02484

OMNI

JUNE 1981 $2.00

OTRAG:
ROCKETEERING FOR PROFIT

INTERFERON:
RE-CREATING THE MAGIC BULLET

2081:
GERARD ONEILL'S 21ST CENTURY

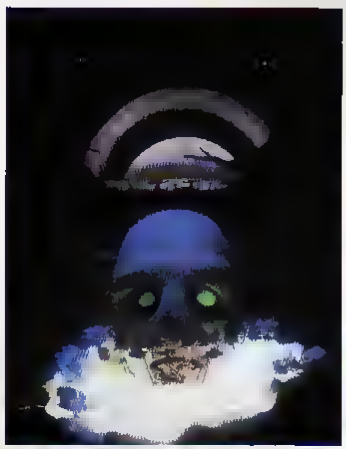
ANNOUNCING OUR THIRD PHOTOGRAPHY CONTEST

Austria 61 S Belgium 87 BF
Denmark 22 DKr Finland 11 80 FM
France 15 FF Germany 8 DM
Greece 180 Dr Holland 7 50 Hfl
Italy 2900 L Japan 960 Y
Spain 300 P

OMNI

JUNE 1981

CONTENTS



This month's cover is by Robert Kittila. First Prize winner in the Omni Cover Photo Contest. Kittila used a Cambo 4" × 5" view camera and a 90mm wide-angle lens to capture Omni's editorial focus on Ektachrome 64 film. The head and trees in the photo were sculpted by Steve Ross.

OMNI, 1981 (ISSN 0149-8711), U.S. Volume 3, Number 9. 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 semifiction and real places or persons living or dead is coincidental. Subscriptions: U.S. APO—$18.00 one year. Canada and elsewhere—$26.00 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) 420-1894. Controlled circulation postage paid at Des Moines, Iowa. Publisher disclaims all responsibility for return of 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 Dr Martin Sherwood

Microbial protein promises huge new supplies of valuable foodstuff without increasing acreage already committed to conventional cultivation

hormone — these, naturally occurring substances can be duplicated in large quantity by biotechnologists. American laboratories are energetically developing all of them. Yet our laboratories simultaneously are ignoring another microbial product, one that is seemingly less glamorous but that could have immense political and strategic significance.

This product is high-quality animal feed, which could be manufactured in enormous quantity many times more efficiently than it is produced by conventional agriculture. But American researchers are devoting no time to this alternative.

The breadbasket is full; meat is on the table. Why worry about tomorrow? The United States is the world's chief producer of soybeans, today a leading source of animal-feed protein. Not only does soybean production fulfill our domestic needs, but our soybean exports also provide considerable revenue for American farmers.

By the year 2000, however, U.S. demand for soybeans might exceed our capacity to grow them by as much as 20 million tons annually. Conventional agriculture simply won't be able to meet that demand. Because soybeans will grow satisfactorily only in a narrow band of latitude, it is not likely that we will find enough foreign producers of soybeans to satisfy our requirements. Even if we were to, do we want to depend on other nations for this valuable, protein-rich food?

The material that could answer our demand is microbial protein. One-celled organisms have a high protein content and can now be produced reliably on a large scale in the factory. This means a potentially huge new supply of foodstuff without a significant increase in acreage committed to crop cultivation.

It also means no worries about weather conditions. Soy production can be badly upset by adverse weather during the plant's short flowering period. Microbial protein, produced in giant fermentors, will yield a bumper crop at any time, because the environment inside the fermentor — the microbe's "weather" — is completely under the control of human designers and laboratory operators.

European nations and the Soviet Union are already vigorously exploiting this resource. Research has been going on there for nearly 25 years. If the United States were to enter the field now, there would probably be no more than a five- to ten-year development gap to make up.

There are several reasons for this. European interest in microbial-protein feeds began with the big oil companies. Yeasts can grow as well by consuming certain hydrocarbons as they can on their usual diet of carbohydrates. This seemed a good way in the early 1960s to generate high-value products from a cheap raw material. But then came the OPEC bombshell, and that raw material became inordinately expensive. Also, regulatory problems with Italian authorities meant that plans for two production plants capable of producing 100,000 metric tons a year had to be scrapped.

Commercial interest waned, but did not disappear. The United Kingdom's Imperial Chemical Industries (ICI) went ahead with a process to produce bacterial protein from methanol, which it makes from North Sea natural gas. ICI's first production plant, incorporating the world's largest sterile fermentor, is now turning out 50,000 to 60,000 tons a year of Pruteen, a light-brown, granular product containing about 70 percent protein.

The USSR persevered with hydrocarbon-based yeast and has at least one plant operational. Formerly Western experts were skeptical about Soviet claims to have mastered this technology. Skepticism was largely dispelled, however, by a presentation — with film — by the Soviet minister for microbiological industry, R. S. Rychkov, at a recent international congress in Paris.

The doubt that bedevils Western minds about the Soviet process is whether it stands up in commercial terms, but this does not trouble the Russians one bit. For them, the process is *strategic*. Isn't it time, on precisely the same grounds, that we began taking this technology seriously?

A good supply of microbial protein won't soon make meat any cheaper. But, in the long run, the real price of any new technological product always comes down, while the prices of traditional products rise. Starting on the technology now might very well stabilize the price of meat so that it remains within everyone's reach.

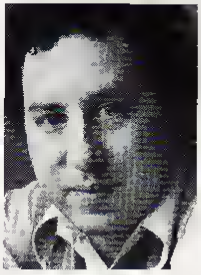
There are plenty of options for both research and development. One way to go is the ICI route toward technology based on a simple chemical, such as methanol. The cost of methanol will probably rise. But with continued promising developments in synthetic-fuel production, there should always be plenty around. And because microorganisms are such versatile creatures, there is also a great potential for turning materials that we don't want into protein feeds.

Already, in Sweden and Canada, some processes are being developed to produce fodder yeast from highly polluting paper-mill wastes. The cost of installing one such plant is estimated to be little more than the cost of constructing a conventional effluent-treatment plant.

In biotechnological terms, microbial-protein production is available now. In terms of product, it is surely of sufficient strategic importance to develop without worrying too much about the economics (although these seem likely to come out right in the end). Does it make sense that Americans continue to consider microbial protein worth less than a row of beans?

