initiate structural changes in the study of the brain?

Perhaps. Like the coyote in North American mythology, McConnell is the trickster who, in his ambiguous role and mischievous duality, is a crucial mediator in problem solving. The temptation is to take a long run along the worm's magic electrified field to sweep out science's Augean stables with a good belly laugh. ∞

THE WILD ONES

CONTINUED FROM PAGE 57

you for something like this—tough and smart and fast. The voice was low, feminine, deadly. He would not have anticipated this encounter, however. I can jam almost all the sensors without its knowing it."

"Jenny," he said as he held the pedal to the floor and continued the turn. "Never thought you'd see me again, did you?"

"I've always wondered. Ever since the day you disappeared. But it's been so long."

"And you've spent the entire time hunting us. You had your revenge that day, but you kept right on—destroying."

"Considering the alternative, I had no choice."

He passed his starting point and commenced a second lap, realizing as he began to draw away that she must no longer be as finely tuned as when he had known her earlier. Unless—

An explosion occurred some distance ahead of him. He was pelted with gravel, and he swerved to avoid the fresh crater before him.

"Still have some of those grenades left," he said. "Hard to estimate when to drop them, though, isn't it?"

They were on opposite sides of the rocks now. There was no way she could get a clear shot at him with her guns. Nor he at her, with the cannon.

"I'm in no hurry, Sam."

"What is it?" he heard the Angel ask.

"It speaks!" she cried. "Finally! Do you want to tell him, Sam? Or should I?"

"I'd a feeling it was her back there," Murdock began, "and I'd long had a feeling that we would meet again. Jenny was the first killer car I had built to hunt the wild ones."

"And the best," she added.

"But she went wild herself," he finished.

"How's about you trying it, Whitey?" she said. "Leak carbon monoxide into the air vents. He'll still look live enough to get you out of here. You answer any calls that come in. Tell them he's resting. Tell them you didn't find anything. Slip away later and come back here. I'll wait. I'll show you the ropes."

"Cut it out, Jenny," Murdock said, circling again, beginning to gain on her. "I'll have you in my sights in a minute. We haven't that much time to talk."

"And nothing, really, to talk about," she responded.

"How about this? You were the best car I ever had. Surrender. Fire off your ammo. Drop the grenades. Come back with me. I don't want to blast you."

"Just a quick lobotomy, eh?"

Another explosion occurred this one behind him. He continued to gain on her.

"It's that virus program," he said. "Jenny, you're the last—the last wild one. You've nothing to gain."

"Or to lose," she responded quietly.

The next explosion was almost beside him. The Angel rocked but did not slow. Gripping the wheel with one hand, Murdock reached out and took hold of the pistol grip.

"She's stopped jamming my sensors," the Angel announced.

"Maybe she's burned out that system," Murdock said, turning the gun.

He sped around the rocks, avoiding the new craters, the light beam bouncing, sweeping, casting the high, craggy walls into a rapid succession of dreamlike images, slowly closing the distance between himself and Jenny. Another grenade went off behind him. Finally, the moment for a clear shot emerged from the risen dust. He squeezed the trigger.

The beam fell wide, scoring the canyonside, producing a minor rockslide.

"That was a warning," he said. "Drop the grenades. Discharge the guns. Come back with me. It's your last chance."

"Suddenly two more grenades exploded between them and rocks rattled against the Angel. Both right windows were fractured. He skidded, his vision obscured by the flash and airborne matter."

"Only one of us will be going away from here, Sam," she answered.

He swung the gun and fired again as he swept along another turn, but a pothole he struck threw the beam high, fusing a section of sandy slope.

"A useful piece that," she commented. "Too bad you didn't give me one."

They came later.

It is unfortunate that you cannot trust your vehicle and must rely upon your own driving skills. Your car would not have missed that last shot.

"Maybe," Murdock said, skidding through another turn.

Suddenly two more grenades exploded between them, and rocks rattled against the Angel. Both windows on the right side were fractured. He skidded sideways, his vision obscured by the flash and the airborne matter.

Both hands on the wheel now, he fought for control, braking hard. Passing through the screen of detritus, slowing and turning, he caught sight of Jenny racing full bore toward the pass that led out of the canyon.

He stepped on the gas again and followed after. She passed through and was gone before he could reach for the weapon.

"Return to automatic, and you will be free for the fighting," the Angel said.

"Can't do that," Murdock replied, racing toward the pass. "She could jam you again then at any time—and get us both."

"Is that the only reason?"

"Yes," the risk.

The red car was not in sight when he came through into the pass.

"Well?" he said. "What do your sensors read?"

"She entered the gully on the right. There is a heat trail."

Murdock continued to slow as he moved in that direction.

"That must be where she was hiding when we came by," he said. "It could be some kind of trap."

"Perhaps you had better call for the others, cover the entrance, and wait."

"No!"

Murdock turned his wheel and sent his light along the passageway. She was nowhere in sight, but there were sideways. He continued to creep forward, entering. His right hand was again on the pistol grip.

He passed these side openings, each of them large enough to hide a car, all of them empty.

He followed a bend, bearing him to the right. Before he had moved an entire car length along it, a burst of gunfire from the left, ahead, caused him to slam on the brakes and turn the cannon. But an engine roared to life before he could take aim, and a red streak crossed his path to vanish up another sideway. He hit the gas again and followed.

Jenny was out of sight, but he could hear the sound of her somewhere ahead. The way widened as he advanced. Finally it forked at a large stand of stone, one arm continuing past it, the other bearing off sharply to the left. He slowed, taking time to consider the alternatives.

"Where's the heat trail go?" he asked.

"Both ways. I don't understand."

Then the red car came swinging into sight from the left, guns firing. The Angel shook as they were hit. Murdock triggered the laser, but she swept past him, turning and speeding off to the right.

She circled it before we arrived, to confuse your sensors. To slow us.

"It worked, too," he added, moving ahead again. "She's too damned smart."

"We can still go back."

Murdock did not reply.

Twice more Jenny lay in wait, fired short bursts, evaded the singeing beam, and disappeared. An intermittent knocking sound began beneath the hood as they moved, and one telltale on the dash indicated signs of overheating.

"It is not serious," the Angel stated. "I can control it."

"Let me know if there is any change."

"Yes."

Following the heat trail, they bore steadily to the left, racing down a widening sand-

slope past castles, minarets and cathedrals of stone, dark or pale, striped and spotted with mica like the first raindrops of a midsummer's storm. They hit the bottom, slued sideways, and came to a stop, wheels spinning.

He threw the light around rapidly, causing grotesque shadows to jerk like marionettes in a ring dance about them.

"It's a wash. Lots of loose sand. But I don't see Jenny."

Murdock ground the gears, rocking the vehicle, but they did not come free.

"Give me control," said the Angel. "I've a program for this."

Murdock threw the switch. At once a fresh series of rocking movements began. This continued for a full minute. Then the heat telltale began to flicker again.

"So much for the program. Looks as if I'm going to have to get out and push," Murdock said.

"No. Call for help. Stay put. We can hold her off with the cannon if she returns."

"I can get back inside pretty quick. We've got to get moving again."

As he reached for the door, he heard the lock click.

"Release it," he said. "I'll just shut you off, go out, and turn you on again from there. You're wasting time."

"I think you are making a mistake."

"Then let's hurry and make it a short one."

"All right. Leave the door open." There followed another click. "I will feel the pressure when you begin pushing. I will probably throw a lot of sand on you."

"I've got a scarf."

Murdock climbed out and limped toward the rear of the vehicle. He wound his scarf up around his mouth and nose. Leaning forward, he placed his hands upon the car and began to push. The engine roared and the wheels spun as he threw his weight against it.

Then, from the corner of his eye, to the right, he detected a movement. He turned his head only slightly and continued pushing the Angel of Death.

Jenny was there. She had crept up slowly into a shadowy place beneath a ledge, turning, facing him, her guns directly upon him. She must have circled. Now she was halted.

It seemed useless to try running. She could open up upon him anytime that she chose.

He leaned back, resting for a moment, pulling himself together. Then he moved to his left, leaned forward, began pushing again. For some reason she was waiting. He could not determine why, but he sidled to the left. He moved his left hand, then his right. He shifted his weight, moved his feet again, fighting a powerful impulse to look in her direction once again. He was near the left taillight. Now there might be a chance. Two quick steps would place the body of the Angel between them. Then he could rush forward and dive back in. But why wasn't she firing?

No matter. He had to try. He eased up again. The feigned rest that followed was the most difficult spell of the whole thing.

Then he leaned forward once more, reached out as if to lay his hands upon the vehicle once again, and slipped by it, moving as quickly as he could toward the open door and then through it, and inside. Nothing happened the entire time he was in transit, but the moment the car door slammed a burst of gunfire occurred beneath the ledge, and the Angel began to shudder, and then to rock.

"There!" came the voice of the Angel as the gun swung to the right and a beam lanced outward and upward from it.

It bobbed. It rode high. It fell upon the cliff face, moving.

Murdock turned in time to see a portion of that surface slide downward, first with a whisper, then with a roar. The shooting ceased before the wall came down upon the red vehicle.

Above the sound of the crash, a familiar voice came through the radio. "Damn you, Sam! You should have stayed in the car!" she said.

Then the radio went silent. Her form was completely covered by the rockfall.

"Must have blocked my sensors again and sneaked up," the Angel was saying. "You are lucky that you saw her just when you did."

"Yes," Murdock replied.

"Let me try rocking us loose now," the Angel said a little later. "We made some headway while you were pushing."

The breakaway sequence began again. Murdock looked up at the stars for the first time that evening—cold and brilliant and so very distant. He kept on staring as the Angel pulled them free. He barely glanced at her stony tomb as they turned and moved past it.

When they had threaded their way back and out through the ravine, the radio came to life again. "Murdock! Murdock! You okay? We've been trying to reach you and—"

"Yes," he said softly.

"We heard more explosions. Was that you?"

"Yes. Just shooting at a ghost," he said. "I'm coming back now."

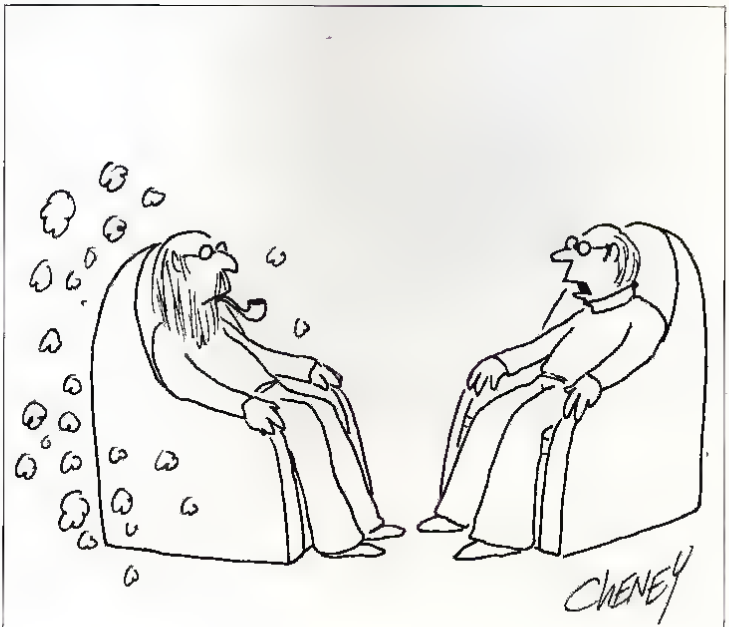
"It's over," the other told him. "We got them all."

"Good," he said, breaking the connection.

"Why didn't you tell him about the red one?" the Angel asked.

"Shut up and keep driving."

He watched the canyon walls slip by, bright strata and dull ones. It was night, sky cold, sky wide, sky deep, and the black wind came out of the north, closing wind. They headed into it. Spinning through the dream of time and dust, past the wreckage, they went to the place where the others waited. It was night, and a black wind came out of the north. **DO**



"I agree, Virgil, that it is not a question of merely accepting man's insignificance in the universe, so much as it is accepting the fact that your chair is on fire."

SERPENTS'

CONTINUED FROM PAGE 70

their faces. Garish bar lighting made them look like wax mannequins, save that Teddy was swaying slightly from side to side, quite out of rhythm with the background music. Her hand crushed Freddy's hand.

It was Teddy who found her voice first and to her horror it trembled and would not stop trembling. "You did very damned well. Two insignificant errors. It was going to be Swahili Immersion after the Japanese. Not French."

"And ...?"

"Our mutual occupation. You bracketed it, but no direct hit."

"So? All right, surprise me."

"We're cops."

Now it was Davy's turn to be speechless. But he recovered a lot faster than they had. "*Pigs*," he said.

Teddy could *not* get the quaver out of her voice. "Davy, how do you feel when some Atlas calls you punk, or kid, or baby?"

Davy's eyes flashed.

The quaver was lengthening, its period. Soon she would be speaking in sing-song ululation, and shortly after that, she knew, she would completely lose the power to articulate and would simply break down and weep. But she pressed on.

"Well, that's how we feel when some punk kid baby calls us pigs."

He raised his eyebrows, looked impressed for the first time since he sat down. "Good shot. Fair is fair. Except that you *chose* to be pigs."

"Not at first. We were drafted at the same time, worked together in a black-and-white. After the Troubles, when our hitch was up, we got married and went career."

"Hmm. Either of you ever work Juvenile?"

Teddy nodded. "I had a year. Freddy, three."

Davy looked thoughtful. "So. Sometimes Juvie cops are all right. Sometimes they get to see things most Atlases don't. And hick cops aren't as bad as New York cops." He nodded. "Okay. I grant you the provisional status of human beings. Let's deal. I've got no eyes for anything lengthy, but I could flash on, say, a weekend or two in the country. Then if we're compatible, if I like your place, maybe we could talk something a little more substantial—*maybe*. So what's your offer?"

Teddy groped for words. "Offer?"

"What terms are you offering? We might as well start with your resumés. That'll give us parameters."

She stared.

"Oh, my God," he said, "don't tell me you came *here* looking for something *permanent*? On a first date? Oh, you people are the Schwartzchild Limit!" He began to laugh. "I'll bet your own contract is lifetime. Not even ten-year renewable." When that sank home, he laughed even harder. "Unbelievable! Suddenly he stopped laughing. "Oh, Momma, you have a *lot* to learn. Now how about those résumés?"

"Shut up," Freddy said quietly.

Davy stared. "*What did you say?*"

"Shut up," Freddy repeated. "You may not call her that."

Teddy stared, too.

Freddy's voice did not rise in volume, but suddenly there was tempered steel in it. "You just granted us the provisional status of human beings. We do not reciprocate. You are cruel, and we would not inflict you on our town, much less our home. You can go now."

The enormity of the affront left Davy momentarily at a loss for words. He soon found some. "How'd you like to wake up in the alley with a broken face, old man? You read the house rules. Your badges are junk silver in here. All I have to do is poke you right in the eye and let those bouncers over there take care of the rest."

Freddy had the habit of sitting slouched

> *"He was clean. His clothes were exotic but neat and well kept. He didn't look like a welfare type, she would have given odds that he had a job, perhaps even a legal one."*

quite low, curled in on himself. He sat up straight now, and for the first time Davy realized that the man topped one hundred eighty-five centimeters and massed well over ninety kilos. Freddy's shoulders seemed to have swollen, and his eyes were burning with a cold fire that had nothing to do with neon. Teddy stared at him, round-eyed, not knowing him. Suddenly it registered on Davy that both of her hands were now visible on the table and that neither of Freddy's were.

"They'll put us all in the same Emergency Room," Freddy said dreamily. "You're a lot younger than I am. But I'm *still* faster. Leave this table."

Davy soon realized that his face was blank with shock. He hastily hung a sneer on it. "Hah." He got to his feet. "My pleasure." Standing beside them, he was nearly at eye level. "Just another couple of dumb Atlases," he said. Then he left.

Freddy turned to his wife, found her gaping at him. The fire went out in him; he slumped again in his chair and finished off his beer.

"Stay here, darling," he said, his voice soft and musical again. "I'll get us another round."

Her eyes followed him as he walked over toward the bar.

Pop had two more beers waiting for him. "Thanks for the munchies, Pop." And the wink.

"Sure," Pop said, smiling.

"He was deliberately wasting our time, Pop. Why?"

"Because time wasted hurts you more than it does him."

"Can I buy you a drink, Pop?"

The old man's smile broadened. "Thank you, buddy. That's neighborly of you." He punched himself up a whisky sour and took a drink. "You're well shut of that one. He is nothing but a little vampire."

Freddy's eye was caught by a graffito crudely painted on a near wall. It read: "TAKE OUT YOUR OWN FUCKIN GARBAGE!" On the adjacent wall someone with a different color spray can had, in a neater, tighter hand, thoughtfully misquoted: "HOW SHARPER THAN A SERPENT'S TOOTH IS A THANKLESS CHILD." Freddy shook his head and sighed. "Why is it that the word *another* is the cruelest word in the language, Pop?"

"How'd you mean?"

"Well, when he's alone with himself, a man may get real honest and acknowledge—and accept—that he is a fool. But nobody wants to be *just another* fool. Another couple of dumb Atlases," he called us, and that was the only thing he said that really hurt."

"Here now, easy! Here, use this here bar rag. Be right back." While Freddy wiped his eyes, the old man quickly filled a tray of orders for the waiter. By the time he returned, Freddy was under control and had begun repairing his makeup with a hand mirror. "See here," Pop said, "if you're hip-deep in used food, well, maybe you could climb out. But if you look around and see a whole other bunch of people hip-deep, too, then the chances of you becoming the rare one to climb out seem to go down kinda drastic. But you see, that's a kind of optical illusion. All those others don't affect *your* odds at all. What matters is how bad *you* want to get out of the stuff and what purchase you can find for your feet."

Freddy took a sip of his new beer and nodded slowly. "Thanks, Pop. I think you're into something."

"Sure. Don't let that kid throw you. Did he tell you his parents divorced *him*? Mental cruelty by Jesus."

Freddy blinked, then roared with laughter that shook the bar.

"Now take that beer back to your wife. She's looking kind o' shell-shocked. Oh, and I would recommend the redhead over there in the corner, the short, funny-looking boy with the holes in his shoes. He's one who's worth getting to know better. He's got some stuff."

Freddy stared at the bartender, then raised his glass and drank deep. "Thanks again, Pop."

"Anytime, son," the old man said easily, and went off to punch up two scotches and a chocolate ice-cream soda. ∞

CONTINUED FROM PAGE 79

it print out all the data that my boss said he wanted to see.

Several weeks later the competitor filed a complaint against me for computer theft by telephone. I had to go through a long trial, which ended with a three-hundred-thousand-dollar judgment against me for stealing something we already had. Eventually we were able to settle with the competitor by trading some computer equipment with them.

"But what was the point of going through all that hassle and expense when I didn't do anything more dishonest than checking a book out of the library? Also, we didn't get the aerospace contract.

"What I'm afraid of is that these laws are going to be turned against people like me who take nothing of value. We're easy targets because technical violations such as using a few minutes of computer time for personal business, are inevitable.

"But there are wide-open opportunities being created by turning the computer into a common carrier, and they are not getting enough attention. As more and more EDP units do message switching, the difference between IBM and ITT is disappearing. And with time-sharing around the world it's easy to plug into someone else's program.

"To ruin a competitor, there's no need to steal. A vindictive employee could cause enormous havoc by erasing data. I know one guy who had a program destroy itself on April 1 as a joke. Instead of designing safer systems, they're just going to make the programmer the scapegoat."

John Taber, an IBM programmer, has similar worries. "Executing a search warrant at a major computer center would be a nightmare," he says. "Just looking for evidence of fraud at my place in San Jose requires running a large computer 'round the clock for a week. And while they are going through thirteen thousand tapes, we wouldn't be able to get any work done. It's the sort of disruption that can force some companies into bankruptcy."

Senator Abraham Ribicoff of Connecticut, last year sponsored a computer-crime bill that would have imposed sentences of up to five years for EDP felonies, but the proposal died in committee. With the legislator's retirement, it is not certain when—or even whether—a new bill will be drafted and introduced in Congress.

Courtney believes new laws may not even be necessary, however. Improved system-control programs restricting users to data they legitimately require and cryptographic devices might provide adequate protection, he believes.

"Internal auditing has also improved, thanks to the new Foreign Corrupt Practices Act," Courtney points out. "This law, which resulted from the international corporate bribery scandals of the past few years, puts everyone on notice that he or she is responsible for his or her own acts. More detailed accounting standards make it virtually impossible to transfer assets into secret funds."

But automation has created irresistible temptations. In Wheaton, Illinois, a policeman peddled confidential criminal files to a trucking company that was reviewing job applicants. After he had accepted a $14,000 bribe, he was indicted by a grand jury on 24 counts of official misconduct, conspiracy, and theft.

In other countries computerized cash machines have helped change the *modus operandi* of kidnappers. Instead of asking his victim's parents to drop off the ransom at a remote location, Masatoshi Tashiro instructed them to put the money in his account at the Daiichi Kangyo Bank. Police didn't know which of 348 remote teller machines he would use for the first withdrawal. They finally decided to send detectives to wait near each of the bank's machines. When Tashiro inserted his magnetic card into a unit at Tokyo Station, the computer immediately flashed his location. When the kidnapper was arrested, he was holding some 290,000 yen.

"Don't let that kind of story deceive you," Senn admonishes. "The guy who wants a quick hit has problems. But for someone who's willing to move slowly and systematically, as I did, times have never been better. I see the opportunities every day at the EDP firms I consult for. Once you've established a workable system, everything else is just details."

Senn stole from his employer after failing to receive a promised bonus. So much money was flowing in and out through his dummy suppliers that it was impossible for his superiors to catch on. "I ran the data-processing firm that serviced our outfit, besides being controller. Printing up phony books after work for the auditors cut into my sleep. But with my bogus outfits and inflating costs on legitimate acquisitions, the money was mine."

By day Senn was just another diligent officer putting in 50- to 60-hour weeks. But at night and on weekends he was out tinkering with planes that took him to vacation homes in Arizona and Mexico. "I'd just put the autopilot on and fall asleep. When the vector changed near Palmdale, there'd be a beeping sound that woke me up. Much of the money went into Swiss gold, which has turned out to be a wise investment. After the authorities caught up with me, all they could attach were the planes and the houses. My company promised to drop all charges if I would simply return the money I insisted I didn't have it."

One reason Senn lied about it was that his lawyer had promised him that plea bargaining would limit his jail term to no more than a year and a half. He figured that such a short sentence was a reasonable price to pay for spending the rest of his life without money worries. He was tired of working so

"I like the metaphorical symbolism and the chromatic nuances, but I don't like the fish in the corner."

hard Prison sounded like a vacation One evening he simply told his wife and three children "Guess what I'm going to jail"

After the judge sentenced Senn to ten years, his lawyer promised him quick parole The court let him spend his last free Christmas in Carmel, California When the holiday was over he was picked up by a Department of Corrections pilot who had been his first flight instructor

"He let me fly myself up to Folsom Then they transferred me over to San Quentin where I was the warden's assistant It was great up there in Marin County The air's so clean, and I got a pass anytime I wanted to go visit the library Conjugal visits were no problem I had the run of the kitchen The other inmates loved me when I persuaded the prison to install a computer terminal for instructional purposes They couldn't believe it when I got the Veterans Administration to pick up the cost of data processing courses on the G I Bill"

At every parole hearing Senn believed he would ultimately be freed But when he refused to give back the money authorities refused to show clemency Then he found out his lawyer had been working both sides of the street A close friend of the company president the lawyer passed along all details of Senn's case

"What was particularly embarrassing" Senn recalls "was the fact that I had given the attorney fifty thousand dollars to put out a no-hit contract on me with his underworld contacts I had participated in some illegal dealings unrelated to my crime with the other officers of the company I was afraid they might try to wipe me out to keep that part of the story quiet"

Senn believes this may explain why the company never pressed charges when he was paroled after serving five years of his sentence "Sure some of the banks I'd defrauded wanted their money back he says "And the IRS came around But I was able to settle cheap Those creditors who refused to take a nominal amount are just out of luck They can follow me around to watch my activities but that sort of thing gets to be expensive As long as I liquidate slowly there shouldn't be any big trouble The whole thing did break up my marriage It was hard to pick up when I came home after so long"

In the dining room the woman he lives with and her three children are cleaning up after a late dinner One by one, members of his new family check in to say goodnight "It didn't go exactly the way I'd planned" he says, "but at least I won't end up apprehended on a Rio beach like the Lavender Hill mob

"Right now I know of three similar jobs that would net ten million dollars with considerably less effort But I'll leave that to the professional cons Were you aware that the U.S Agriculture Department has Leavenworth inmates programming millions in Commodity Credit Corporation payments? By the time they get out they'll be ready to go in a new career

CONTINUED FROM PAGE 97

thropologists have been men. I'm not claiming to have read every ethography on sex that's ever been written. I tried to use the material of those field anthropologists who have made sex a special area of study and who have achieved some renown in illuminating sexual activities in other cultures. I drew my conclusions from the best evidence that was available to me.

Omni: By the way, have anthropologists studying sexuality in foreign cultures ever been suspected of being participant observers in the Gay Talese mode of inquiry?

Symons: It's hard to say. They certainly don't admit to it. There are hints that some may have specific knowledge about sexual positions and so forth.

Omni: You make an intriguing case for what can be inferred from homosexual and lesbian behavior.

Symons: My basic claim is that there are fundamental sexual differences between men and women, but that courting behavior and moral injunctions mask many of those differences. For homosexual men and lesbians, however, there's no need to compromise. Since males are relating sexually to other males and females only to other females, it's here that we should have a dramatic insight into male and female natures—in their undiluted states.

Omni: What do you think homosexual behavior reveals about the basic male sexual nature?

Symons: An emphasis on variety, physical attractiveness, and youth. The search for new sexual partners is the most striking aspect of the male homosexual's world. The most frequent form of sexual activity among male homosexuals is the one-night stand, where sex occurs without commitment or obligation between strangers. Physical attractiveness appears to be the most important factor in sexual desirability, and older homosexual men are much less successful in finding sex partners. As one writer put it, 'Age is the monster figure of the gay world.'

This isn't to suggest that homosexual men, like most others, don't want intimate relationships. It's just that such relationships are hard to maintain, largely because of the male desire for sexual variety, the availability of willing partners, and the male tendency to show sexual jealousy.

Omni: You believe that homosexual pornography reveals more than just bodies. Is that correct?

Symons: The fact that there is a substantial industry turning out pornographic books, magazines, and motion pictures for a male homosexual audience—while there is no pornography produced for a lesbian audience—tells us something. If there were a market for such material within the lesbian community, some entrepreneur would be exploiting it. I think the interest of homosexual males in pornography reflects the basic male tendency to be sexually aroused by "objectified" visual stimuli. It is not an expression of contempt for women, as is often claimed.

I also think it's interesting that no anthropological studies I know of report girls making pornographic carvings or drawings, while numerous studies have reported boys carving sexual symbols—visual stimuli—on tree trunks and leather pouches. Women born with certain masculinizing conditions—such as the adrenogenital syndrome (excessive prenatal exposure to male hormones, or androgens)—are also reportedly more susceptible to sexual arousal through visual stimuli.

Omni: And what does lesbian behavior reveal about female nature?

Symons: What it reveals is that when women don't have to compromise their sexual natures by dealing with men, they very rarely behave as men do. Studies report that lesbians tend to form lasting, intimate, paired relationships far more frequently and easily than male homosexuals do; that stable relationships are overwhelmingly preferred to any other. There are fewer lesbian bars, and, unlike male gay bars or even heterosexual singles bars, they're not sexual marketplaces. The primary activity in lesbian bars is socializing with friends. In contrast to gay male relationships, a social relationship tends to be the foundation for a sexual relationship among lesbians, and sexual activity is usually not focused on the genitals. Lesbians rarely pick up partners for one-night stands, do not cruise, and do not have anonymous sex in public places, and there are no lesbian baths.

> *"Each time a bull stopped copulating with a cow, that cow was removed and a new cow was brought in. The bull's sexual response to the seventh cow was as strong as his response to the first."*

The latest Kinsey Institute study on homosexual behavior, done about a year ago in the San Francisco Bay Area, found that twenty-eight percent of the males had had more than a thousand sexual partners in their lifetime. Seventy-five percent had had more than a hundred partners. None of the lesbians reported a thousand partners, and only two percent had had as many as a hundred partners. Now compare two percent to seventy-five percent. That's an overwhelming difference!

Omni: Do studies of homosexuals in different cultures invariably reveal the same thing?

Symons: I just don't know of any comparable data. If there are data on this somewhere, I'd like to see them. The similarity between lesbian relationships and heterosexual relationships—and their differences from the relations of homosexual males—implies, I think, that the sexual inclinations of heterosexual males are rarely expressed fully in society. I suggest that many homosexual men achieve in reality the kind of sexual contacts that most heterosexual men only fantasize about.

Omni: You also seem to think that contemporary attempts, via a nonsexist education, to raise boys and girls to be alike are doomed to failure. Why?

Symons: If one assumes, as I do, that there really are male-female differences in the brain—just as there are in the genitals—resulting from prenatal and pubertal hormonal differences, then it seems to me that providing the *same* environment for both boys and girls is likely only to result in *different* behaviors, *different* feelings, and *different* desires. I don't say it will be impossible to devise some kind of rearing practices for which the outcome is identical behavior in boys and girls, only that identical rearing isn't likely to do it.

Omni: Has modern contraception had any bearing on the types of sexual strategies men and women employ?

Symons: If modern contraception were around long enough—hundreds of thousands of years—it would begin to. It hasn't been around long enough. I think what contraception has shown us, however, is that even when women don't incur risks of pregnancy by having sex, they still don't show traditional patterns of male sexual interest. Women don't appear to have the same degree of interest in variety that characterizes men. One-night stands don't seem to be the preferred form of sexual interest. Women don't show the interest in swinging that men do. In fact, women's photos are the prominent lure used as the bait in swingers' directories.

Omni: Plump women. You imply that throughout man's history they've been considered more desirable. What happened in our society?

Symons: Under conditions where food was scarce, plumpness was often taken to be a visual indicator of health and high reproductive status. If thin women are more desirable in this country, my guess would be that thinness is somehow class associated. I certainly don't think, by the way, that the kind of thinness you see in models is designed to be attractive to men. If women believe that, they're mistaken. You don't see women who look like that in *Penthouse* or *Playboy*.

Omni: How do you think overpopulation will affect sexual interest and activity?

Symons: Well, it's hard to know what degree of overpopulation you're referring to, but certain circumstances have an effect

on fertility If a woman s percentage of body fat falls below a certain level, she won't ovulate There are good adaptive reasons for not bearing a child when you lack the resources for doing so Where people differ in nutritional adequacy I d predict that signs of adequate nourishment would be perceived as attractive

Omni It s not an uncommon cultural observation that older men are considered more attractive than older women How does Darwinian psychology account for this phenomenon?

Symons The reason is that the male may be equally valuable as a husband even if he s in his thirties forties, or fifties whereas a female in her thirties—at least in the state of nature—will have completed half or maybe two thirds of her reproductive career The indices of age—wrinkles and so on—may be the same for both sexes but the way they re evaluated is different

Omni How has the psychosexual revolution of the last twenty years or so altered our conceptions of women's reproductive value?

Symons I think it's really open to question whether men these days are choosing women for their power—economic sexual or otherwise This may happen somewhat more frequently than it did before but I don t think the basis of sexual selection has changed considerably

Omni Do you think economically independent women will someday choose men for their beauty rather than for their status?

Symons I think this sort of thing will occur more often than before but I don t think it means that men and women will become identically alike

Omni Do you suspect that at any time in history there have been groups of humans with little or no interest in sex? Many sex clinics today report that absence of desire is a common and intractable symptom

Symons Ever since molecules first began replicating the story of reproduction has been one of those who survived to tell the tale The desire for sex was selected for As for the absence of desire reported in sex clinics that may have something to do with the Coolidge Effect

Omni What is that?

Symons It refers to the phenomenon of rearousal by a new female and it occurs in many mammalian species particularly, those that, in a state of nature keep harems It s particularly strong in cattle and sheep If a male of a certain mammalian species is placed in the laboratory, he will copulate and ejaculate several times with a female in estrus but eventually his sexual activity will cease Experiments have shown that if the original female is immediately replaced by a new female in estrus the male will immediately begin sexual activity again Fatigue is not a factor in his decline of interest If the first female is removed and then returned his sexual interest is not renewed If the original female is placed with a second male however copulation and ejaculation take place which suggests that the act of copulation by itself does not make the female less sexually attractive to males in general

In cattle and sheep the Coolidge Effect is so strong that the sexual limits of the experimental males just haven't yet been discovered One study found that each time a bull stopped copulating with a cow and that cow was removed and a new cow was brought in the bull s sexual response to the seventh cow was as strong as his response to the first. What the Coolidge Effect demonstrates is that while males of many species are willing to copulate indiscriminately with any female in estrus, they are extremely sensitive to differences among individual females and are partial to variety and prejudiced against familiarity

Omni Why is it called the Coolidge Effect?

Symons Story has it that one day President Coolidge and his wife were given separate tours of an experimental government farm When Mrs Coolidge was taken by the chicken pens, she asked the guide whether the rooster mated once a day And the guide said "Oh no Mrs Coolidge dozens of times a day" And Mrs Coolidge said, 'Tell that to the President " When President Coolidge was touring the pens, he was told about the rooster He nodded and asked "Is it the same hen every time?" The guide answered Oh no Mr President It s a different hen every time The President reportedly said 'Tell *that* to Mrs Coolidge

Omni Do you think cloning will ever become a dominant preference among human beings once the technology has been sufficiently refined?

Symons Since cloning hasn t been around long enough, it s hard to make inferences But one could say that if cloning were to produce more reliably than sexual reproduction, offspring that were healthy and had fewer extreme nonadaptive traits, then cloning might become the reproductive method of choice

Omni But doesn t cloning reduce the mixing of genes, the variation that is the warehouse of natural selection?