Dr. Martin Sherwood is editor of the British journal Chemistry and Industry

OMNIBUS


EDELHART


OBERG


CARD


KIRK


IWASAKI

This month's featured article reads like a spy thriller *James Oberg* examines the turbulent history of OTRAG, a West German space transportation company (page 68) Two questions about the rocket company led Oberg to investigate the organization Could a private rocket company compete with government space monopolies, and what enabled the Soviet Union to stir up a global maelstrom of misinformation?

"These private rocketeers continue to be immersed in controversy," Oberg says "However, this time the Soviet Union is silent, while Israel and Egypt accuse West Germany of providing missiles to pro-Soviet Libya."

Though OTRAG has operated largely as a secretive outfit, the concept of cheap, expendable boosters built by a nongovernment agency is not unusual.

Random House has just published Oberg's book *Red Star in Orbit* based on his article of the same title that appeared in our May 1979 issue A second Oberg work, *New Earths*, explores the potential for terraforming other planets It will be published by Stackpole Books in October

Whenever people met our own *Mike Edelhart* at social gatherings one question they often asked was "Is interferon a cure for cancer?" As an *Omni* editor, Edelhart felt he should know the answer He went to Dr *Jean Lindenmann*, one of the discoverers of interferon The two collaborated on *Interferon New Hope for Cancer*, a study of the drug's potential, which Addison-Wesley published in May

Beginning on page 56 "Cell Defender," the excerpt from Edelhart and Lindenmann's book, provides the most up-to-date information about this potent protein

Photographer *Malcolm Kirk* took his first trip to New Guinea in 1967, when he led an expedition for *National Geographic* During the four months the group trekked across the island a 600-mile journey Kirk became fascinated by the ritual body painting of the tribes he encountered Human decoration appeared to project powerful, nonverbal statements of class and individuality Kirk returned six more times to the island between 1967 and 1980 to assemble photographic material for his book *Man as Art New Guinea* which will be published this fall by Viking Press Kirk's stunning images bare a cultural force that extends to the cosmetic-laden faces of New York and Paris (page 80).

Beginning on page 96, paintings of the cosmos by *Kazuaki Iwasaki*, one of Japan's many popular space artists, are on view for the first time in an American publication An amateur astronomer since the age of thirteen Iwasaki stresses the importance of scientific accuracy in his work *Frederick C Durant III*, former deputy chief of the National Air and Space Museum, interviewed Iwasaki in Tokyo exclusively for *Omni*

June's science fiction is by *Orson Scott Card* ("A Sepulcher of Songs," page 74) and *Russell M Griffin* ("Angel at the Gate," page 62) Last February Dial issued an anthology of Card's short stories, entitled *Unaccompanied Sonata and Other Stories*, which includes three of his stories previously featured in *Omni* Griffin is making his first *Omni* appearance Bantam published his science fiction novel *Century's End* in May

The second excerpt from Gerard K O'Neill's new book *2081* starts on page 88 Having described the five major developments of the present that he believes will shape the next century, O'Neill now predicts what life will be like in 2081 Robots clean house, during the coldest months an enclosed town in Pennsylvania has a climate similar to that in Hawaii, people travel with ease to solar-powered space colonies Current scientific fact guides this physicist's vision as he creates a futuristic setting A photograph of Peter Aldridge's abstract sculpture in Steuben crystal *Passage An Interval of Time* accompanies "2081."

Each year the American Society of Journalists and Authors gives its Magazine of the Year Award to the publication that best demonstrates innovation and excellence in editorial content and graphic design *Omni* is the recipient of the 1980 ASJA Award The ASJA, the national organization of independent professional nonfiction writers, said about *Omni*, "Although this magazine is only two years old, its unique blend of science journalism, art, photography and science fiction has communicated to its readers a sense of wonder."

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*)
Marianna Howatson (*senior vice-president*)
Benson Saks (*chief financial officer*)

EDITORIAL
Editor-in-Chief Bob Guccione *Executive Editor* Ben Bova *Managing Editor* J Anderson Dorman *Senior Editors* Dick Teresi Scot 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 Hitlin *Assistant Editors* Geoffrey Golson Marc Kaplan *Copy Chief* Robert Boylan *Copy Editors* Charles J Hrandi Brian McKernan *Editorial Assistants* Susan Caputo Leslie Epstein Jayne Gassman Francesca Lunzer *Contributing Editors* Stuart Diamond Robert Malone Dr Ethan Mordden

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* Jon Winston *VP/Production Director* John Evans *Midwest Advertising Mgr* Norm Kamikow *Southern Advertising Director* Peter Goldsmith *Western Advertising Director* John Roman *Controller* Marc Bendesky *Director of Marketing and Distribution/Publications* George Cadenwarthy *Nat'l Marketing Mgr* Ralph Perricelli *Mail Sales Operations Mgr* Richard Fogel *Director of Newsstand Sales* Robert Castardi *Newsstand Distribution Mgr* Vincent DeLisi *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) 1103 East Wacker Drive Suite 2036 Chicago Ill 60601 Tel (312) 565 0466 *South* (Peter Goldsmith) 1627 K St N W Washington D C 20006 Tel (202) 296-6050 *Detroit* (John Bluth) 950 East Maple Suite 204 Birmingham Mich 48011 Tel (313) 646-3646 *West Coast* (John Roman) 924 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) 385 6181 Telex no 919565

EDITORIAL OFFICES
New York 909 Third Ave New York N Y 10022 Tel (212) 593 3301 Telex no 237128 *West Coast* 924 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 919565
U K & European Editions
Director of Publications U K David Jones *Advertising Director* Eleanore Graham *Editorial Assistant* Andie Burland

BUREAUS
Washington D C William R Corson 1707 H St N W Washington D C *Berlin* Hans-Hohn Ehrlinstrasse 1 Berlin 45 *Rio de Janeiro* André Fodor 98 Rua Mexico 15th floor Rio de Janeiro ZC39 *Budapest* Paul Kirlyhegyi 5 Regi posta utca Budapest 5 Hungary *Zagreb* Gedomir Komljenovic Strebrnjak 96 Zagreb Yugoslavia

JUNE

LETTERS

COMMUNICATIONS

Subway Series

Norman Spinrad's MX missile subway system represents the first intelligent alternative to the ICBM 200-square-mile underground racetrack proposal [Last Word March 1981] It would be considered utterly funny if we were not seriously in danger of wasting $30 billion

Neil P Ruzic
Beverly Shores Ind

Aware that *Omni* is devoted to excellent science-fact articles and science fiction stories I wondered whether these two modes will someday be combined to produce science fiction editorials I refer to Norman Spinrad's modest proposal to attach MX missiles to the rearmost car on New York subway trains

My greatest fear in the nuclear age is not so much of our annihilation of one another as it is of the accidental detonation of one nuclear weapons The probability that this will occur increases dramatically should Mr Spinrad's proposal be implemented Missiles fired up through manhole covers? Edgar Rice Burroughs was never quite so fanciful!

John Insabella
Tenafly N J

New Sounds

The Endless Scale," by Doug Garr [March 1981] discusses the development of new sounds and varying intonations in music yet Mr Garr totally omits the first synthesizers and experimenters in the field the black American jazz musicians

Listen to successful attempts by John Coltrane Miles Davis or Billie Holiday who cross the boundaries between sound production and music Duke Ellington produced electronic synthesizer-type sounds when sound reproduction was still in its crudest form

These and other avant-garde musicians did not invent new instruments to give their music unique expression (probably because they could not afford the materials) they created innovative ways to play existing instruments

Malcolm Lynn Baker
Eugene Ore

Time Warp

"Future Chronology" by David Wallechinsky and Amy and Irving Wallace [February 1981] predicts a long economic depression in 1983 and an even more severe depression in 1993 when the United States will cease to be a world power The resulting stagnation of industrial output and technological development and the depletion of investment capital, would render it seemingly impossible to launch a space program that could have 50 000 people living in orbit by the year 2000

Such technological progress is inconsistent with predicted economic chaos

Herbert Wyatt
Valdosta Ga

Fan Mail

"Pregame Warm-up" [Continuum March 1981] reported that the Pittsburgh Steelers spent the night with their wives before Superbowl *X* and the next day went on to beat the Minnesota Vikings Shame on you! The Steelers beat the Vikings, 16–6, in Superbowl *IX* in 1975

Any real Steeler fan would know that

Douglas M Meredith
Pittsburgh Pa

You're right, of course Had our Continuum editor been a 'real Steeler fan,' he would have caught this error Unfortunately this editor is a Viking fan because the Vikings have lost the Superbowl so many times he is no longer able to distinguish one humiliation from another —Ed

Selling SPS

Some common fears about solar-power satellites were set straight by G Harry Stine [Space February 1981] It's hard to believe there are people who suspect that energy-transmitting laser beams from these satellites to solar collectors on Earth could be hazardous to one's health or that the earth would be shadowed by gigantic batteries out in space

If the public is going to be sold on solar-power satellites, then we should be better informed about the financial commitments and should be told how long

CONTINUED ON PAGE 127

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*

The End and the Means

I write in reference to "Ecofighters," by Eric Schwartz [Earth], in *Omni*'s February 1981 issue.

The end still doesn't justify the means!

People who go out to ram vessels on the high seas, as Paul Watson does, are no better than the criminals they are assaulting. They are criminals, too, and deserve to be treated accordingly.

I agree that it is hard to see the whales slaughtered. Mankind is only destroying himself in destroying them. But if people take the law into their own hands, as those like Watson are doing, that is the end of all government and control. We have anarchy and therein lies the end of civilization.

We have too much evidence of people acting violently for their beliefs these days. Watson is no better than the fellow who decides he's mad at society and goes out to shoot a person he doesn't even know. Lack of respect for law will yet be the downfall of our civilization.

Kathryn K. Krauel
Seattle, Wash.

Three cheers for Paul Watson and crew. What they did may not have been legal, but I believe it was just. If the governments of the world refuse to police these atrocious injustices, I am proud to see that some people have done their own policing. I highly disapprove of the killing of an animal for any reason other than survival. Anyone killing such a beautiful animal as the harp seal is only one rung lower than the politicians who block the passage of protective laws.

Kevin Spiers
Lubbock, Tex.

Having read the article "Ecofighters," I say more power to people like Paul Watson and Dexter Cate for the work they do. The wasteful and unwarranted slaughter of whales should be stopped by whatever means are necessary.

Granted, there are cases where hunting is merited, such as to control deer populations. But this becomes a necessity only because of the thoughtless elimination of the predators that would normally keep the deer population in check.

If the killing of not only marine mammals, but of all animals and plants, is allowed to continue unchecked, the consequences will be incalculable.

If organizations such as the International Whaling Commission refuse to take the responsibility for strengthening international laws and their enforcement, the "task will have to pass to those who are truly concerned for the welfare of the world's wildlife. If ensuring this welfare means the sinking of a ship, then so be it.

Carol A. Burkart
Reading, Pa.

Paul Watson, "environmental terrorist," at the helm of the Sea Shepherd, *crusading to save the whales*

I was surprised to see an article glorifying piracy in *Omni*'s February Earth column. A science magazine, no matter what the format, should maintain some objectivity, some emotional detachment, and not oversimplify issues.

To maintain that a private citizen has a right to take violent action against those he considers immoral is to condone the recent actions of political terrorists. If Mr. Watson can attack "wrongdoers" with impunity, then so can Khomeini and his militants. So, for that matter, can Charles Manson. In the spirit of Watson's reward for sinking whalers, I can offer a reward for sinking the *Sea Shepherd*. I could even recruit people to bomb abortion clinics and food-stamp offices if I felt that those actions were "something that has to be done," to quote Watson.

Obviously, if this argument is carried to its logical conclusion, world society would disintegrate into anarchy, which helps no one except possibly the whales.

The obvious solution is a commitment to the rule of law. If you disagree with the law, you can work to have it changed, or take the civil-disobedience route, which by

definition is nonviolent. Boycotting Japanese goods is another nonviolent alternative. But under no circumstances should you, as an individual or group, initiate violence against your fellowman.

Michael K. Condon
Shrewsbury, Mass.

It's a Bird, It's a Plane, It's a Dynastat!