Symons You re right Cloning might lead to fewer possibilities for adaption over time In reality I don t think that there is really any evolutionary prediction that one can make

Omni One last question People rarely write books that violate their own deepest convictions Have you had difficulty maintaining intimate relationships? Has jealousy or a compelling desire for sexual variety been of concern to you personally?

Symons One way people can avoid dealing with the content of a book is to explain away its views on the basis of the author s feelings I think this diverts attention from the substance of the book

Omni Let me phrase it differently then Do you find that your personal experience *doesn't* concur with the main premises of your book?

Symons No I don't find that

Omni On that note, let me thank you and wish you and your spouse well **DO**

MACRO

CONTINUED FROM PAGE 92

cal capacity to carry out such projects has never been greater while the need to rely on them to deal with rising social crises has never been more urgent

"Our country has fallen way behind the Japanese and Europeans in its ability to carry out large projects" Davidson agrees "Let me give an example Here at MIT is the Francis Bitter National Magnet Lab where magnetic levitation was developed Trains equipped with it could fly thousands of miles per hour They even built a model of one of these railroads seven years ago The U S government said, Very good boys you were a complete success and moved on to other projects

"But the Japanese and the Germans took the same research and applied it to their needs Late in 1979 the Japanese national railroad announced that it had run a full-size mag-lev car at five hundred three kilometers per hour a new world record They plan to install it on their Tokyo-to-Osaka line By 1990 you'll be able to make that four-hundred-eighty-kilometer trip in one hour even their Bullet Train now takes three and a half hours Meanwhile look at what the United States is talking about for its Northeast Corridor The most daring proposal is something the Japanese actually built fifteen years ago

Davidson's ultimate goal and that of other macroengineers, is to develop tools that speed up the process of turning science fiction into reality To accomplish this they are pooling the resources of some strange bedfellows industrialists and environmentalists

Russell Peterson president of the National Audubon Society and former chairman of the President's Council on Environmental Quality, addressed one recent macroengineering conference "American industry is one of the most potent forces in human history" he said "And it can be a constructive force if only it learns to look at things in a long-term perspective You don't even begin to see the most important things in life unless you look at them in a macro way

The question is When are big projects the best way to solve a given problem? Learning to decide is another aim of the macroengineers At MIT computer models are being developed to aid the decision-making process These "macromodels" include criteria not normally taken into account in making engineering decisions psychological effects influence on lifestyles and political impact "There is an urgent need to develop engineer-managers who can relate technology to the deeper values of society" Davidson says

Meanwhile American industry is chafing to put these new tools into action Cordell Hull treasurer of Bechtel Corporation, in San Francisco, believes that macroengineering may hold the key to solving our energy crisis "Look at the kinds of alternative energy sources everyone is talking about" he says "synthetic fuels hydroprojects nuclear power, oil shale, tar sands solar-power satellites The common factor is their immensity And it will take hundreds of them to fill our energy gap and substitute for imports"

Hull knows whereof he speaks Bechtel is now managing the world's largest construction project the new city of Jubail in Saudi Arabia On the site of a fishing village, the Arabs are building an industrial city roughly the size of Detroit or Hamburg The project must provide housing and hospitals for 250,000 to 350,000 people, 480 kilometers of paved highway a fully equipped deepwater port an international airport a modern telecommunications system, and sewage desalination and electric generating systems All this began to take shape just over five years ago By the end of this century the Saudis will have pumped as much as $50 billion into the city's infrastructure alone

> *"Soviet engineers plan to replenish the Aral and Caspian seas by pumping two giant rivers 3,000 kilometers over the Urals They could melt the polar ice cap or throw Earth off balance"*

Normally an infrastructure like that is built up gradually over decades and even centuries" says Bechtel Vice-President Richard Godwin who is overseeing the project "Nobody has ever tried to put it all in at once before

Jubail is also a rarity in that it is wholly financed from Saudi oil income—to the tune of as much as $5 billion a year Few other projects can count on a bankroll like Saudi Arabia's Instead they turn to ever more innovative forms of "macrofinance" A single comparatively small dam across the Canadian section of the Columbia River required a complex financial agreement between two federal governments, one province and a variety of public and private utilities

Macroprojects have always been in the forefront of financial innovation—sleight-of-hand some might call it French engineer Ferdinand de Lesseps began selling shares in his Suez Canal Company before he had even won the concession from the Ottoman sultan More than a century later oil companies financed the Alaska pipeline by sweet-talking bond-rating services into counting oil in the ground as equity on the balance sheet

"It's not the cost that stands in the way of most macroprojects," Davidson claims "Bankers are much more flexible than you might suppose Where the average citizen would ask, How much does this cost?' a banker asks What's the return?' He doesn't care how big it is, as long as there's a good return on the investment"

Then what does stand in the way? Davidson's answer will 'All we have to do is decide on our priorities and every obstacle melts away When we decided to land on the moon, it didn't matter how much it cost We did it The same could be true for any other macroproject But we have to decide which ones we really want!

Macroprojects now on the drawing boards show an astonishing variety The ones below are all feasible and probably economically very sound Social criteria not technological ones, will decide whether they are carried out

MAN-MADE ISLANDS

The floating cities and island communities mentioned at the start of this article could be built at any time Craven's Hawaii Floating City Project has been working out the details for a decade The study group's plan calls for low-density land uses to be strung out along a river valley and connected by energy-inexpensive ferries carrying commuters to a floating residential area "downtown"

Craven points to a series of recent technological breakthroughs that make the concept feasible Among them are offshore nuclear-power plants designed by Westinghouse to be safer, cheaper, cleaner more secure and less controversial than their land-based counterparts stressed-concrete "vertical bottles" used to store oil off the coast of Norway hydrofoils and semisubmersible platform ferries now used in Japan and the Soviet Union floating steel mills desalination plants and oil refineries built on barges in Japanese shipyards and towed to permanent locations as far away as Brazil and offshore oil rigs which have long shown the practicality of using large stable floating platforms far out in the open sea

"There is no part of the technology that has not appeared somewhere," Craven says "It is all proven" Craven is so confident in the basic engineering that the Hawaii Floating City Project has moved beyond designing the city proper It is now working on the associated islands that will house its utilities the most difficult is a thermal-energy plant which will service the electrical needs of the city from the ocean itself

Japanese architects borrowed Craven's ideas for Aquapolis, a not-so-miniature floating city that was the showpiece of Okinawa's International Ocean Exposition in 1975 and 1976 Housing the fair's Japanese pavilion Aquapolis was equipped with its own power water and waste-dis-

posal facilities It covered an area of 10 000 square meters rested 30 meters above the ocean surface and could accommodate more than 1 000 visitors at a time Fourteen typhoons struck Okinawa during the six-month exposition yet Aquapolis remained open 95 percent of the time and welcomed 3 5 million visitors

Planetran Twenty one minutes from New York City to Los Angeles? The know-how already exists says Rand Corporation physicist Robert Salter Supersonic ground transport can be achieved by running a mag-lev railroad (a wheelless frictionless train kept off the ground by magnetic forces) in a semivacuum tube In other words a transcontinental subway

Planetran does not require scientific breakthroughs or even new technology says Salter But the project s political outlook is much less optimistic than the technical one

The problem is the price tag $250 billion to $500 billion But once built Salter claims Planetran will be so inexpensive to operate that the entire investment can be paid off with fares of only $54 for cross-country passengers and 15 cents a ton-mile for freight

Nor must all of Planetran be built in one fell swoop It could start say with short stretches from San Francisco to Los Angeles or from Dallas to Houston Tubes could be laid on the surface in flat open country instead of being hidden underground Tunnel digging comprises more than half the expense

But maximum speeds can be obtained only in nonstop coast-to coast travel The 21-minute time is achieved by continuous acceleration of 1 gravity for the first half of the trip (to a maximum of 22 500 kilometers per hour) and continuous deceleration for the second half A more comfortable trip at acceleration of ⅓ g would take 36 5 minutes or 70 minutes including stops in Chicago and Dallas

Is Planetran really farfetched? Salter asks rhetorically Probably not The real question he insists is whether we can afford to continue polluting our skies carving up our wilderness areas and arable land and extravagantly wasting fossil fuels for forms of impractical transportation that seem practical only because we are so accustomed to them

MACRO WATERWORKS

The Tehuantepec shipway Who says canals have to be liquid? Twenty-five years before the Panama Canal was dug a visionary engineer obtained a concession from the Mexican government for a railroad canal across the Isthmus of Tehuantepec A century later the idea is again attracting interest Ships in one ocean would be lifted from the water on submerged pontoons like those used in shipyards around the world Then the entire assembly would be pulled across the continent to the other on a giant railroad

The idea is even older than the nineteenth century Ancient Greeks carried boats across the Isthmus of Corinth on huge oxcarts The Turks conquered Constantinople by stealthily transferring their armada onto land And smaller marine railways have been used in Europe to transfer ships from canal to canal for several centuries

Contemporary engineers have improved on these methods One MIT professor prefers a "highway canal" which would carry ships on gigantic trucks like those used to carry ore in mines A retired U S Navy admiral suggests a moving lock Ships would remain afloat but the entire lock would be moved across the Mexican countryside like a giant bathtub

No one knows which of these methods should be adopted or even whether a Tehuantepec shipway will be built But the profits from Mexico s nascent oil industry might someday make it a reality

India s garland canals An ambitious Indian engineer named Dinshaw J Dastur has proposed building a 7 000-mile network of irrigation ditches linking every major river in India and reaching every city and village The plan s most novel feature is its construction method manual labor The so-called garland canals would employ an army of the unemployed all of whom would be rewarded with land rendered fertile by the canals

"India's 7,000-mile network, the garland canal project, could put a whole army of unemployed back to work and then reward the workers with land rendered fertile by the canals"

With this single project Dastur claims "India s perennial problems of floods and droughts energy crisis food shortage and unemployment would be solved on an abiding basis in the next ten to fifteen years

Engineers outside India view the plan optimistically The World Bank and the U N Food and Agriculture Organization have cautiously pledged support "If economic development were a priority above military strength" Indian planner Rashmi Mayur says "the twenty-eight percent of India s budget now spent on defense could make such a project a reality"

But such realistic planners as B B Vohra hold that less costly solutions are both available and preferable Groundwater they insist could do much to solve India's food shortages if it were exploited more aggressively So far the argument remains unresolved

Russian river reversals Imagine reversing the Missouri River so that it flowed over the Continental Divide and into the Pacific That is the astonishing scale of a Soviet scheme to rescue the dying Caspian and Aral seas

Soviet planners have long been vexed by wasted rivers flowing from water-rich Siberia into the Arctic Ocean Meanwhile the landlocked Caspian and Aral seas are shriveling because their sources are diverted for irrigation At the present rate the Aral will be a salt marsh by the end of this century Fishing mining public health caviar production climate oil drilling and transportation have already been badly affected

The solution Soviet engineers propose is to reverse the flow of the giant Ob and Yenisei rivers in western Siberia Instead of emptying into the Arctic the water of those two rivers would be pumped uphill and over the southern reaches of the Ural Mountains—3 000 kilometers—into the Aral and the Caspian Enough would remain to irrigate 75 000 acres of arid central Asia

Western environmentalists are horrified by the whole idea Depriving the Arctic of so much fresh water they claim could raise its salinity and melt the ice cap warming the entire Northern Hemisphere and raising ocean levels enough to inundate large cities around the world Or they worry that shifting so much weight from the Arctic to the equator might throw the entire planet off balance and cause it to wobble in orbit

Soviet planning is so secretive that no foreigner knows whether this plan has received a definite go-ahead But about 100 Soviet research institutes are looking at various parts of the plan including its environmental impact

Meanwhile only projects that fit into this master plan are being worked on Long-range Soviet planning assumes that construction will begin within five years and that Siberian water will enter the Aral Sea by the mid-1990s

The Trans-Mediterranean aqueduct Canadian engineer Joseph Debanné has proposed an enormous energy swap between France and Algeria its former colony Debanné suggests laying a plastic pipe 150 feet in diameter from Marseilles to North Africa The pipe would carry enough fresh water from the mouth of the Rhône—the equivalent volume of an average North American river—to double the arable acreage of Algeria and Tunisia combined To pay for this a second pipeline would carry a river of crude oil from North Africa to France

The aqueduct would cost $6 billion to $9 billion But with a return of say 100 million barrels of oil to France Debanné believes that the exchange would be profitable to both countries According to recent reports Libya is seriously interested in making the trade if Algeria does not

"When did you first feel the need to leap into the ocean en masse?"

Dirigibles were the rage in the Twenties and Thirties. Remember the *Hindenburg*? That mammoth dirigible was modest compared to the airship of the future if Boston engineer Francis Morse's predictions come true. Morse, who helped design the Goodyear blimp, envisions a generation of nuclear-powered dirigibles with accommodations for 3,500 people, promenade decks longer than the *QE2*'s, hangars for shuttle planes or helicopters, and 1 million cubic feet of cargo space—all with a cruising speed comfortably over 160 kilometers per hour.

Lighter-than-air craft can be far more economical than airplanes, Morse points out. Once they reach a certain size, much less of their lift goes into carrying the aircraft, and much more can be used to carry cargo. Dirigibles may never be as fast as their heavier-than-air counterparts, but they can transport huge cargoes at low cost—and offer ocean-line luxury to unhurried passengers.

The airship's revival need not begin with nuclear leviathans. A conventional dirigible small enough to fit existing hangars would weigh no more than a Boeing 747, yet would have ten times the floor space. The larger they become, the more economical they are to operate.

African scientists now see the airship as the most promising transport for economic development, according to a recent UNESCO survey. Africa lacks roads, railways, and airports for traditional transportation. Dirigibles need only mooring masts where they can tie up.

ORBITAL INGENUITY

Earth shuttle. NASA has already spent billions of dollars to develop the space shuttle. How much more would it cost to refit it for orbital transport between two places on Earth? Probably less than it's worth. Scientists throughout the country are looking into a smaller Earth shuttle for ultra-high-speed transport. Some believe that what Boeing calls single-stage to orbit (SSTO) craft could be operating by the end of this century.

The SSTO would be a completely self-contained rocket that could connect any two points on Earth within two hours. No first-stage boosters would be used and then discarded, as on the larger space shuttle. Cargo could cost between $10 and $20 per pound to ship, and passenger tickets would cost from $3,000 to $10,000—a mite extravagant for tourists, perhaps, but not unreasonable for executives, diplomats, and other high-priority travelers.

So much research goes into space travel anyway that this may be among the most practical of macroprojects. Aerospace engineer J. Peter Vajk calls it the leading contender to become the global transport system of the future.

" Solar-power satellites. Name the arguments against solar power: It's inconsistent, since it works only in the daytime; it depends on the weather; you can use it only where the sun shines (it's not really practical in Boston or Seattle); and most of the energy is lost in the atmosphere before it even reaches Earth.

HERE COMES THE SUN

There is an obvious solution to all these problems. Capture the energy before the atmosphere absorbs it: go where the sun always shines: outer space.

This may be the future's best energy source. Engineers at NASA and some aerospace companies have been working for more than a decade on ways to capture solar energy by satellite. Placed in geosynchronous orbit, satellites can be exposed to the sun 99 percent of the year and receive 4 to 11 times as much energy as an earthbound solar station. Microwaves, lasers, or even mirrors could bring the energy back to Earth.

"There are no known technical barriers to the design, deployment, and operation of solar-power satellites," concludes solar engineer Peter Glaser, who has been studying the concept since he proposed it in 1968. By the next century, he believes, the cost will be competitive with other energy sources.

But the real question is not whether any one of these projects is practical. It is how we apply macroprojects in general to meet human needs. Frank Davidson says it's time to train a new breed of engineer-managers, men and women equally at home in science and in the arts.

"If engineering is to protect and enhance the physical and social environment," he says, "we must have a cadre of people with both reliable technical competence and broad and sensitive judgment on human issues."

To show the way, in preparing a recent symposium report, Davidson even brought in psychiatrists to assess the way designs in public housing affect personal and family life. The French government has followed with a special Institut Auguste Comte, designed to train managers headed for the top in the characteristics and management of 'large-scale programs of equipment.' And Yale, MIT, and the Polytechnic Institute of New York have begun to develop programs that will train students in the basics of both engineering and management.

If the reindustrialization of America is to be more than an empty slogan, Davidson believes, government and industry must form joint study groups to examine macroengineering projects. One result might well be the establishment of a multibillion-dollar industry to develop supersonic ground transport.

Could a Presidential Commission on Macroengineering help get America moving again? Davidson and some other responsible authorities have no doubt. OO

That was his most difficult period.

EXPLORATIONS

By Norv Brasch

The academic district of Paris, home of the Sorbonne, has seen more than its fair share of scientific glory. Here in the square mile known as the Fifth Arrondissement, Leon Foucault demonstrated the rotation of the earth with a simple pendulum. Here, too, Claude Bernard, the father of modern medicine, dissected live animals and extrapolated his findings to the functioning of the human body. Rue Broca, Rue Descartes, Rue Jussieu— the street names read like an index to the history of French science.