As was mentioned in your comprehensive interview [February 1981], not only did Malcolm Forbes found his own balloon museum, but he holds the coveted Harmon Trophy for his 1973 transcontinental balloon flight. His flamboyant flight plans have been somewhat up in the air ever since 1975, when an accident prevented the Windborne—a fantastic fleet of 13 balloons designed to waft him across the Atlantic—from ever really getting off the ground. But Forbes will soon be flying high again—not in a balloon but in a one-of-a-kind airship called a Dynastat.

Designed and built by veteran balloonist George Stokes, this unique airship bellies through the air like a porpoise, achieving flight speeds of up to 25 miles an hour without an engine. A test flight of the vehicle, which has not yet been delivered to Forbes, is scheduled for the near future. Stokes plans to produce Dynastats for other interested flight fanciers. They will sell for approximately $50,000 apiece.

Phoebe Hoban
New York, N.Y.

Credit-Where-It's-Due Dept.

I would like to thank Nikon for the use of equipment to photograph Jerry Andrus's impossible box ["Magic Man," May 1981].

Scot Morris
New York, N.Y.

What Future?

I have a very simple message for Mr. Robert Anderson ["First Word," January 1981]. I don't consider myself one of the most referred to by Mr. Anderson who view the future "through historical extrapolation or fictional realities." Whoever he may be referring to, the intellectual, scientific and medical communities consider the future as the consequence of our present acts and of natural occurrences.

Unfortunately because of our sophisticated communications, I am confronted daily with reports of unjust and unacceptable acts of big corporations. It is depressing to learn of these acts that endanger the health and the very existence of the creatures on this planet.

It also angers me that the chairman of the board and the chief executive of Rockwell International, one of the biggest corporations in the United States, which builds nuclear weapons in its Rocky Flats, Colorado, plant, would make the statement, "We create the future by buying it, and we will get what we pay for."

Mr. Anderson, after Rockwell's nuclear warheads are used in the next world war, what future will be left to buy?

Robert Hadden, Jr.
Stony Brook, N.Y.

Vindication

In "Sumerian Astronauts" [Antimatter, October 1980] *Omni* summarized from my book *The Twelfth Planet* some of the evidence for the astoundingly accurate Sumerian descriptions—millennia before Christ—of our solar system, which depicts the sun in the center and all the planets we know of today, plus one more. Discoveries made during the past four centuries have confirmed one Sumerian claim after another; astronomers have even begun to search for an ultra-Plutonian planet. Yet the Sumerians' explanation for their incredible knowledge is still rejected: Visitors from that large planet taught us, they said.

But the Sumerian evidence is not limited to the distant heavens; it also deals with what happened on Earth. Many texts have been found, accompanied by illustrations on clay, that describe the voyage to Earth, the landing on Earth, and the establishment of settlements in southern Mesopotamia. These were laid out in an arrow-like pattern that led to a spaceport at Sippar ("bird city"), using Mount Ararat as the key landmark.

All that was swept away by the Deluge. But vast stone structures, related to a rebuilt spaceport, remain to this day.

One such structure is an immense platform in the mountains of Lebanon at Baalbek. Some of its colossal stones weigh more than 1,000 tons. Local traditions, as well as biblical references and recently discovered Canaanite texts and drawings, attest to its serving as a landing place for airborne craft.

The others are the stone structures at Giza in Egypt: the three pyramids and their companion Sphinx. As I show in my recently published *The Stairway to Heaven*, they formed, with Baalbek and Jerusalem, the components of a postdiluvian landing corridor leading to a spaceport in the Sinai.

One hopes that nowadays vindication will not tarry for hundreds of years, as it did in the cases of Copernicus and Galileo.

Zecharia Sitchin
New York, N.Y.

Reclaiming Swampland

Kenneth Brower's article, "The Ungreening" [December 1980], is timely and well written, but Mr. Brower failed to report on several factors that contribute to increasing desiccation the world over.

One such factor is the amount of energy reflected back into space by the exposed surfaces in newly desiccated areas. These energy shifts in the polar and tropic zones will normally balance themselves out. Man's efforts serve to perpetuate imbalances because of his concern only for current needs and his reluctance to look into the future. Even without man's interference, cyclic changes occur that alter energy balance—wobble of the earth's polar axis and solar electromagnetic aberrations, for example.

The change in albedo increases cooling, and the use of wood therefore rises with the resulting destruction of forest resources. This leads to more heat loss from newly exposed soils. Where wood isn't used, the use of fossil fuels releases huge quantities of carbon dioxide, thus producing the "greenhouse effect."

The "reclamation" of the Sudd for its potential value as farmland, to which Brower alludes, will alter the energy balance still further. The Sudd, if left as a swamp, will have a low albedo because of the shading of water surfaces by luxuriant plant growth. If the Sudd is transformed into irrigated farmland, its albedo will be very high because of the reflectivity of open canal surfaces and the flooding of rows during irrigation. Flooding is mandated by the accumulation of salts in the soils, necessitating additional water to leach the unwanted salts out: about five gallons of water for salt control to every one gallon that is used for plant sustenance. Salt control requires a very expensive field underdrain system to remove the leaching waters. Without an underdrain system, the water table rises and there is an uncontrollable salt buildup at the surface by efflorescence, such as has occurred in the Indus River Valley in Pakistan.

The bared soils between rows will alter the balance in infrared radiation. Infrared radiation from the Sudd has been seasonally fairly steady, as has the transpiration rate of its plants. Farming the region will make the infrared radiation seasonally variable. The decrease in evaporation owing to the loss of water surface and the probable net decrease in transpiration attributable to alternation of flora could easily reduce the amount of moisture in the atmosphere above the Sudd, and thus change the infrared radiation and the heat-storage capacity of the atmosphere. The totality of these alterations in the environment and what extremes they may reach and where the balance will be made by nature remain open to conjecture.

The alteration of the Sudd may also be expected to produce a disaster in human terms. The inhabitants of the Sudd are hunter-gatherers, and theirs is an unsophisticated existence. Draining their swamps and placing these people at work on the farms will erase their cultural identities and damage their self-esteem. Victims of "culture shock" usually survive, but with serious social problems tending to destabilize the fragmented societies' remnants. The problems of American Indians and Australian and Brazilian aborigines validate this premise.

One last point merits consideration. The building of dams is likely speeding desertification over the long run. Because

CONTINUED ON PAGE 144

POISON EATER

EARTH

By Nick Sullivan

In the laboratory TCDD is shorthand for the most toxic substance in the arsenal of man-made chemicals. It is so lethal that just three ounces of it could kill a million people. Minute amounts of the toxin exist in the infamous herbicide Agent Orange, used in Vietnam. But Dr. Ananda Chakrabarty has a plan to turn barrelfuls of TCDD into a harmless white powder.

Dr. Chakrabarty invented the oil-eating microbe that became a celebrated defendant in the U.S. Supreme Court's decision to patent man-made organisms, or "bugs" as they are known in the trade. His new experiments go one step further. The biologist is "training" microbes to adapt to the chemical toxicity in their environment. As the microbes multiply they develop immunizing enzymes capable of detoxifying nasty chemicals, while ensuring their own survival. If successful, "within three to five years," Chakrabarty predicts, "it will be possible to lab-engineer a bug that eats *any* toxic chemical or compound."

Until recently scientists tackled only the chemicals that were easiest to degrade. SRI Laboratories, in California, produced a bug to dissolve the pesticide parathion into harmless phosphates. And Drs. George Kidd and George Pierce, of the Battelle Memorial Institute, in Columbus, Ohio, produced a bug to degrade DDT and another to decompose PCB, the biphenyls once used as insulators in electrical devices. The new bug is also engineered to reduce a toxic ingredient in Agent Orange called 2,4-D to simple carbon dioxide, chlorine, and water.

The principle behind these substances is relatively simple. Scientists search out microbes that already contain recessive genetic instructions for bestowing immunity from a particular toxin. Through many successive generations microbes evoke life-giving enzymes. The enzymes — chemical-degrading, fragile, three-dimensional proteins — are what the scientists are searching for. The end product is the enzyme," says Dr. Pierce. "For our purposes, the whole organism is just a bag to hold the biological machinery."

When bioengineers first experimented with their new microbe, they found that it was too complex and unstable to withstand changes in the environment. It soon weakened or disappeared entirely. Scientists solved this problem by splicing a strand of DNA from the carrier organism that contains the genetic coding for the vital enzyme into a simpler, more stable, one-cell microbe. This technique creates a new man-made bug strong enough to protect the chemical-degrading enzyme that is its dominant characteristic.

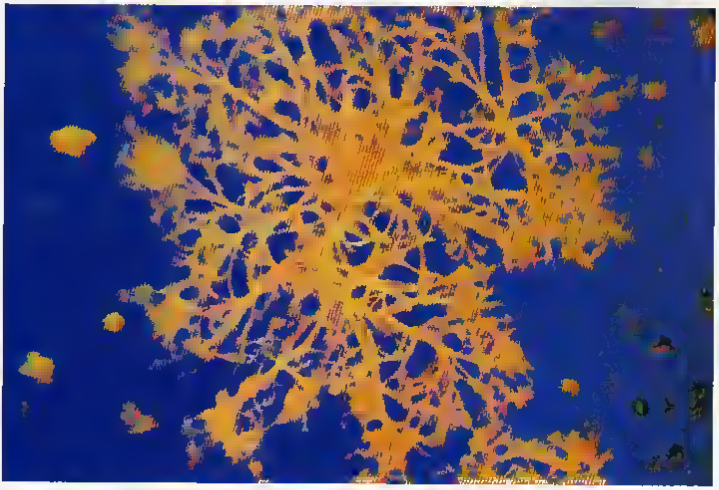
Chakrabarty encountered a different problem. There is no known TCDD-degrading enzyme. Since creating a new enzyme out of thin air is still beyond the scope of today's science, Chakrabarty utilized special microbes that depend on carbon for food. TCDD contains carbon. By making the microbe dependent on the toxin for its only sustenance, the organism is forced to mutate an immunity to the poison. "This is what happens in nature," says Chakrabarty. "When a microbe encounters toxicity it searches for new genes until it becomes immune. We're simply manipulators."

One method that scientists use to hasten the microbe's hunt for an immunizing enzyme is gene splicing. DNA from microbes already immune to toxic chemicals such as TCDD is spliced into the experimental microbe. Gene splicing used to be an arduous task, taking weeks or months to perform by hand. Now a new gene-linking machine performs the difficult process in a matter of hours, encouraging Chakrabarty's hopes of an imminent breakthrough.

But what works in laboratory-controlled conditions will not necessarily work in a free environment. If one were to take Chakrabarty's yet-to-be-born bug and place it in a room with a barrel of TCDD, it will eat and decompose the TCDD. But in an open environment the bug would find an easier source of carbon for its food, perhaps a decaying log. The ability of one of these organisms to zero in on a specific toxin still has to be developed.

The other bug in Chakrabarty's bugs may be that these lab-engineered, incubated microbes are too delicate to survive outside a laboratory environment.

CONTINUED ON PAGE 143



Man-made microbes are being trained to neutralize lethal toxins like Agent Orange

QUICK WIT

LIFE

By Dr Bernard Dixon

Mention intelligence these days, let alone try to measure it, and you enter a minefield. "I.Q.'s measure nothing but the ability to succeed at I.Q. tests," you'll be told by shrill experts who believe the tests are culturally biased. Concede that they have a point, and you will be pilloried by equally combative defenders. Their continuing warfare has become one of the most bitter battles in modern psychology.

Is there any way out? A young psychologist at the University of Edinburgh, Dr. Chris Brand, believes there is. His experiments indicate that innate ability may be at the root of what we call intelligence. Quickness of mind—the capacity to take in information instantaneously—seems to be the key.

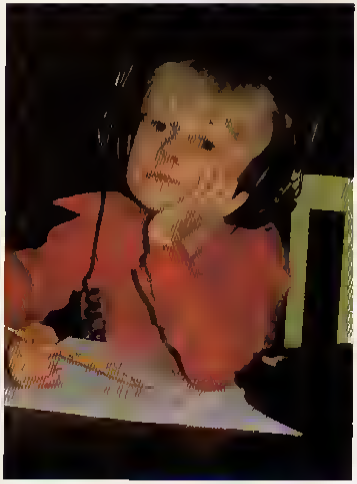
Dr. Brand has been busy for four years now compiling an impressive series of studies to support his thesis. His experiments are conducted principally with two instruments: a tachistoscope and a tachistophone. These enable him to measure the accuracy with which people register images and sounds presented very briefly. Subjects sitting in front of a tachistoscope screen, for example, are shown a short line and a much longer one and are asked to say which is which. The images are flashed for a few tenths of a second at first, then for progressively shorter periods. Brand defines "inspection time" as the briefest period at which a person can maintain a particular accuracy, say, 95 percent.