Perhaps the most impressive chapter in Parisian science is honored by one of the Fifth's least impressive streets. Only the most perceptive visitor would spot the words **Institut du Radium** above the doorway at 11 Rue Pierre et Marie Curie. Behind this unassuming facade lives the memory of four great scientists, all of them Nobel Prize winners named Curie. Collectively they led a quiet revolution that changed our view of basic matter and immortalized the Fifth Arrondissement as the cradle of the present Nuclear Age.

The story begins on the opposite side of the district. In the neatly pruned Jardin des Plantes, along Rue Cuvier, are the laboratories of the Muséum National d'Histoire Naturelle, where Henri Becquerel conducted his experiments. An eminent physicist, well connected in scientific circles, Becquerel keenly followed Wilhelm Roentgen's discovery of X rays in 1896. While conducting his own experiments, he found that uranium samples spontaneously emitted energy in sufficient quantity to fog an unexposed photographic plate. But Becquerel was hard pressed to find an explanation for this phenomenon.

The problem intrigued Pierre and Marie Curie, a young couple drawn to each other by an obsessive passion for science. Pierre was so engrossed in physics that he habitually ignored matters of his daily existence. Marie combined her husband's devotion with stubborn pragmatism. By 1897 she had advanced far enough toward her physics degree to begin searching for a doctoral thesis. The Curies walked from their humble apartment on Rue de la Glaciere to Becquerel's laboratory on Rue Cuvier, where the three scientists pored over the peculiar properties of uranium. It was perfect material for a doctoral dissertation— original, adventurous, and potentially important. Marie began her research in a cold, damp room at the School of Physics and Chemistry a few minutes from the Curies' apartment.

"The more Marie penetrated into intimacy with uranium rays, the more they seemed without precedent," wrote Eve Curie in her charming, somewhat romanticized biography of her mother. "In spite of their very feeble power, they had extraordinary individuality. By mid-1898 Marie was ready to publish her initial findings and to give the mysterious energy a name—*radioactivité*."

As Marie's work became more promising, Pierre procured a leaky, floorless shed at the School of Physics and Chemistry and joined his wife in this makeshift laboratory. Having tested every known pure element for radioactivity, they began checking compound substances. Samples of pitchblende, a mineral laced with uranium, proved more radioactive than pure uranium. The conclusion was unavoidable: Pitchblende must contain another element, low in concentration but highly radioactive. The Curies spent most of their savings to have a ton of the seemingly worthless rock shipped from mines in Bohemia, at that time part of Austria.

Over the next four years the tenacity of the Curies proved to be their greatest asset. They spent long hours in the shed, boiling, separating, precipitating, and collecting, until eventually the two scientists isolated 100 milligrams of a substance so powerful it glowed in the dark. After several attempts Marie was able to calculate the atomic weight (226) of the new element, radium.

Eight tons of pitchblende yielded a single gram of radium, and the Curies were understandably proud of their discovery. However, by today's safety standards, they were careless with the samples. Pierre kept a vial of radium in his vest pocket and, when it produced a burn,

Polish-born Marie Curie, the only person to win the Nobel Prize twice in a scientific field

Okay kid. Let's see what you can do!

used himself as a human guinea pig to study radium's physiological effects. He soon realized that radium's power might destroy malignant growths, and early experiments in curietherapy, another name for radiotherapy, were undertaken.

Radium took the international scientific community by storm. In 1903, the same year that Marie was awarded her doctorate, the Curies and Becquerel were jointly presented the Nobel Prize in physics. The announcement brought an intensely private couple into the limelight. Reporters hovered around the new family home on Boulevard Kellermann, hoping for a choice word or a cute anecdote from the venerated physicists. Marie dodged all personal questions, offering only her standard retort: "In science we are interested in things, not in persons."

Despite all the interest shown abroad, the French scientific establishment was slow to recognize the importance of radioactivity. The laboratory that Pierre had so long coveted never materialized, and he refused to play political games for the sake of advancement. "Death is quicker than public officials to claim great men," Eve Curie wrote in an uncharacteristic moment of bitterness.

There is more than a touch of irony in her choice of words. On a rainy afternoon, April 19, 1906, Pierre walked along the Seine to the Pont Neuf. Lost in thought, he failed to notice a cart coming down Rue Dauphine, fell under the horses, and was crushed to death by the wheel that followed. Absentmindedness proved to be Pierre Curie's fatal flaw.

Marie was shattered by the blow. In Pierre's death she lost a lover and a collaborator. For weeks she confined herself to her room, writing pitiful letters to her dead husband. But a small circle of friends would not let her talents wither away. The following November, Marie stood before a packed classroom of gawking spectators as the first woman professor of the Sorbonne. Forgoing the expected eulogy, she picked up Pierre's lecture at precisely the place he had left off. "When one considers the progress that has been made in physics...."

Life was rocky for the woman scientist and her two daughters. Again the family was shaken by a sex scandal linking Marie with a colleague, Paul Langevin. Again Marie felt victimized by the press, this time for good reason. But in the midst of the scandal she was awarded the 1911 Nobel Prize in chemistry for her continuing work with radium, becoming the only person to win the Nobel twice in a lifetime in a scientific field.

When the tempest blew over, Marie returned to the one unfulfilled dream she had shared with Pierre: a proper research facility in which to pursue the theoretical and therapeutic possibilities of radium. She finally had her way. Two buildings were authorized for the institute: the Pavillon Curie, for pure research, and the Pavillon Pasteur, for medical applications. Marie bustled over even the most minuscule details of the construction, cultivating the garden that now separates the buildings before either was completed.

World War I delayed the move into the new Radium Institute. Determined to defend her adopted country, Polish-born Marie spent the war years organizing and driving mobile x-ray units to the front lines. In 1918 she was in Paris again, walking daily from her apartment on the Ile St. Louis, through the lively Latin Quarter, to her beloved institute.

Her best work behind her, Marie became the mentor of a new generation of nuclear scientists. Outstanding among them were her own daughter and son-in-law, Irene and Frédéric Joliot-Curie, who later won the Nobel Prize for their work in artificially induced radioactivity. Other landmarks at the laboratory were celebrated with tea in the garden, served in chemical beakers with glass stirring rods.

The Radium Institute continues today in its original function, with a small section maintained as an informal museum. Marie's office, which has been left virtually intact, reflects her penchant for the functional. Pierre's highly sensitive brass scale is one of the few concessions to sentimentality. Marie's calling cards still sit on her desk, her laboratory jacket and favorite pen stashed unceremoniously in one of the drawers. The lead casket in which Marie carried a gram of radium given to her in America lies beneath the window overlooking the garden.

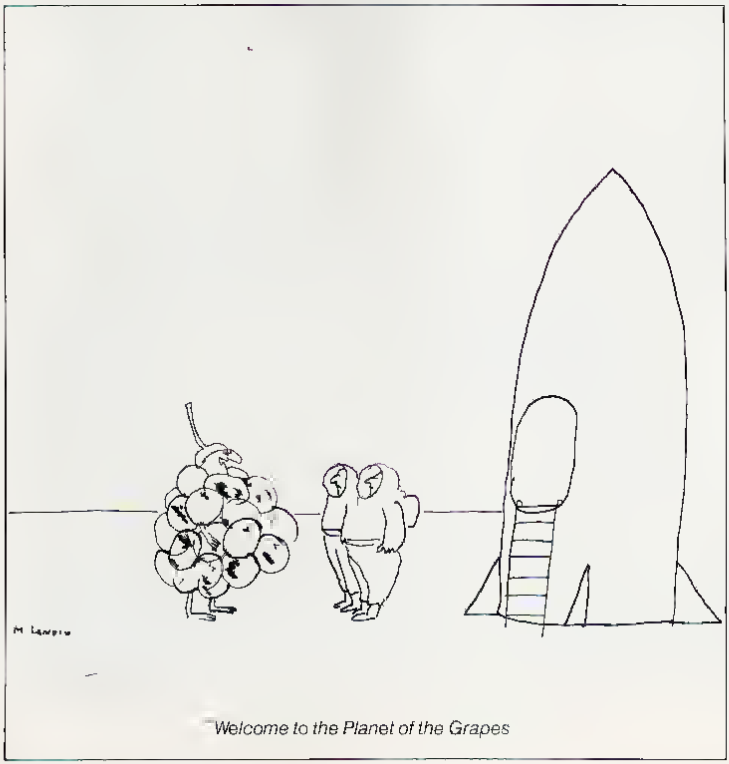
Sometimes, in her rare reflective moments, Marie would open the window and gaze into the placid garden, which remains a bastion of tranquillity for the scientists of the Radium Institute.

The workroom adjoining the office houses the instruments that played a role in the accomplishments of the four Curies. Pierre and his brother Jacques designed the piezoelectric quartz that later aided Marie in the discovery of radium. A Hoffmann chamber brought Irene and Frederic within a hair's breadth of identifying the neutron in 1932. Marie's handwritten calculation of radium's atomic weight is also on display.

The museum is open to the public, if little publicized. An advance phone call (329 12 42) can be helpful. Should the language prove to be a formidable barrier, just try showing up at 11 Rue Pierre et Marie Curie. Your perseverance will be more than amply rewarded.

Four scientists representing two of the most remarkable marriages in scientific history perhaps deserve a grander memorial, but such an honor would be foreign to the modest Curies. ∞

Norv Brasch is the author of an upcoming book, The Birthplaces of European Science *(soon to be published by United Technologies Corporation, Hartford, Connecticut).*



Welcome to the Planet of the Grapes

SCULPTURE

CONTINUED FROM PAGE 30

Both clear and colored glass tubes for neon come in several diameters and may be tinted or coated with phosphorescent powder, creating 40 varied hues, the widest range of color now available in electrical lights. After all the impurities are pumped from the tube, it is filled with either argon or neon, two noble gases that make up less than 1 percent of the air (noble gases exhibit great stability and extremely low reaction rates). When the electrons and positive ions are electrically excited and bombarded, they ionize, producing billions of "couplings" every second. It is these unions that emit light.

Neon (from the Greek word meaning *new*) utilizes the same electrical principle as lightning: both are electrical discharges in gas. Since there is no filament in neon tubing, the light is shadowless. It radiates in a continuous, uninterrupted line; it does not grow hot to the touch and will not burn out. Argon glows bluish white, neon is orange-red. The gases, distilled from air, are neither toxic nor explosive. A broken tube is easily spliced with an identical glass tube and refilled with gas.

A neon tube used continuously can last 30 years or more. Energy-efficient, neon consumes little electricity. A standard beer sign uses slightly more current than a 100-watt incandescent bulb uses to light a small room adequately.

The amount of necessary current is measured in thousandths of amperes. If the milliamperage is too low, the neon will lack brilliance. Too strong a current will destroy the electrodes, drastically reducing a neon light's lifetime.

Operating current for neon tubing 6 to 15 millimeters in diameter is between 15 and 60 milliamperes. The wider cold-cathode tube, usually between 18 and 25 millimeters in diameter, operates on the same technological principle as neon but requires between 60 and 200 milliamperes to glow.

"Very little engineering research has been done on neon and cold-cathode tubes," Stern explains. "My evaluation is that these tubes, if properly developed technically, will far exceed all other forms of known lighting in terms of both brilliance and efficiency."

To light a 15-foot-square room adequately with a ceiling 8 feet high—that is, to provide 50 footcandles of illumination 3 feet from the floor—the amount of light necessary to read by—hot-cathode tubes or fluorescents draw 800 watts of electricity with a tube life of 3,000 to 8,000 hours. Incandescents, using the same conditions, draw 2,400 watts and last a mere 1,000 to 2,000 hours. Cold-cathode tubes, the wider neon lights, require 1,200 watts of power and have a life span of 25,000 to 40,000 hours. Although Stern has no exact figures for the smaller neon tubes, he points out that they require less wattage than cold-cathodes because of their smaller diameter and are, therefore, still more efficient.

"Wattage consumption by cold-cathode tubes," Stern concludes, "is more or less equal to fluorescents, although their range, their graphic potential, I feel, overrides that factor. They certainly look good compared to light bulbs, which require twice as much consumption to operate. This proves conclusively that the neon tube with its wonderful graphic flexibility has a life far beyond other existing light sources."

"Technology is one part of the neon picture," Stern continues. "What I find more interesting is that here was a trade, a craft, a skill, an art—and a very demanding, precise one—that was limited to making words, telegraphic images that related to advertising signs only. Those signs are exciting and real street communication. But the graphics deteriorated, became schlock, because the industry was suffocating itself. Neon signage was accused of polluting the environment. An eyesore. But it's really visual vitamins. You're breathing it right now. It's stimulating, limitless. You can communicate with it. It has beauty and humor. I like getting calls from California in the middle of the night for neon mushrooms. I feel great because I helped rekindle a wonderful, natural way of using the noble gases to light our lives." DD

DIMINISHING RESOURCE

PEOPLE

By Dick Teresi

He's not home right now. He's out picketing an elevator factory. was the answer we got recently when calling the home of **Darwin Crum**, electrical engineer and founder of the American Society for the Conservation of Gravity (ASCG).

Crum has taken on the job of warning the world about yet another diminishing natural resource. Each time gravity is defied, he says, its hold on the earth becomes weaker and weaker.

He made this discovery after visiting the home of a clockmaker who complained that his clocks were starting to run uniformly slow. To Crum this could mean only one thing: The force of gravity was fading. He started the ASCG to monitor the use of this fast-diminishing resource and to encourage conservation measures.

Among the statistics Crum offers are: The Sears Tower skyscraper in Chicago, with its 103 elevators, uses as much gravity in a day as 50 climbs up Mount Everest; the United States, with only 6 percent of the world's population, consumes 59 percent of the planet's gravity; one moon shot used more gravity than was used in the entire eighteenth century.

In prehistoric time, man was largely a horizontal creature, Crum says. 'He didn't use much gravity except maybe to fall off a dinosaur. As he got more vertical, he used more. In time there came the elevator, the skyscraper, the airplane, and the bane of gravity, air freight.

Crum has written the White House, asking that airplanes be made to observe the 55-mile-per-hour speed limit and that the ton be reclassified to 500 pounds.

He suggests that people avoid escalators, elevators, and airplanes, that they lie down a lot, and that the 550-foot-tall Washington Monument be lowered into a 535-foot-deep hole so people don't waste gravity by walking the full distance to the top.

Asked whether he knew when we might run dangerously low on gravity and start drifting into space, Crum told *Omni* reporter Douglas Colligan that he wouldn't disclose the probable date. 'I don't want to encourage hoarding,' he explained.

You can contact the ASCG at P.O. Box 94486, Schaumburg, IL 60194. A $10 membership fee gets you a bumper sticker, a membership certificate, a newsletter, and a gravity-status indicator, a device that lets you know how much gravity is left on the planet.

Darwin Crum. He's asked the White House to make airplanes observe the 55 mph speed limit

Gerald Feinberg. Tales of bizarre creatures

•

While many scientists looking for extraterrestrial life are speculating about the existence of other Earth-like planets, Columbia University physicist **Gerald Feinberg** thinks we should be looking in the centers of stars or through the vast stretches of interstellar space.

Feinberg believes there are two kinds of creatures out there: plasmodes and radiobes. Plasmodes, he says, have evolved within our sun and the stars into patterns of organized motion from random collisions of electrons and ions. The creatures are alive in the sense that they persist as ordered arrangements and replicate by magnetically converting random arrangements of stellar matter

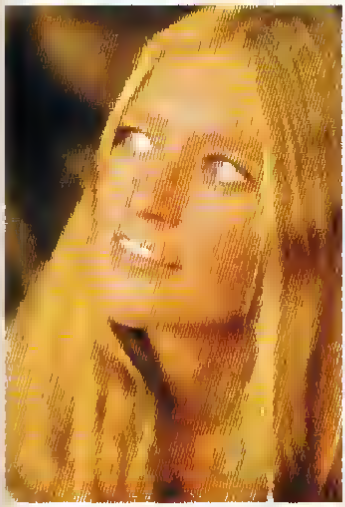
into plasmodelike nonrandom forms

Radiobes live in the cooler climate of interstellar space and are composed of atoms widely spread apart that anchor and emit radiation from nearby stars. In highly evolved states radiobes emit laserlike beams of light, which can order other lifeless collections of atoms to form new radiobes.

Feinberg says one of the prime requirements for life is *orderliness*. And plasmodes and radiobes, as he sees them, are highly organized. In fact, some plasmodes, he says, not only might repel foreign particle charges — thus defending themselves — but might also attract particles for feeding purposes.

Feinberg and his coauthor, **Robert Shapiro**, head of New York University's biochemistry department, discuss these and other concepts in their new book, *Life Beyond Earth, the Intelligent Earthling's Guide to Life in the Universe*.

For those who would like to use Feinberg's space creatures in their next SF horror film, the physicist warns that plasmodes would pose no threat to Earth. "They would regard us as completely uninteresting," says Feinberg. "Why would creatures living in the middle of the sun with the whole universe at their disposal want to come out to a little piece of cinder millions of miles away?"



Jane Tate: Bears are not always cuddly

Vacation season approaches, and animal behaviorist **Jane Tate** is readying herself for the carnage. Every year, says Tate, a University of Tennessee graduate student, visitors to national parks and other wilderness areas are injured by black bears panhandling for food along roadsides and in campgrounds. People who treat the animals like giant-sized teddy bears sometimes end up getting bitten or swatted. Since a black bear weighs anywhere from 125 to 350 pounds, the injury usually requires more than a Band-Aid.

"In forsaking their shy and secretive ways to beg for food, black bears are . . . under stress, and aggression is likely," Tate says. After watching hundreds of encounters between bears and people in Great Smoky Mountains National Park, in Tennessee and North Carolina, however, Tate found that almost every aggressive act on the part of bears was precipitated by the actions of people.

The most common mistake people make that ends in a bear attack is simply crowding the animals. But Tate also saw people putting their hands in bears' mouths to feed them, placing their children next to them "to get a good picture to take home," petting the animals, and holding out empty hands to them.

One woman took a Polaroid photograph of a bear and then thrust the print into the animal's face. The bear looked at the print and bit her.

Bears often make a blowing sound before they attack or bite. Sometimes a bear will charge a person or a group. If you're faced with a blowing, charging bear, Tate advises, you can prevent further aggression by stopping whatever you're doing that is irritating the animal and either standing still or retreating slowly. Better yet, Tate says, don't get close to bears in the first place. OO

Tourists pet bear cubs. One of several common — and dangerous — mistakes people make

MIND

CONTINUED FROM PAGE 24

explained that his professional proximity to television sets, sound systems, and video games did not make him any more confident when these devices were in his own home. "I got a fancy digital clock-radio for my birthday," he said. "When I took it out of the box and plugged it in, it didn't work. Now I don't know whether it was defective to begin with or whether I had somehow messed it up. I'm not sure because of my feeling of ineptitude around the thing."

Such helplessness can affect people who are secure in their mechanical ability. One Houston lawyer said, "The amplifier for my sound system broke down during a party at my home. I'm mechanically inclined—I even do the repairs on my Austin-Healey myself—but when you're diddling around with something electronic, you can't see a current running through a wire or a burnt-out chip. I couldn't repair the amp, and there was no music for the rest of the party. I felt totally helpless."

Experts argue that this concern is evidence more of an ego problem than of a technological one. Isaac Asimov, for instance, said, "Personally, I think people who say that something depersonalizes them feel very insecure." But it can also be argued that anxiety brought on by a technological boom in the home is symbolic—or symptomatic—of our frustration over the larger moral and ecological problems of global technology.

For example: If our dependence on technology continues to rise, opportunities for self-experience may lessen. In his book *From Panic to Power: The Positive Use of Stress*, clinical psychologist John J. Parrino calls this phenomenon feedback deprivation. "Our bodies are based on feedback systems, mentally, emotionally, and physically. Anything that jolts you above and beyond your equilibrium creates stress. In the case of high-tech gadgetry, you are placing an object between you and the source of your feedback. As you reduce the number of responses an individual makes to that source, you put him in a state of feedback deprivation. This can be very disorienting to the individual."

We are not confused only by static from our feedback systems. The worst troubles arise when the babble of high-tech anxiety meets the hard sell of advertising.

Advertising is a high-power purveyor of high-tech anxiety. Advertisers want to raise our technological consciousness. They expend astronomical sums and bombard us with intimidating images to do so.

In just the first nine months of 1979, for example, Ford Motor Company spent more than $100 million to sell us its better idea. "We're making technology pay off!" Toshiba has run a TV commercial showing an experimental voice-activated television set. The set is not even available and may never be. However, according to Sandy Goebel, Toshiba account supervisor at DKG advertising, "The purpose of the campaign was to build awareness of Toshiba as a high-technology company. There's a certain want-to-be-first-on-your-block syndrome with technology. Whenever you come up with a new product—something that's unique—it's probably innovative for only six months or a year at most, because it will be leapfrogged at the next Consumer Electronics Show."

The message from advertisers is TOOL UP FOR THE 80s. The subliminal anxiety-provoking message is: Do it, or life will leave you behind. Automobiles, private planes, or superpowered sound systems are sold not for function or technological advantage but for their dream value. This leads to a frustrating and expensive spiral provoked by gadgets we cannot repair, replace, or modify.

Still, we Americans are a gadget-loving breed. We have come to rely on our wondrous technology to the point where we take it all for granted. High-tech anxiety is not so much a consequence of technology run amok as it is a result of our endless unrealistic expectations of perfection. American consumers are not the mere victims of absurd, extravagant technology; they are the perpetrators of it.

Nobel Prize winner Arno Penzias said, "Technology provides us with everything but a way to say no to it. We ought to develop another attribute that no one mentions anymore, character. It's bad enough that we ask so much of technology. It should not assume the additional function of making moral choices for us and providing us character. Where are we as human beings if we have to get our morality from outside ourselves? Technology can provide us with a state where choices are taken away from us. *That* is scary. Then we're in 1984."

The good news about high-tech anxiety is: it doesn't seem to rub off on future generations. In fact, schoolchildren today regard technology as a game, a whimsical new language, a part of their evolutionary inheritance. They talk about travel to other galaxies the way their parents talked about transoceanic jet flights. My seven-year-old son attends an after-school computer course and informs me that in the near future he will be able to have microelectronic brain implants that will make time travel and other multidimensional experiences a matter of common course. Some experts believe it or not, agree with him.

Children... it seems already know what their parents have yet to learn. The advancement of technology is like gravity: we cannot beat the attraction. We should cultivate our curiosity more prudently and set limits on our expectations. We must learn to make responsible, qualitative choices about our future tools, rather than quantitative ones, or today's high-tech anxiety will become tomorrow's high-tech horror. ∞

SPACE

CONTINUED FROM PAGE 22

One project for the mid-1980s is a communications antenna about 50 meters in diameter—the first of its size in space. The lack of gravity and the sun's thermal effects on such a lightweight structure must be observed before NASA puts the antenna into full operation. Other construction projects being examined include a 250-kilowatt power supply which could serve three purposes as a source of independent power for processing materials in space as a feasibility study for a solar power satellite, and as part of an advanced solar electric propulsion system.

Sometime in the 1990s the SOC might inexpensively build equipment to improve satellite communications. One project is a large platform with many different kinds of antennas; the other is a communications antenna 100 meters or more in diameter. Both structures would be transported to geosynchronous orbit.

A geosynchronous orbit is any circular orbit 35,900 kilometers above the earth's surface, and a geostationary orbit is a geosynchronous orbit in the plane of the equator. Geostationary orbit is particularly useful because any satellite placed there appears to be stationary from a point on the ground. Thus, it is a good location for relaying communications messages between fixed points on the ground and for viewing a particular area of the earth continuously for such purposes as weather observation and military reconnaissance. Currently, about 60 percent of U.S. satellites are in low Earth orbit, and the remaining 40 percent are in geosynchronous orbit.

Unlike *Apollo* and *Skylab*, which required large ground crews to plan each mission, the SOC should be able to monitor itself with its computers. One of NASA's goals is to have the astronauts control the SOC, freeing the ground crew to concentrate on long-range planning.

In the third phase of his near-term space program, Von Braun proposed that a reusable lunar spaceship be assembled in orbit to circle the moon. Although NASA has no plans to return to the moon this decade, it is contemplating the development of a manned orbital-transfer vehicle. The OTV could move payloads from shuttle orbit to higher altitudes. Since it takes about as much energy to reach geosynchronous orbit as it does to fly to the moon, the OTV could also circle the moon and return to the operations center.

Whether Von Braun's dreams and those of NASA planners become reality will depend upon the actions of the White House and Congress. It was the lack of funding, not of technology, that limited the space program during the 1970s. But if the United States does not develop such basic resources as a space station and reusable OTVs in the 1980s, it surely will lose its leadership in the conquest of space. **OO**

FORUM

CONTINUED FROM PAGE 12

because a few corporations made a little extra money above what they would get anyway under the Moon Treaty (Note that "benefits" are what's left after costs are paid.)

Perhaps your editorial hysteria obscures deeper arguments as to how the United States will benefit from the treaty.

We can examine the historical record. There is precedent for international division of nearly uninhabited areas. Early in the sixteenth century the pope divided the Americas between the two countries most able to explore and exploit those resources, to the total exclusion of anyone else. Those countries were Portugal and Spain. The reason why this letter is not written in Portuguese (New Haven falls on their side of the dividing line) is that other European countries fought long and bloody wars merely to get access to the Americas.

A treaty based on whoever happens to be strong enough to reach the moon during one quarter of one century would be virtually certain to set off new rounds of trade wars. Making all mankind the common landlord of the moon seems the best chance to avoid total warfare over moon rights.

Finally one must reflect that the United States will not always be the leading power on Earth. (Indeed, as *Omni* has pointed out, it is not the leading space power *now*.)

When that comes to pass, we will want to ensure that those nations have been committed by their own history to sharing the wealth of the moon with all mankind, including us.

Michael Federow
New Haven, Conn.

Ben Bova replies: *Space industries can help to solve economic problems on Earth. Our overcrowded planet needs the energy and the natural resources that await us in space. Profit-seeking corporations move faster and create more wealth for us all than do bureaucratic government programs. (If you doubt this, contrast the spread of the "microelectronics revolution" in the West with the lead-footed programs of the East.) The U.N. Moon Treaty threatens to delay or stymie altogether the development of free-enterprise industry in space. Thus the treaty threatens to delay or prevent totally the utilization of space resources. This is a sure way to guarantee that neither the rich nations nor the poor ones ever reap the benefits of the riches that abound throughout our solar system.*

Fact and Emotion at Love Canal

Misperception regarding what occurred at Love Canal pervades Don Wall's article in the December 1980 *Omni* [Mind, "Love Canal"]. His article is based on hearsay, unsubstantiated rumor, and opinion rather than on facts. We are disturbed when a respected publication such as *Omni* prints such a misleading article. Hooker Chemical Company acted responsibly in its use of Love Canal. The facts show that:

- Hooker's use of Love Canal more than 27 years ago as a waste-disposal site was proper and would even conform to most of the pending federal RCRA regulations.
- The clay covering on Love Canal was disturbed by government agencies despite Hooker's warnings against doing so. This happened when Hooker no longer had any control over the property.

Three studies prepared for the Environmental Protection Agency (EPA) indicate that the air in the Love Canal area compares favorably with air in Los Angeles, Oakland, Phoenix, and several cities in Texas and New Jersey. The concentrations of chemicals measured by New York State and by the EPA contractor at Love Canal are far lower than those permitted under comparable government workplace standards. The exposure levels, therefore, were a fraction of a percentage of what the government allows in the workplace.

It is impossible to understand why Mr. Wall chose to present a discussion of the chromosome study. Within a few days after the release of the study the U.S. Department of Health and Human Services issued a report that said the chromosome study "provides an inadequate basis for any scientific or medical inferences from the data ... concerning exposure to mutagenic substances ... in the Love Canal area." New York Governor Hugh Carey's independent physicians panel reported that the chromosome study "presents a paradigm of administrative ineptitude" and that "such a poorly designed investigation should not have been launched in the first place."

This special panel of distinguished physicians, chaired by Lewis Thomas, M.D., chancellor of Memorial Sloan-Kettering Cancer Center, stated that the panel "has concluded that there has been no demonstration of acute health effects linked to exposure to hazardous wastes at the Love Canal site."

With regard to Dr. Beverly Paigen's epidemiological study, the special panel stated that her report "... falls far short of the mark of an exercise in epidemiology. Her data cannot be taken as scientific evidence for her conclusions." The panel also said "... the illnesses cited as caused by chemical pollution were not medically validated. ... The panel finds the Paigen report impossible to interpret. It cannot be taken seriously as a piece of sound epidemiologic research, but it does have the impact of polemic."

The panel said: "It is clear enough from the available data that no acute cases of intoxication by chemical pollutants have been observed within any part of the Love Canal community. That is, no clusters of cases of acute liver disease, or kidney disease, or pulmonary manifestations, or hemolytic anemia or agranulocytosis and certainly no peripheral or central-nervous-system syndromes. Whatever else may be going on, there has not been a sufficient concentration of toxic material to produce overt illness attributable to poisoning."

Michael D. Reichgut
Manager, Public Relations
Hooker Chemical Company
Houston, Tex.

I read with interest *Omni*'s Mind column about the effects of the Love Canal incident on the local residents.

I am appalled at the American chemical industry, the Environmental Protection Agency, and the Hooker Chemical Company. It should be a crime punishable by imprisonment for the people involved in making executive decisions and all the workers doing the dumping!

If these corporate executives were brought to trial and sentenced, we'd see fewer chemical dumping incidents in the future. The EPA is obviously not doing its job properly. I don't believe there is a single municipal water supply in the entire country that is clean or safe to drink from.

Bruce Bryan
Chicago, Ill.

The Future of Fusion

Cheap fusion power, achieved soon, can and will transform a series of global-energy and other economic conflicts into a hopeful and cooperative future for us all. Our Riggatron throwaway Tokamak fusion-reactor concept seems to offer our only real near-term hope. No new plasma confinement gimmick, it is a Tokamak of the class invented by Acad. Artsimovich in the middle 1960s. Tokamaks form the standard core of all the world's fusion programs. Nearly 15 years of world effort and many billions of dollars have been spent in understanding their physics. They will work. Our contribution was to invent an engineering embodiment derived from aerospace research-and-development thinking to yield small, copper-coil, water-cooled machines, contained in light-bulb-like envelopes, whose large power output and resulting short lifetime allow very cheap and short development efforts and very low cost energy output. We invented this approach in 1976.

Unfortunately the article by R. Bruce McColm ["The Business of Fusion," January 1981] may mislead your readers into thinking that these generic ideas were invented by my friend and colleague at General Atomic Corporation [G.A.] Dr. Tihiro Ohkawa, who has happily subsumed them for the novel and unproven confinement concept of his OHTE machine. While we are gratified that others such as G.A. see the virtues of our engineering approach (imitation is the sincerest form of flattery), we are chagrined that the article did not note that Dr. Ohkawa got these ideas from extensive discussions we held with him and others at G.A. a year or two after our inventions.

Thank you for the fine interview [Inter-

view January 1981] K. C. Cole should be commended for an excellent piece of work. Only one small error seems to have crept in. The fusion research at MIT is not part of the big Main Line Tokamak programs, characterized by Princeton, Oak Ridge and G A. In fact my coinventor Dr. Bruno Coppi of MIT is the principal architect and inventor of the MIT line of high-field Alcator Tokamaks that form the background for our Riggatron reactor concept. Dollar for dollar the MIT program has certainly led the world in the production of physics useful for eventual fusion-power machines. Quite soon we at INESCO will be pushing well past the Alcator frontiers and on to *real* fusion power by the mid-1990s.

Robert W. Bussard
President
INESCO
LaJolla, Calif.

Give Mankind the Stars

I've often said that this may be the most critical generation in history. We can, if we will, go to space; our children can live not only on Earth but also in the solar system of 9 planets, 50 moons, a million asteroids and a billion comets. We have the resources, but unless we expand Earth's resource base into space, the next generation may not be able to go.

This year may be crucial. The new administration favors research and development and high technology, but it is under enormous pressure to cut spending and taxes. Programs without a recognized constituency will be ruthlessly pared.

Space does have a constituency, and this is our great opportunity. A number of pro-space organizations and publications are supporting a campaign to let the President and Congress know that space has a vocal constituency and that we support a manned space laboratory.

Friends of space should write the President and their representatives in Congress. Those who wish to become more active can, at no cost, join the nationwide telephone-communications organization of the L-5 Society. A few thousand letters and telegrams can give mankind the stars!

For further information write me at:

Jerry Pournelle
L-5 Telephone Tree
1620 North Park Street
Tucson, AZ 85719

PHOTO CREDITS

Page 8, Jonn Muth; Margot Lind; **page 12,** Manfred Kage/Peter Arnold, Inc.; **page 20,** Howard Sochurek; **page 22,** NASA; **page 24,** Melo; **page 28,** Universal City Studios, Inc.; **page 36 top,** R. Van Nostrand/Photo Researchers; **page 37 top,** Stanford University; **page 37 bottom,** UPI; **page 38 top,** Cathleen Ursillo/Photo Researchers; **page 38 bottom,** Boeing; **page 39 left,** Allan D. Cruickshank/Photo Researchers; **page 40 left,** Frenz Edson/Shostal Associates; **page 40 right,** Tom O'Brien; **page 41 left,** Gary Duker; **page 41 right,** UPI; **page 42 top,** Linda Bogdanoff; **page 42 bottom,** Angus McKee/Young Artists; **page 104,** Anthony Wolff; Dan McCoy; Gottfried Helnwein; **page 124,** French Institute; **page 126 left,** U.S.; Paul Ross; **page 126 right,** U.S.; John Marmaras; **page 140,** Harry Lebelson; **page 145,** U.S.; Dan McCoy; **page 145,** U.K.; Granger Collection.