Results from such studies in five groups of people reveal a striking correlation between inspection time and I.Q. as measured by conventional tests. Individuals with a high I.Q. recognize the lines with much shorter exposure times than others. By the standards of most psychological research, the correlation is exceptionally strong.

More recently Brand and his colleagues have used the tachistophone, which generates musical tones for as little as three milliseconds. The subjects, listening through earphones, are required to say which of two notes hit a higher pitch. Once again their inspection times are very closely correlated with I.Q. test scores.

It was about a century ago, in the early days of experimental psychology, that scientists first began searching for a way to measure intelligence. They investigated reaction times, sensory thresholds, and many other possibilities—all to no avail. One of the broadest student surveys, conducted at Columbia University in New York City, showed that the figures from such tests did not match one another. Nor did they have any relationship with the students' academic success. So these efforts were abandoned as misguided and naive. To this day the nearest approach we have to a scientific index of intelligence is the I.Q. scale devised by Alfred Binet at the turn of the century.

In the intervening time, psychologists have experimented with innumerable modifications and adaptations of the Binet scale. Their efforts have been directed toward measurement of the fundamental basis of intelligence, as well as to the development of tests unaffected by the subjects' cultural background. But the result of this work has served only to add further fuel to the debate over intelligence and its hereditary underpinnings. So, nearly 80 years later, we are left in an awkward position. Though the Binet scale continues to be hotly criticized, it is still widely used in educational assessment for want of a better measure.



Tachistophone is used in radical, new I.Q. test

Has Brand at last found the answer? There is no question that his discovery is new and exciting. We know that some people are much more skilled than others in picking up vanishingly brief traces of information. It is interesting to have this characteristic confirmed with laboratory precision, having suspected it for a long time from observations in offices and classrooms. But can intelligence really be reduced to such a simple process as our ability to register momentary experiences?

The obvious weakness in Brand's work is that so far he has demonstrated only a correlation between high I.Q. and low inspection time. This does not mean the two measures are equivalent. But the strength of the relationship—and its existence even in four-year-old children—suggests that this is much more than a statistical fluke.

Several practical benefits will follow if measurable differences in mental speed underlie individual differences in intelligence. Physicians, for example, would appreciate a more fundamental method of monitoring I.Q. in patients with brain disease. People feigning low intelligence as a means of avoiding criminal responsibility or military service could also be tested by Brand's technique.

If Brand's research holds up, it seems to offer a genuinely culture-free intelligence test. I.Q. tests that rely on vocabulary, general knowledge, and problem solving are inevitably slanted to favor the cultures of those who devise them. Brand may have found a way around this. We may at last be able to resolve the bitter argument over differences in intelligence between social groups and among the races.

It seems unlikely however, that his breakthrough will calm the debate over I.Q. In so emotional a field a new scientific measure of accuracy may provoke only greater anger.

SPACE

By Alex Wagner

Space technology is part of our daily lives. Rechargeable pacemakers, artificial limbs, CAT scans, minicomputers, pollution monitors—these and other products now taken for granted by most Americans have directly resulted from the U.S. space program. With the liftoff of *Columbia*, a new chapter in space history began. The list of technological advances will continue to grow. What other revolutionary achievements in space might change the course of human life?

It is important to find out.

For years space activists have independently sponsored Space Day celebrations in their cities. The annual observance is intended to promote national interest in space enterprise. Since activism has picked up considerable momentum in recent years, more Americans than ever before will participate in Space Week. Nationwide, space-related events are scheduled from July 13 through July 20. Lectures, films, conferences, concerts and special events will commemorate the achievements of our space program, notably the first landing on the moon by the men of *Apollo 11*.

Omni has assembled the following inventory of activities planned by the space-activist groups.

New York. On July 15, at 7 PM, the New York chapter of the World Future Society will sponsor a lecture by guest speaker Ben Bova, *Omni* executive editor and award-winning science-fiction writer. He will discuss the techniques of prediction. The lecture will be given at the Hunter College School of Social Work Auditorium, 129 East Seventy-ninth Street, New York, NY 10021. For further information call Marian Percival, (212) 570-5304. On July 16, from 8 PM until midnight, the Amateur Astronomers Association and the Amateur Observers Society will host a lunar-eclipse observing session. The site is to be determined. Call (212) 535-2922 for details. Scheduled on July 16 and 17 is a Careers in Space conference, again at the Hunter College School of Social Work Auditorium. For more information call Michael McAuliffe, (212) 695-1879. On July 19, beginning at 1 PM, the L-5 Society of New York will hold a "space erase" cleanup and removal of graffiti from space-park exhibitions at the Flushing Meadow Park Hall of Science. Details can be obtained by contacting the president of the New York chapter, Alan Wasser, (212) 860-3676.

The Vanderbilt Planetarium, Little Neck Road, Centerport, New York, plans a series of events during the entire week. Call (516) 757-7500 for the schedule.

For further information regarding New York City and State events call Ann Deering, (800) 621-1466, extension 2004.

California. The Alliance for the Future will hold the following activities in the San Francisco Bay Area. On July 11 a Get Away Special, outlining the various uses of the shuttle, will be held at the University of California at Berkeley. Space in Context, a symposium on how space relates to the needs of the earth, will take place July 14 in San Francisco. Peace in Space, a discussion on maintaining peaceful uses of space internationally, will be held July 16 in everyone's favorite city. Speeches, films and exhibitions will be part of the San Jose Space Day on July 18. Another event planned in San Francisco is Visions of Space and Celebration, an artistic version of space employing music, films, slides, and exhibitions, on July 19. For further details contact Alliance for the Future, 1168 Kearny Street, San Francisco, CA 94133, or call (415) 566-3068.