SECURITY PLUS

INNOVATIONS

We live in an age that requires increasing attention to security. Defending our businesses and our homes from thieves, muggers, and industrial spies demands more than common sense and caution. The greater the value of the secrets and properties we wish to protect, the more sophisticated the defense must be.

Sophisticated, however, does not always mean difficult or complex to use. For instance, if you live in a high-crime area or if your work requires you to travel to communities where the danger is greater than usual, you may be interested in the **Security Blanket AL 24**. This item *looks* like a normal flashlight. The first of its kind, this one-foot-long, 1.75-pound hand-held system emits a beam of 20,000-candlepower continuous light, which is powerful enough to immobilize an attacker by temporarily blinding him or her, allowing you time to escape. Containing nickel-cadmium batteries that are recharged using AC/DC outlets or car cigarette lighters, the Security Blanket is a safe, effective, and legal means of self-defense.

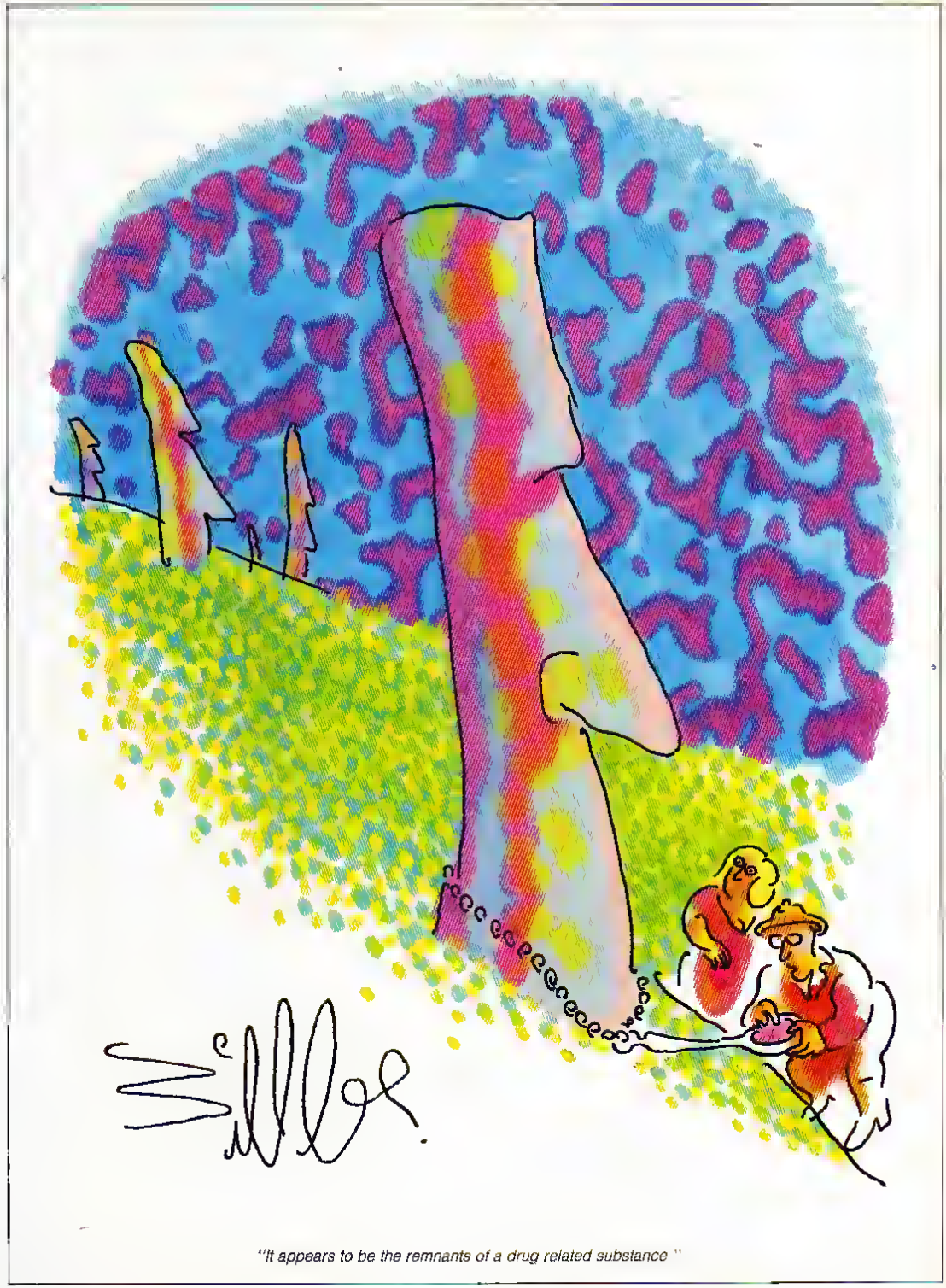
For those whose security needs are more complicated, there's the **Voiceless Telephone S1 50b**. This unit allows for telephone conversations that cannot be heard, tapped, recorded, or identified. Just dial your number and place the telephone handset in the supplied coupler. Now simply spell out the words on your miniature terminal, and they are instantly seen—in printed words that cannot be overheard—on the matching unit. The S1 50b contains a built-in scrambler with computer-programmed code selection that's virtually unbeatable. Every word prints out on your unit for visual verification. The words simultaneously print out on the matching set exactly as you see them. When the need arises, you can change back and forth swiftly from verbal to computer conversation. The S1 50b adapts easily to any phone in the world (including pay phones), has multiterminal hookup capacity, and is entirely encased in an ordinary-looking briefcase, making it totally portable.

For undetected photography, nothing tops the **Covert Camera Spy System CCS-II**. This microminiature professional system shoots extra-long distances or eight-inch close-ups. The camera photographs around corners while you remain hidden, and, because its components are so compact, the entire unit fits neatly into your pocket. Distance presents no difficulty with the CCS-II binocular attachment. This accessory is actually smaller than the palm of your hand, and when not in use, it folds to half its normal size. The camera clamps over one eyepiece of the binocular while you aim through the other. The target is now magnified eight times, letting you shoot the sharpest long-range photos imaginable. At close range, the camera chain measures proximity and allows you to set the appropriate reading on the distance scale—from eight inches to infinity. While conventional cameras may distort close-ups, the CCS-II allows perfect reproductions of books, files, documents, or contracts. The electronic shutter times every exposure automatically as you aim. Weighing only four ounces, it can be carried as unobtrusively as your wallet or keys. In its fitted belt case, the camera is no longer than the width of a pair of glasses. Operation and assembly of the CCS-II require absolutely no training. All accessories come housed in an attaché case to guard against damage and provide convenient portability.

The **Electronic Handkerchief** is actually a telephone that disguises your voice. While you speak normally, this unit transforms your voice into something unrecognizable—deepens it to discourage harassment, distorts it to defeat a voice analyzer, or disguises it to avoid being tapped. The Electronic Handkerchief also contains a voice scrambler and is available in a handsome walnut cigar box so that, as far as any visitor to your home need know, all you have on your desk is a humidor.

The above items, and many other security devices, are available from CCS Communication Control, Inc., headquartered at 633 Third Avenue, New York City.

CCS's security gadgets (left to right): voiceless phone, light, spy camera, voice disguiser



"It appears to be the remnants of a drug related substance "

COMMUNICATIONS

CONTINUED FROM PAGE 10

as though it were continuous instead of broken (thus, if I hide my watch when I am drunk I must be drunk again before I can remember where) so Miss Twinkleton has two distinct, separate phases of being."

Science imitates art

Stanley Sporny
Takoma Park Md

Fusion's Golden Egg

As a prospective nuclear engineering major at Georgia Institute of Technology I feel somewhat disillusioned concerning my choice of a field of study.

With all this bickering and squabbling going on about the technique used to build and maintain a fusion reactor, we just might kill the goose that lays the golden egg. History is filled with examples of mankind's bad timing and procrastination.

Still, it's hard to believe that fusion would usher in a new golden age. The same thing was said about nuclear fission. These on-line fusion-reactor schedules seem too optimistic. We've got a possible Third World War in the coming decade. Now that would really throw their schedules off!

Peter Hudson Wright
Huntsville Ala

Just when every other paper and magazine is full of energy crises and impending doom, you pull through with your fusion issue [January 1981]. What this country needs is a good shot of hope every 30 days, and *Omni* is just what the doctor ordered!

Ed Krebs
Laguna Beach Calif

Star-Crossed

The article "Supergene" by Kathleen Stein [December 1980] really excited me with its promise of longevity and the thrill of being so close to the "cutting edge" of molecular biology.

In pondering some of the social consequences of this research, I am reminded of James Blish's magnificent "Cities in Flight" tetralogy. Blish proposed that "Anti-Agathic Drugs" would put the stars within reach by enabling man to live long enough to travel to them.

May I submit that the supergenes are going to take us to the stars?

Joe Soter
Santa Ana Calif

Pleasure Seat

In "Pleasure Machine" [Mind, January 1981] David Cohen describes how researchers Randy Thomas and Tim Brock have developed a machine that measures pleasure. Don't give us figures. Tell us how to make the seat! Or at least inform us whom to contact for more information. I want to be the Lansing distributor.

David M. Dunn
Lansing Mich

CONTINUED FROM PAGE 28

what is happening to her and, as Tomlin puts it, "to blow the whistle on some things that are wrong with society." In honor of the Shrinking Woman's appearance on his show Douglas sings "Little Things Mean a Lot," which becomes a motto for Pat.

"The final sensibility of the movie is soft and caring," Tomlin reveals.

"It's a point we try to make as frequently as possible without getting mawkish. One of my favorite relationships in the movie is the one Pat has with a gorilla, marvelously played by Rick Baker. [He was Dino De Laurentiis's King Kong.] Like Pat, the gorilla is caged for scientific study, a victim of human insensitivity. It's really a poignant relationship, each drawing courage from the other, though Pat obviously benefits more because of her greater intelligence. Experiences like this give her an awareness of life so that when she vanishes she is joyful and at peace, waving her little hand at a crowd in a shopping center."

Of course the movie has villains, corporate and scientific. But even the heavies are never *criticized*. They are shown to have a sinister element and a pompous element and a ridiculous element. But *everyone* does, and what these characters are is a broad stroke *meant* to include everybody. Even Pat's loving husband has sold out a bit. His company wants to make a doll of Pat, and while she's standing on the countertop cooking breakfast, she climbs up on a soapbox and puts her tiny foot down. She says she doesn't want to be a product. She's *tired* of products. She's not really angry, but she has passed through the fire. She's not preaching, she's pleading.

In a way, so is Tomlin. "Right after the argument with her husband, Pat falls into the garbage disposal and the maid accidentally throws in all kinds of trash. Garbage pours down on Pat, on our Everyperson, but no one hears her scream. There is a propagandistic point in that, but it's acceptable because of the element of comedy surrounding it."

"The original Shrinking Man movie is unintentionally funny today because it is *so* melodramatic—a film about man against his environment and about man surpassing nature in the end. I don't relate to that kind of macho theme, and I did not want to make a movie like that, or like *The Empire Strikes Back*. I'm tired of the whole allegory of good and evil. It's really a very male-oriented concept, about battling and war and who is going to triumph and who is going to surrender. That's boring! Things are rarely that black-and-white. A monster like Rodan railing against the elements is more interesting. Which is not to say that *The Incredible Shrinking Woman* is feminist, even though when Pat is a foot tall, she continues to carry on as a wife and mother. She's just indomitable. I don't think we'll get saddled with that bromide, but, then, I've been innocent before."

"There are a whole lot of people out there whose existence is built on certain kinds of values and virile behavior. They interpret every change as a challenge to that, as a primal threat rather than as a different facet to their lives." The actress sighs, her voice less cheerful, less excited than when she is talking about her film. "There is just a tremendous misogyny in the culture. It's a fact of life, and one has to deal with it."

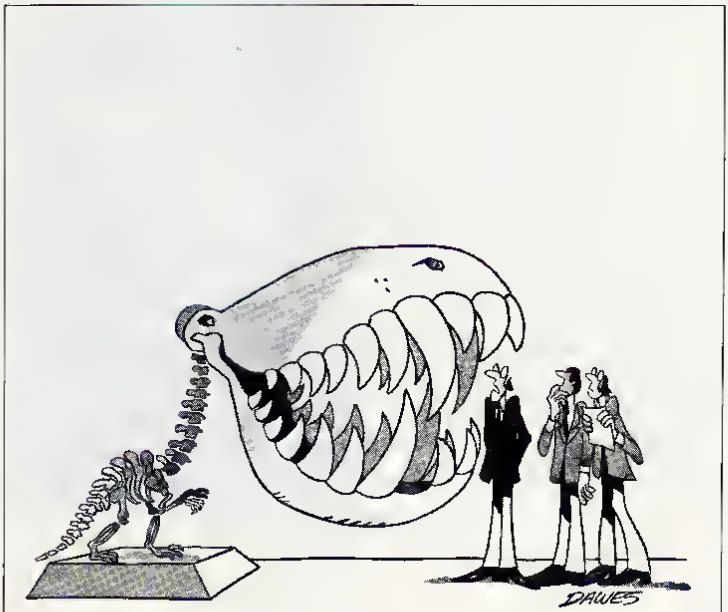
Unlike the social commentary and glaze of despair that echoing Tomlin's beliefs infuse *The Incredible Shrinking Woman*, the film's gentle swipes at science do not reflect attitudes held by the performer. "I really do love all kinds of futuristic ideas and gadgets. Technological progress makes me glad, except when it diminishes our lives or threatens to. Weapons frustrate me. But I adore seven-foot TVs, and I have Advents all over the place. I also think it would be pretty thrilling to go into outer space, and, God, how I wish there were more life forms with which we could communicate. I'd love to see us make some progress in that direction."

One facet of technology with which Tomlin lived for almost a year was the abundance of special effects work employed to bring *The Incredible Shrinking Woman* to the screen. Apropos of the staggering array of visual and mechanical wizardry in the film, one crew member went so far as to describe the project as *I Love Lucy Meets Star Wars*. "The difference," Tomlin corrects, "is that the effects are not outer-space images. They're really very banal. They're so real and so unobtrusive that they leave you alone with Pat as she's shrinking. They let you have feeling for her and not for the images. The effects were never meant to be dazzling, simply as organic to the movie as possible."

A similar standard was established for the scientific slant of the film. "We made it as accurate as we could, within the context of being an entertainment. Jane Wagner, who wrote the script, did a lot of research about the possibility of organisms shrinking so that there would be scientific credibility in the dialogue. We wanted to do that so the people in the audience who *know* about these things won't feel cheated."

Because of the filmmakers' dedication to every detail of their picture, no single performance or element can be said to stand out. Everything shines in balance, which is exactly what Tomlin and her associates intended. "I hope the movie is resonant on many different levels. I hope everybody identifies with it, and is a part of it intellectually and emotionally. I just want it to be a terrific overall experience."

Does Tomlin feel that *The Incredible Shrinking Woman* will have said enough so that a quarter-century hence a sequel will be unnecessary? The comedienne smiles puckishly. "If the world is still around, then, yes, it will have succeeded."



"We're not sure what to call it, but we're pretty sure everything was afraid of it."

UFO UPDATE

By E. Lee Spiegel and Karen Ehrlich

Have UFO studies yielded any worthwhile results? True believers and hard-core skeptics met in Washington, D.C., recently in a rare balanced attempt to find the answer.

Sponsored by the Smithsonian Institution's Resident Associate Program, the event lacked the carnival atmosphere of most UFO gatherings, and the vendors of UFO paraphernalia were refreshingly absent. It was orchestrated by Frederick Durant, former special assistant to the director of the National Air and Space Museum. Durant's unwavering neutrality kept the speakers and audience of nearly 300 Smithsonian associates in line, on target, and on time.

The UFO proponents were astronomer J. Allen Hynek, scientific director of the Center for UFO Studies (CUFOS) and former Air Force science adviser on UFOs; Allan Hendry, chief investigator at CUFOS; and Dr. Bruce Maccabee, a U.S. Navy physicist and chairman of the Fund for UFO Research.

On the other side were NASA engineer James Oberg, a frequent contributor to this column; Robert Sheaffer, a founder of the UFO subcommittee of the Committee for Scientific Investigation of Claims of the Paranormal (CSICP); and Philip J. Klass, senior avionics editor of *Aviation Week and Space Technology* and chairman of the CSICP subcommittee.

Durant started the symposium with a question: "What has been learned about UFOs after one third of a century of investigation?" The answers were fairly predictable, but they set the stage for drama later in the meeting.

According to Hynek, UFO studies have been fruitful, even though the mystery remains unsolved. "We have gathered the background data we need in order to find an answer. We have learned that there is no special type of person who makes the UFO report," he said. "They represent a good cross section of the population. We've learned that people can honestly be fooled, even persons of considerable training. Also, the stranger the experience, the greater the reluctance to report. We have made a good beginning," Hynek said, but more professional work is necessary.

UFO panel at Smithsonian included (from left) Maccabee, Hynek, Oberg, Durant, and Hendry.