Space telescope model at Space Week '80

The California Museum of Science and Industry with support from the Los Angeles section of the American Institute of Aeronautics and Astronautics (AIAA) and the Organization for the Advancement of Space Industrialization and Settlement (OASIS), will sponsor Space Awareness Month. Activities include a program for the elderly on July 4 and a children's space program on July 11. Space movies and slides will be shown at the museum from July 13 through July 17. On July 19 there will be a Space Fair, including multimedia presentations, balloon and rocket launches, outdoor displays of space hardware, and folk music concerts. Charles Carr at the California Museum of Science and Industry, 700 State Drive, Los Angeles, CA 90037, (213) 744-7400, has complete details.

On July 17 and 18 a two-day Careers in Space conference, sponsored by OASIS, will be held at the University of Southern California. For more information write to Ray Haas, PO Box 704, Santa Monica, CA 90406, or call (213) 374-1381.

The Planetary Society will hold colloquiums throughout the nation on planetary exploration. Write to Ken Savary, PO Box 3599, Pasadena, CA 91103, for details.

The Viking Fund/Delta Vee will present space movies and videotapes during all of Space Week. Under the auspices of Viking/Delta Vee, aerospace companies will hold open houses that week. Direct all inquiries to Stan Kent, 357 Saratoga Avenue, Santa Clara, CA 95051, (408) 243-1600.

Washington. From July 13 through July 17 the American Society for Aerospace Education will host the 1981 National Aviation/Space Education Convention at the University of Washington in Seattle. Write to American Society for Aerospace Education, 1750 Pennsylvania Avenue,

CONTINUED ON PAGE 141

From the prime contractor to the prime beneficiary:

Congratulations, America.

Once again, America is leading the world into space.

Rockwell International is prime contractor for the Shuttle orbiter. Also, our Rocketdyne Division built the main engines. And we assist NASA in the integration of the Space Transportation System. Our achievements in space and aircraft development demonstrate the high technology which characterizes all the businesses of Rockwell International.

We join America in saluting NASA, the *Columbia* crew — John W. Young and Robert L. Crippen — and the 50,000 people in many companies who worked with us to build America's Space Shuttle.

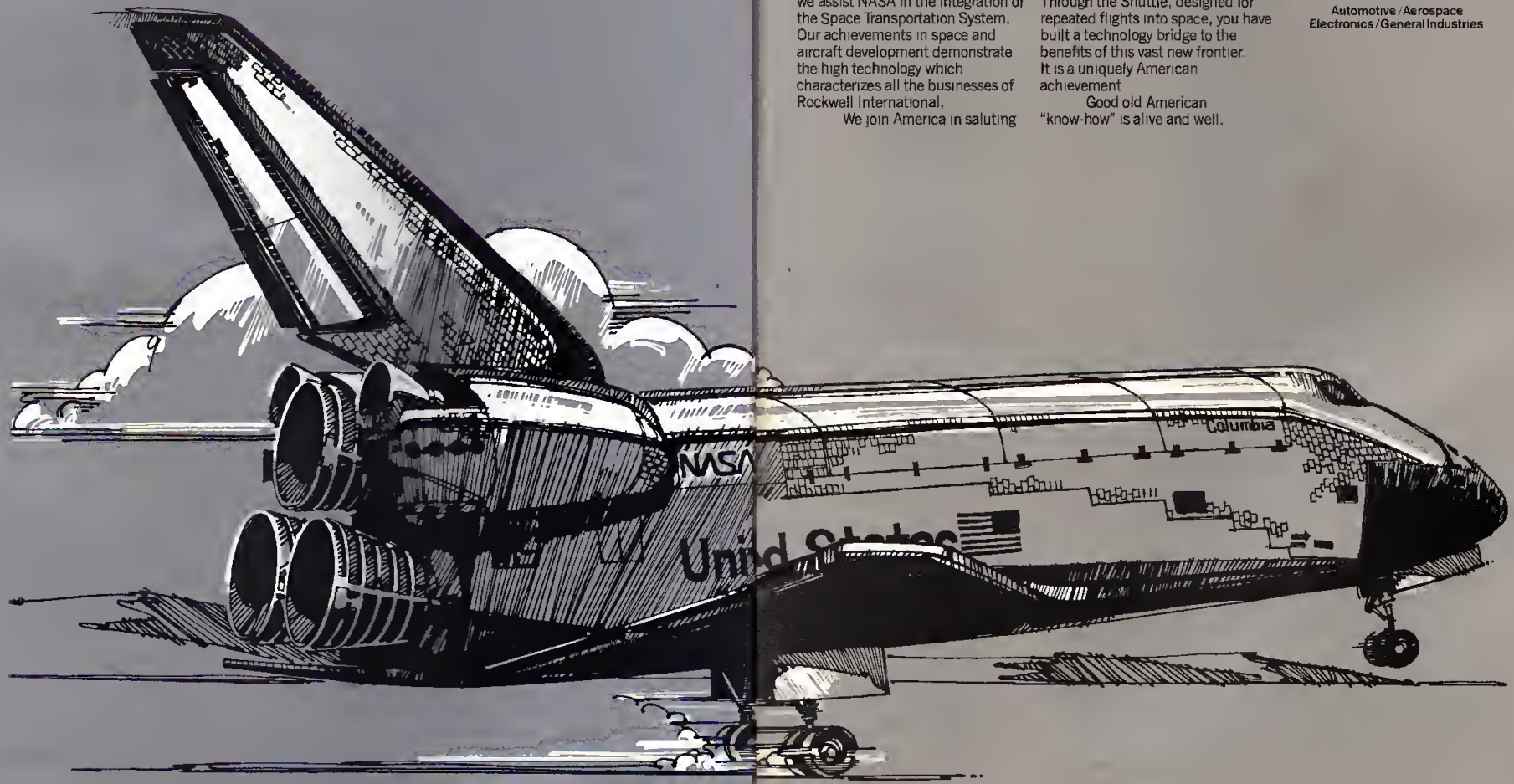
Congratulations, America. Through the Shuttle, designed for repeated flights into space, you have built a technology bridge to the benefits of this vast new frontier. It is a uniquely American achievement.

Good old American "know-how" is alive and well.