Sheaffer said that any such work will be wasted. "What we have learned is that UFOs will invariably outwit anyone who tries to corner them, as telepathies, fairies, ghosts, and similar phenomena have done for far longer than UFOs. Ufology is a failed would-be science."

And Klass pointed out that "there is not, to my knowledge, a single photograph showing a craftlike object that does not have a taint of suspicion. UFO promoters have been able to come up with nothing stronger than unexplained cases."

Inquiry filled the five-hour symposium. One of the highlights was a film shown by Oberg. In it he aptly showed how misinterpreted window reflections in U.S. spacecraft had ended up as banner headlines in the *National Enquirer*. "Aliens on the Moon when We Landed" and "Crippled UFO Orbits Earth" were grossly inaccurate reporting. "This kind of exploitation is very damaging to UFO studies," Oberg warned.

A few precautions might help to minimize the damage, other panelists suggested. "Let's require that independent witnesses be present," Hendry recommended. "When people who don't know each other report the same UFO in the same locale, we don't have to concern ourselves with the background or reliability of a single witness. The possibility of a hoax is reduced to an absolute minimum."

And Klass said, "Instead of encouraging the public to clog channels with cases that have prosaic explanations, we should say, 'Don't bother us unless you have the physical evidence, a photograph that is extraordinary or an extraordinary experience.'"

Then he attempted to discredit Travis Walton, and war broke out. Walton, a lumberjack, claims to have been abducted by a UFO in the presence of several witnesses. But, according to Klass, Walton flunked a lie detector test. Hendry, however, produced letters from two polygraph experts who had reviewed Walton's test. One charged that the interview technique was inadequate and 30 years out of date; the other said it

CONTINUED ON PAGE 144

Readers try their hands at designer genes

COMPETITION

By Scot Morris

We've heard of the liger—a cross between a lion and a tiger. What, we asked last October, will the world be like when genetic research reaches its ultimate potential? When the gene splicers can combine virtually any two kinds of living things, what weird critters will populate the earth? We envisioned the **laughing jag**, a cross between a hyena and a jaguar, and the **crockabalone**, half-crocodile and half-abalone clam, whose hides are sold as giant ashtrays.

Competition #16 asked readers to suggest two such unlikely species that will be created by the fledgling science of logogenetics. Some sample names will illustrate the range of our bestiary. We saw **kitty hawks**, **cheepskates**, **jackal an terns**, **smeltfowl**, **buffalo chips**, **paradachs**, **parajacks**, **pekabou**, a **harteherring** (whose mating call is "Beg Pardon?"), a high-sounding **platytoad**, and a **peckadillo** in a pear tree.

The first step was coming up with a clever name. Beyond that, we looked for a keen naturalist's eye for the creature's habits and habitats. Entrants were to send two species to the *Omni* Ark, and two by two they came.

We changed the distribution of prize money this time out. When it came down to picking the grand-prize winner, we were most knocked out by the elusive **rhesus peanut buttercup** and its companion, the **walkie-talkie**. The card, however (the obverse of which showed the LSU mascot), bore no name or address. By gross dereliction of contest entranceship, this unknown Louisianan has we rule forfeited the jackpot. The $100 grand prize has therefore been divided into four extra $25 runner-up prizes.

Thanks to everyone for all the fun. Herewith, our favorite examples of unnatural selections.

GRAND PRIZE WINNER

Rhesus Peanut Buttercup—a triple cross between an Indian monkey, a vine of the legume family, and a plant with yellow cup-shaped flowers.

Walkie-Talkie—a cross between a centipede and a parrot.

—No name or address

RUNNERS-UP 2–14, $25

Sassoon—a cross between a sasquatch and a baboon. It lurks in suburbs at night and styles women's hair.

Armand Hammerhead Shark—a cross between an armadillo and a hammerhead shark. It keeps your refrigerator free of bad odors and Richard Dreyfuss.

—Bruce Nelson, Saunderstown, R.I.

The Grouse-and-Bitch—a perpetually complaining bird dog.

Semimole Indian—an Indian who is part mole.

—Sheila Bishop, Youngstown, Ohio

Batboon—a nocturnal monkey prone to wearing white bucks.

Buck-Dilled Platypus—a web-footed deer found mostly around pickle barrels.

—Alan Levine, Massapequa, N.Y.

The Benbovine—a cross between a Bengal tiger and a Jersey cow.

The Bobgoocheony—a four-way cross between a bobolink, a goose, a cheetah, and a pony.

—Bruce Boston, El Cerrito, Calif.

Parrigator—a cross between a parrot and an alligator. If it says it wants a cracker, give it one.

Preying Mantilla—a cross between a praying mantis and a gorilla. Don't let the head scarf and folded hands fool you; give it anything it wants.

—Tom Henken, El Monte, Calif.

The Pigeon Toad—a new urban pest that not only sits on statues but gives them warts.

The Cod Almighty—the leader of a great school of cod, born of a mother cod crossed with a sperm whale in an immaculate conception.

—Guy Gnoza, Philadelphia, Pa.

The Shag Carpette—offspring of an English sheep dog and a miniature carp.

Mile Worm—a cross of 63,360 inchworms.

—Daniel Radcliffe, Seminole, Fla.

Imposs Bull—a three-way cross between an impala, a possum, and a bull. The result is a 2,000-pound antelope that hangs from trees and drops down on unsuspecting matadors.

Crossing an Alaskan king crab, a kingfisher, a jackass, a jackrabbit, and a jackal gives you a **Fullhouse**.

—Greg Nelson, Nashville, Tenn.

The Amoebit—a cross between a rabbit and an amoeba. This curious animal can multiply and divide at the same time.

—Jeff Donovan, Deer Trail, Colo.

The Grasshoppotamus—a short-lived creature that can leap to tremendous heights—once.

—K. R. Reed, Las Vegas, Nev.

Chevy Impala—an antelope that keeps falling down.

—Glenn Ruggiero, San Francisco, Calif.

The Donkeyote—an idealistic ass that howls at windmills and tilts at the moon.

—Linda Ostreicher, New York, N.Y.

The Llalot—a breed of political cat that is a cross between a lion and an ocelot. Closely related to the **cheetalot**. Neither species breeds true.

The Thoroughpig—a cross between a horse and a hog, otherwise known as my husband.

—Janeen Evanoff, South Gate, Calif.

HONORABLE MENTION

The Quacking Aspen—a duck-billed tree.

—David Waldron, Portland, Ore.

Spider Robinson—a bird that spins science-fiction tales.

—Linda Knell, Altus, Okla.

Sheepupine—a cross between a sheep and a porcupine. It not only supplies the wool but knits you the sweater, too.

—Eugene L. Roberts, Baldwin, N.Y.

Aram-alamb-ading-donk a cross between a ram a lamb a dingo and a donkey This rock-dwelling creature blends into the background and is usually seen traveling in large packs searching for grass and other kinds of dope
— Ralph Harris, Los Angeles, Calif

The Tesserat a four-dimensional rodent
— Donald Coryell, Boyce, La

The Harvard Lampoon a cross between a lamprey and a baboon created at Harvard University for the sole purpose of satirizing genetic research
— Don M Stockbauer, Houston, Tex.

The Grouporgy a cross between two very dull fish — the grouper and the porgy — that produced some very interesting results
— Mike Silverman Portland, Ore

The Cowena a cross between a cow and a hyena It's the laughingstock of the party
— Matthew Ballinger Vineland Ont Canada

The Snary a cross between a snake and a canary A bird that sings with a lisp
— Christi Lewis Isleton Calif

The Elephants Gerald an animal with a beautiful voice that can break glass It is forever tripping over itself It's created by crossing an African elephant with a recent American president
— John A Talbott, Los Angeles, Calif

The Lamel This cross between a lamb and a camel produces wool sweaters with bumps
— Adolph Zimmer, Laguna Beach Calif

Aloebaby a hybrid plant (aloe and baby's breath) commonly used in French aphrodisiacs
— Geoff Williams, Sedalia Mo

The Ass Pinscher A cross between a donkey and a Doberman, this dog thinks that it's a goose
- Chris Doyle, Burke Va

Cockadoodle Moo This cross between a chicken and a cow is the ultimate answer to breakfast
— Wolf Vanhee Seattle Wash

The Elephowl A hybrid elephant owl it has the strength to move mountains yet the wisdom not to do so
Helen Toye New Orleans, La

The Mastajack A cross between a jackal and a mastodon this beast is a jack a' all trades mast-a-don
Edward Hartgrove Pavilion, N Y

The Squonge a cross between a squid and a sponge for making self-inking stamp pads
Carl Carson Riverside, Calif

Coq Au Koala a cross between a French chicken and an Australian bear It can take the shirt right off Mean Joe Greene's back
— Brenda M Pavlik New York, N Y

The Bee Geese buzzin and honkin to keep "Stayin Alive
— Samuel Zisblatt Boston Mass

The Aye-Aye Skipper a cross between the aye-aye and the mudskipper The perfect pet for the boat owner who has no crew
— Vincent Kish Bellerose N Y

Llam-Kipper a cross between a llama and a pickled herring This creature was chosen as the Israeli national mascot
— Lars Beck Loveland, Ohio

The Hippster a cross between a hippo and a hamster a large aquatic rodent attracted to riverboat paddlewheels
— Dan Van Riper Bastrop Tex

Sarsaporilla a rare three-way mix between a sardine a sapsucker and a gorilla Often thirsty for root beer (must be the sardines)
— Jack P Gelb San Jose, Calif

The Snork a cross between a snail and a stork It delivers babies very slowly
— David Kenney Nepean, Ont Canada

The Zebrox a cross between a zebra and an ox a black and-white copy of an ox Symbiotic species the key operator
— D Wilson, Bloomfield Ind

The St Martin-Maarten Martin-Marten a biogeopolitical West Indian bird-mammal It can be trained to wear a beret and hold its little feathered paw in a dike
Jimmie J McKinley Longview, Tex

Gnat King Cobra a very small venomous flying snake with a fantastic singing voice The song "Mona Lisa" is believed to be its mating call
John E Luzier, Fleetwood Pa

Cockenbull an animal that is so unlikely that no one will believe it exists
— Diane Nagel Cranberry Lake N Y

The Cohwalskie a cross between a coho salmon a walleye and a muskie It is a famous Polish fish
— Jim Marx, Dahinda, Ill

The Bearass Crossing a grizzly with a donkey yielded this large ferocious and stubborn beast It feeds mostly on fish which it stomps to death with its rear hooves It also likes apples which it rips off trees with its front paws Oddly enough it is completely hairless
— D Reed, East Greenwich, R I

Elephantness a cross between a pachyderm and the Loch Ness monster A real untouchable
— Donna Clesie Temple City Calif

Coral Reefer a cross between a coral snake and *Cannabis sativa* The deeper you dive the higher you get
— Rick D Amico, Rye, N Y

Bearbull a Wall Street hedgehog
— Lani Anderson, Washington D C

Dungeon This cross between a pigeon and a dung beetle is the perfect city bird It leaves the statues clean and shiny and also scoops up after the dogs
— Morris Minor, Freeport, N Y

UFO

CONTINUED FROM PAGE 140

looked perfectly valid. With that, Hendry dramatically tossed both letters over the lectern, point made—he implied.

Next came a UFO case from 1979 involving Minnesota Sheriff's Deputy Val Johnson (see UFO Update, October 1980). Johnson claims that he was injured and his patrol car was damaged in an encounter with a UFO, and Hendry's report on the case substantiates this.

Klass conceded two possible explanations. Either an extraterrestrial craft flew by and the creatures reached out with a hammer and hit the headlight, hood, and windshield and bent two car antennas over, or Johnson did it himself because he likes to play practical jokes.

To which Hendry replied, "Actually, I'm inclined to agree with Mr. Klass. I think that Johnson is such a practical joker that he deliberately injured his eyes, as adjudged by two doctors, and entered a phony state of shock to impress the ambulance driver who removed him from the scene."

The onlookers tied the debate, and one question from the audience provoked an interesting exchange between moderator Durant and Maccabee. "Do any of you believe that the U.S. government or the Air Force has extraterrestrials from crashed spacecraft squirreled away in storage?" Durant asked provocatively. "Is there any evidence of this?"

"That's the question," Maccabee answered. "Is there evidence? If there were evidence one way or the other, we wouldn't have to reduce it to belief. I have no direct evidence, but I wouldn't be surprised."

"Would you like to believe it, Professor Maccabee?" Durant continued.

"I would not like it. As a matter of fact, I would rather believe that this whole UFO question had been solved many years ago. The fact that it wasn't solved many years ago is what attracted my interest. But I wish UFOs didn't exist."

The debate solved nothing, and no one who entered the day with a fixed opinion on the existence of UFOs changed his mind. But the symposium was significant for several reasons. Its sponsorship by the Smithsonian automatically made the subject more credible. And the interplay between the sides seemed to give each participant more respect for the opposition.

"The most important thing," concluded moderator Durant, "is that we're sitting down at one table. And that, I think, certainly augurs well. For the last thirty years we've never been able to get these participants together in one place. I hope this will be continued."

It was Klass who offered the final challenge. "It's time," he said, "for the leaders of the UFO movement, after a third of a century, to put up or shut up."

Clearly, both sides have their work cut out for them. ∞

"HE HAS HEMORRHOIDS"

STARS

By Brian O'Leary

Can you see yourself as an astronomer operating a powerful radio telescope like the one in Arecibo, Puerto Rico? Go a giant step further and make yourself an inhabitant of the planet Xi Boo 2, located 24 light-years from Earth. It is 1956 on Earth, the year before *Sputnik* was launched.

You direct the telescope toward our sun, a fourth-magnitude star barely visible to the naked eye. It is located in the constellation Monoceros, just south of Orion, which looks the same from Xi Boo 2 as it does from Earth.

For 4.5 billion years our solar system has been mute, but over the past few years you have detected garbled and possibly intelligent signals coming from that direction.

Then, suddenly, the meter goes off scale. You lower the volume and tune in the frequency; for the first time in history a human voice comes through the static. It says, "He has hemorrhoids."

It is the voice of Dr. John Brinkley, a notorious quack, millionaire, phony rejuvenator, and owner and principal announcer of radio station XER, which at 500 kilowatts was the world's most powerful transmitter during the early 1930s.

Sound incredible? Maybe not. In recent years scientists have been giving a lot of attention to the search for extraterrestrial intelligence (SETI). The program's basic premise is that our most powerful radio telescopes might detect intelligent signals coming from Earth-like planets.

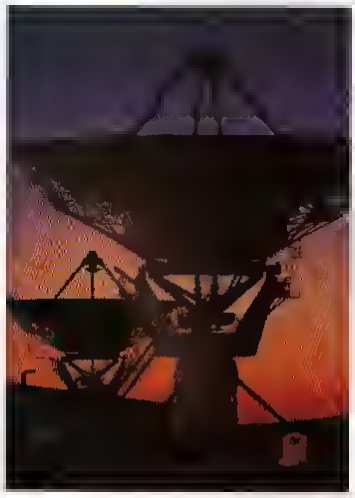
If our radio telescopes were to receive a 1932 vintage John Brinkley analogue, this would be more than adequate proof of extraterrestrial life. Yet isn't it pre-Copernican thinking to assume that we'll be the ones smart enough to recognize intelligent signals and to respond to them?

Not that we shouldn't support SETI. It's an exciting and worthwhile project that should be funded and pursued vigorously. But as the search is now being carried out, the first signal we detect from another civilization will probably be from sophisticated beacons that could have been there for billions of years. And yet there may be a better way. Before we detect anyone else, they will find us.

This subject opens vague and unending speculation among science-fiction writers, but one fact is clear: Just 50 years ago, Earth suddenly became conspicuously bright at radio frequencies. To any observer, earthly radio signals are probably the most obvious sign that we have begun to enter the galactic club.

In 1932 Brinkley erected and began broadcasting from the 500,000-watt XER towers in Villa Acuña, Mexico, across the Rio Grande from El Paso. He went there to circumvent federal limits on the power of radio stations; most were limited to 5,000 watts, 100 times fainter. For hundreds of miles Brinkley's station overwhelmed others near it on the radio dial; it could be picked up throughout North America.

Brinkley's was a talk-and-correspondence show. Gerald Carson's *The Roguish World of Dr. Brinkley* quotes him: "I have a letter from a gentleman in Waco, Texas. I hope they hear me, because this gentleman is president of that company up there in Waco. He has hemorrhoids."



Have we been listening to the wrong stars?

This message and hundreds like it leaked into space in 1932 and the years that followed. The Brinkley broadcasts form a hemispherical wave front traveling at the speed of light toward the stars. Brinkley's enormously powerful transmissions suffered little interference from other sources. (Nowadays Earth's radio and TV bands are jammed; we send out only a hodgepodge.) These particular broadcasts may be the most coherent, pervasive, and intelligible ones humans have sent into interstellar space.

So far Brinkley's messages have intercepted about 1,500 known stars. In half that time they reached about 200; we could receive an acknowledgment from these today.

Do any of these stars have planets? Probably. Do any have intelligent life? We don't know, but we can surmise that the stars most similar to our sun may be conducive to life's development. Sunlike stars make up a small percentage of the nearby stars, and so several of them have already got Brinkley's message.

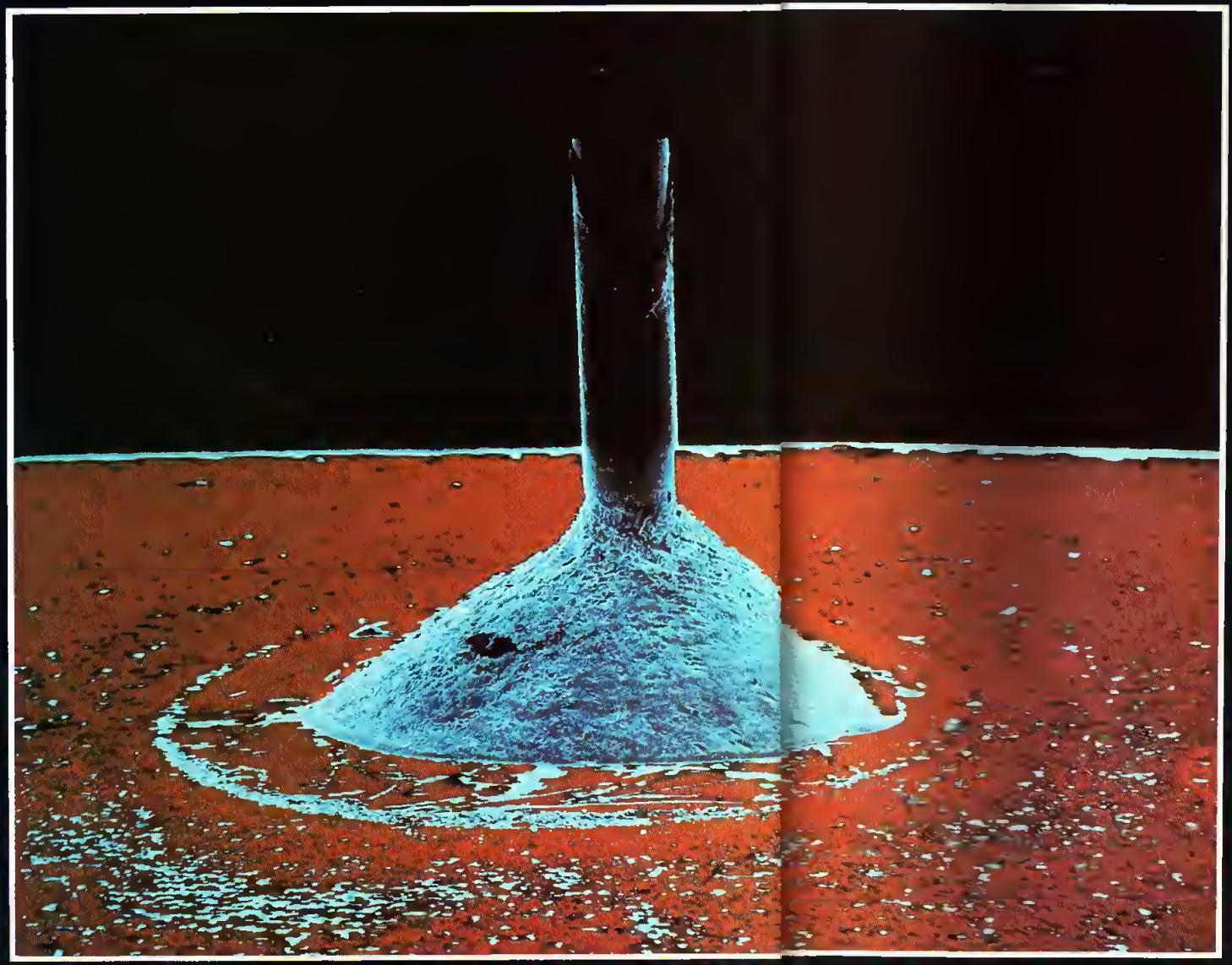
That number will grow dramatically with time. As the Brinkley wave fronts pass through space, the number of stars intercepted increases with the cube of the time elapsed. As we double the waiting time, we greet eight times the candidate civilizations. The probability of a contact goes up dramatically as we move into the 1980s and 1990s.

Xi Boo, a sunlike star that the naked eye can just distinguish in the constellation Bootes, received Brinkley's message about 24 years ago. Any answer should be reaching us just about now. It is humbling to think that the earliest, most coherent sign of our technological civilization could come unwittingly from a charlatan.

But if we get this useless pre-Copernican thinking out of the way, we might be able to do something timely with the SETI program: listen to the sunlike stars that have had time to receive early AM broadcasts and send back an acknowledgment. The time is ripe for Xi Boo.

The answer might be a simple, humbling "Boo."

Or it could say "Use Preparation H."



PHENOMENA

The vital technological synapse between electricity and sound. A gold wire soldered to a quartz crystal transforms electrical current into sonic vibrations. This component, found within radio transmitters, illustrates high technology s dependence on microscopic sturdiness. The crystal is ground with lapidary perfection to ensure precise frequency control. A pyramid of tin bonds the wire to a gold-plated surface. Photographer Manfred Kage used a homemade wooden camera, built on a scanning electron microscope, to record this image, magnified by a factor of 50. The microscope acts as a color enhancer, hence shades of gray take on the red and blue spectra of Kage's imagination. A Rodenstock 105mm lens at an f/5.6 aperture along with Agfachrome S film completed Kage s setup for capturing the nexus of electrical communication

GAMES

By Geoffrey Golson

'All essential knowledge relates to existence, or only such knowledge as has an essential relationship to existence is essential knowledge.'
—Concluding Unscientific Postscript
by Søren Kierkegaard

If Kierkegaard seems confusing, then you'd better steady yourself before trying the following quizzes. They're tough.

You probably think you know all about science and space, after all, you're reading *Omni*. But can you speak the language of science? Define these terms.

1 Parsec
2 Albedo
3 Clouds of Magellan
4 Binary star
5 Population I and II
6 Dark nebula
7 Heliopause
8 Cosmological red shift
9 Occultation
10 Astronomical unit
11 Amalthea
12 Epicycle
13 Chryse
14 Terraforming
15 Viroid

If you're positive you know the definitions of more than 12 terms, your vocabulary is astronomical. If you're sure of fewer than 6, you're a bit slow. Try to keep up and concentrate.

PLANETARY KNOWLEDGE

Each planet in the solar system has its own distinguishing characteristics. Or does it? A smart person ought to be able to identify each planet with one clue. But to be sporting, we'll give you five clues for each of the nine planets.

1 • Has a weak gravitation, cannot retain a gaseous atmosphere. • *Mariner 10* flew within 800 kilometers of this planet's surface. • Has a very weak magnetic field. • Its surface resembles Earth's moon. • Has a maximum temperature of 350° C.
Planet _____

2 • Has two known moons. • Was discovered in 1846. • Has a substantial amount of methane in its atmosphere. • Can rarely become bright enough to be seen by the naked eye from Earth. • Another planet may be its runaway moon.
Planet _____

3 • Atmosphere is 95 percent carbon dioxide. • Has largest known volcanic mountain in the solar system. • Has pink dust storms. • Only half the surface, mainly in the southern hemisphere, is substantially cratered. • Soil contains aluminum.
Planet _____

4 • It is not a true sphere. • Has methane and krypton in its atmosphere. • Emits infrared radiation into space in all directions. • Has a polar diameter of 12 755 kilometers. • Its biggest meteor crater is 3.2 kilometers wide.
Planet _____

5 • It is a low-density body. • Has one known moon. • It cannot retain an appreciable atmosphere. • Its orbit is the most eccentric in the solar system. • Discovered by Clyde W. Tombaugh.
Planet _____

6 • Has surface winds of 3 to 6 kph. • Atmospheric pressure is 90 times greater than Earth's. • Has no moon or magnetic field. • Probably has molten-iron core. • 75 percent of solar radiation that reaches this planet is reflected.
Planet _____

7 • Density is less than that of water. • One of its satellites may have an atmospheric pressure similar to that of another planet. • Has ammonia in its atmosphere. • Visible to the naked eye from Earth. • Galileo observed this planet closely.
Planet _____

8 • Rotates in 9 hours 50 minutes. • Has 15 satellites. • Radiates about two times as much energy as it receives. • A system of rings lies in the equatorial plane. • Has a cloudy atmosphere that includes hydrogen and helium.
Planet _____

9 • First planet to be discovered with a telescope. • Its diameter is 51 520 kilometers. • Planet's axis is tilted at 98 degrees, so it whirls around the sun nearly on its side. • Has a system of rings. • Has five known moons.
Planet _____

We've included at least one clue that is a trademark for each planet. If you can identify all nine correctly, you're astronaut material. If you can identify only four or fewer, you're immaterial. But we'll still let you play.

WHERE WERE YOU?

Here are 20 important dates: 1178, 230 B.C., 1895–1957 A.D., 66, 1583, 1948, 1609–1619, 1938, 1783, 1924, 1961, 1953, 1932, 1643, 1958, 1859, 1897, 1951, 1924. Match them to the science events listed below.

1 The first manned orbital spaceflight, by Yuri Gagarin, in *Vostok 1*. Date _____

2 Discovery of the neutron.
Date _____

3 Edwin Hubble proved at Mount Wilson Observatory that there are galaxies besides our own. Date _____

4 The first artificial satellite, *Sputnik 1*, was launched. Date _____

5 Stanley Miller and Harold Urey created the essential building blocks of life in a laboratory. Date _____

6 Robert Goddard demonstrated the first successful liquid-fuel rocket, which traveled 61.3 meters. Date _____

7 Galileo invented the telescope.
Date _____

8 The first recorded appearance of what is now called Halley's Comet. Date _____

9 The discovery by Johannes Kepler of the three fundamental laws of planetary motion Date _____

10 The first nuclear fission of uranium Date _____

11 Discovery of the electron Date _____

12 Publication of *Origin of Species* Date _____

13 The discovery of the high-energy radiation belts surrounding Earth Date _____

14 Completion of the first transistor Date _____

15 Discovery of X rays Date _____

16 The first measurement of Earth's circumference without astronomical instruments Date _____

17 Air is proved to have weight by the invention of the barometer Date _____

18 The explosion of the first hydrogen bomb Date _____

19 Canterbury monks observed a possible meteoric impact on the moon Date _____

20 John Mitchell conceived the notion of black holes Date _____

Consider yourself a scientific historian if you're sure of 16 dates. Consider yourself a good guesser if you're sure of 12. Don't consider yourself if you can't be sure of 6.

WHAT'S IN A NAME?

What do the following have in common and what does each item refer to?

1 Chained maiden
2 Air pump
3 Altar
4 Chisel
5 Sea goat
6 King of Ethiopia
7 Compasses
8 Swan
9 Dolphin
10 Furnace
11 Clock
12 Water snake
13 Rule
14 Winged horse

ANSWERS

Here are the definitions of the terms at left.

1 The distance of an object that would have a stellar parallax of one second of arc. One parsec equals 3.26 light-years.
2 The reflecting power of a nonluminous body.
3 Two neighboring galaxies visible to the naked eye from southern latitudes.
4 System of two stars revolving around a common center of gravity.
5 Two classes of stars (and star systems), classified according to their spectral characteristics, chemical compositions, radial velocities, ages, and galaxy locations.
6 A cloud of interstellar dust that obscures the light of more distant stars and that appears as an opaque curtain.
7 The scientist's term for the outer boundary of the solar system.
8 Shift in the wavelength of light coming from a celestial object (similar to the Doppler effect in sound) said to arise from the expansion of the universe. It is used to indicate the object's velocity away from the observer.
9 An eclipse of a star or planet by the moon or some other celestial body as seen from Earth.
10 The average distance between the sun and Earth.
11 A tiny potato-shaped moonlet in orbit around Jupiter.
12 The orbit in which a planet moves and which has a center that is itself carried around at the same time on the circumference of a larger orbit.
13 The region of the Martian surface chosen for the *Viking 1* landing.
14 The process of changing the environment of a previously uninhabitable extraterrestrial body so that it can support terrestrial life.
15 The smallest known living organism composed of fewer than 10,000 atoms.

Planetary knowledge

The planets according to the sets of clues at left are
1 Mercury
2 Neptune
3 Mars
4 Earth
5 Pluto
6 Venus
7 Saturn
8 Jupiter
9 Uranus

Where were you?

The events matched to the dates are

1	1961	11	1897
2	1932	12	1859
3	1924	13	1958
4	1957	14	1948
5	1953	15	1895
6	1926	16	230 B.C.
7	1583	17	1643
8	A.D. 66	18	1951
9	1609–1619	19	1178
10	1938	20	1783

What's in a name?

The strange words listed in the quiz are all English versions of the names of some constellations. Their proper names are

1	Andromeda	8	Cygnus
2	Antlia	9	Delphinus
3	Ara	10	Fornax
4	Caelum	11	Horologium
5	Capricornus	12	Hydrus
6	Cepheus	13	Norma
7	Circinus	14	Pegasus

LAST WORD

By Norman Spinrad

For $5 billion, the subways could be cleaned up and each train could carry an MX missile

As a new administration gets into gear, publicly committed to lower taxes, a balanced budget, and a beefed-up national defense all at the same time, one of the early decisions it faces is whether to go ahead and build the so called racetrack system for the new MX missile. Under this scheme, 200 square miles of western desert will be riddled with a maze of underground tunnels like so much Swiss cheese. Two hundred MX missiles will be loaded onto railway cars and will shuttle endlessly back and forth from one firing point to another.

The idea is to deter any Soviet notions of a first strike. Improvements in Soviet weaponry have made our fixed-silo, land-based ICBMs vulnerable to destruction by such a first strike. The theory is that the USSR with a saturation strike on our missile silos could take out our capacity to strike back and then threaten our untouched cities with devastation. this makes a nuclear war more 'thinkable" and hence more likely. By shuttling those 200 MX missiles back and forth through all those tunnels so that the Russians never quite know where the missiles are at any given time, we would supposedly deter any thoughts of a Soviet first-strike strategy — a sophisticated and very expensive version of the old shell game played for ultimate stakes.

Of course there are two things wrong with this scheme. First of all, the USSR could simply target about 20 of its biggest and most thoroughly MIRVed ICBMs on this 200-square-mile racetrack and convert it into a 200 square-mile hole. In the Thermonuclear Age one missile per square mile does not exactly represent significant dispersion. Secondly, the whole scheme is monstrously expensive — $30 billion at current estimates — making it the most costly construction project in history, money quite literally thrown into holes in the ground, at a time when economy in government has very nearly become a national obsession.

At the same time we Americans desperately need to upgrade our railroad network in order to be able to handle the shift to domestic coal and away from imported oil, and we desperately need a vast improvement in our mass-transit systems in order to get people out of their gas-guzzling cars. The $30 billion thrown into a brand-new subway system for missiles going nowhere would certainly be more than enough to improve our rail system to Japanese Bullet-train standards and make our cities' subways without question the finest in the world.

Which is exactly my modest proposal.

Why dig 200 miles of tunnels in the middle of nowhere for MX missiles when we already have 200 miles worth of subway system under New York City? Admittedly, the New York subways are foul, disgusting, crumbling and crime-ridden. But for say $5 billion, the New York subways could be cleaned up and modernized. Each subway train could have an extra car tacked on to carry an MX missile. Presto instant mobile dispersion for a fraction of the cost! Shuttling constantly under the Manhattan bedrock, the missiles could be fired up through manholes or from elevated sections of the New York subway system in case of need.

Moreover, there are three other less obvious advantages. First of all, any MX system would need thorough military ground security anyway, and so it would cost nothing extra to put a division or two of soldiers in the New York subway system which is the only feasible solution to the subway crime problem.

Secondly, by dispersing our MX missiles under our cities instead of in the desert, we avert the possibility of a Soviet first-strike strategy, since the USSR cannot destroy our missiles while holding untouched cities as pawns, and this makes nuclear war "unthinkable" again, enhancing the deterrent factor.

Thirdly, and best of all, there is no way the Soviet Union can precisely target MX missiles on subway trains even if Soviet spies ferret out the train schedules because, as everyone knows, no New York subway train ever runs on time. Nobody ever knows where the MTA's trains are! Thus we achieve a true mathematical randomization of motion of our MX missiles. This principle applies equally well to the Long Island Rail Road and just about every other commuter line in the United States.

So let's use that $30 billion to upgrade our railroads and our urban transit systems. Governors of the western states are complaining about the racetrack system. the program is not politically popular. But if every ailing railroad and subway system in the country could get $10 million or $20 million in improvements for every MX missile it agreed to accept, we'd soon have every state, city, and railroad in the country clamoring to get in on the action. Our mobile missiles would be dispersed not over a mere 200 square miles but throughout the whole country. Our mass-transit and railroad systems would be the envy of the world, removing our dependence on foreign oil. And the Russians would be no better able to pinpoint the precise positions of our missiles than the average commuter is able to get home on time.

Guns *and* butter, national defense *and* mass transit! What do you say to that, President Reagan? OO