Rockwell International

where science gets down to business

Automotive / Aerospace
Electronics / General Industries



LONELY VOICES

MIND

By R. Bruce McColm

It's 3 A.M. A call comes in to a telephone-answering machine that sits on a bookcase in a Lower Manhattan loft. Street noise in the background indicates that the call is from Times Square. Someone is counting change and sighing. A male voice says, "I killed her." The voice chokes, forcing out every syllable. "I—I—I had to kill her." Just then he hangs up.

Midafternoon. A perky young girl calls. "My friends are in a gang at school called the Wanderers. They said I could become a member if I would shoplift. I don't know whether I really want to shoplift. I've just called to tell you how I feel about this."

The Apology Line, as the mute answering machine is called, is the brainchild of Chris (not his real name), an artist and carpenter in his thirties. In late October last year he plastered Times Square with ads that read: "You have wronged people. It is people that you must apologize to, not to the State, not to God. Get Your Misdeeds Off Your Chest! Call Apology (212) 255-2748."

Originally the telephone service was an art project intended to assemble tapes of criminals confessing their crimes for public replay in a Soho gallery. Instead the line has mushroomed into a confessional with callers phoning from California, Mississippi, Nebraska, and Canada to own up to everything from petty theft to incest.

To varying degrees, all these callers are trying to overcome or avoid loneliness, a serious but underpublicized problem in today's society. Philosophers and psychologists have concocted a host of neuroses, syndromes, and conditions to explain the problems of human estrangement and alienation. However, according to Dr. Robert Weiss, a social psychologist at the University of Massachusetts, all these sad emotional states may be nothing but plain, old-fashioned loneliness.

In his *The Experience of Loneliness: Studies in Emotional and Social Isolation* (MIT Press, 1980), Dr. Weiss published the findings of the first national survey on loneliness, conducted by the Laboratory of Community Psychiatry at Massachusetts Mental Health Center in Boston. Weiss and his colleagues found that loneliness is a distinct psychological syndrome, more common and more intensely felt than previously thought. Its recognizable symptoms are tense feelings, restlessness, loss of appetite, inability to fall asleep, low-level anxiety, and a general sense of being out of touch.

In an effort to reconnect themselves to life, lonely people jam the phone lines of late-night radio talk shows and community-outreach programs. Among these telephone connections, Apology Line is unique. It allows people to talk intimately for as long as they want to a dead line that doesn't hear them, talk to them, or know who they are. The line is like a bottomless hole down which they can pour their phobias and frustrations.

"Anonymity is the key to the whole project," says Chris. "They don't know who I am, and I don't know who they are. It reminds them of confession. You saw the silhouette of the priest but never knew who he was. Most people carry a lot of things around inside them and can't tell anyone because of guilt or the fear of arrest."

As Apology Line achieved wider public recognition, the nature of the calls changed from criminals talking about prostitution, drug dealing, and murder to better-established people chatting about their sexual fantasies and preferences, marital problems, infidelities, and failed ambitions. Adolescents, according to Chris, frequently call about their drug problems and peer pressure and act out psychodramas on the phone about stealing large sums of money from their parents or even killing their parents. A Beverly Hills housewife called cross-country at 4 A.M. to talk to the mute machine for an hour about her divorce, her attempts to get a job, and her longing to move back East.

According to Chris, "This is a new way of communication. People just can't confide in anyone or find anyone who will listen anymore. Your friends have problems, and the bartender at the local saloon has heard it all before. But it's not a surrogate for a person visually present. Rather, people tell the machine truths about things they normally wouldn't tell other people. They feel that, by talking to the Apology Line, they reach the whole public."

CONTINUED ON PAGE 129

THE ARTS

By Sal Manna

When he was growing up in New York City Martin Scorsese wanted to be a priest Though he never did become one his life as a film director has more than once taken on the trappings of a religious crusade Scorsese s latest missionary undertaking is an attempt to save films made in color from permanently fading and being condemned to a pinkish-hued oblivion He says *Raging Bull* was shot in black and white because of just such a fear

"After only a few years the color in our films will be irretrievably lost Scorsese wrote last year in an open letter to the movie industry "Eastman Kodak will do nothing to remedy the situation simply because the immediate and outrageous financial profits have priority over the quality of the product So long as it is in Kodak s interests not to do so through its total monopoly in the United States and in many other parts of the world, Kodak will be responsible for the destruction of our past and current work "

Scorsese's remarks underscored by Francois Truffaut Federico Fellini and others, have turned the film business upside down and severely shaken the folks at Kodak It Scorsese is on target a precious cultural heritage is in jeopardy nearly every color film made since the early 1950s is in danger of fading And that includes all of NASA's space footage The epical film of the first moon landing could end up a washed-out relic, a monument to the failure of film technology

Director writer and Scorsese protege Paul Schrader pulls no punches "Unless special and expensive methods are adopted " he says "there is serious trouble ahead We have had the Kodak color film for one generation and its life is almost up We ve already lost the color in some pictures Marty [Scorsese] has been deliberately abusive to try to focus attention on the problem There is an unfortunate lack of interest and an appalling lack of information "

Rebel Without a Cause (1955) and *Tom Jones* (1963) are the two most often cited examples of films that have lost their color quality because of unstable film stock The lush green English fields that Tom Jones roamed over now look scorched, as if the sun had suddenly moved closer to the earth

Mark Del Costello Scorsese's assistant and the person designated to lead the fight to preserve the color film says that "we had no idea what we were getting into but we've come a long way in a short time We're not making an accusation, only a plea for help"

Without question, economics is at the heart of the issue When Kodak came out with a photographic printing process that was cheaper than the Technicolor dye-transfer process the film industry jumped in headfirst That was in 1952 Today the only Technicolor printing plant is in the People s Republic of China *The Godfather II* (1974) was the last American-made film to use Technicolor

Technicolor was more expensive because it involved passing a strip of blank film through a printer three times each pass transferring a dye onto the film first yellow then cyan (blue) and finally magenta This is a mechanical method rather than a photographic one the dyes were considered to be of the highest quality and to have infinite stability and life span Kodak hotly denies that its color film stock is in any way inferior to Technicolor and suggests that if film moguls were serious about preserving films they could do so if they'd only spend the money

Black and white Raging Bull *won't fade away*

"Color dyes can fade That s the nature of photographic film," says Kodak spokesman Henry J Kaska "But that doesn t mean that the motion pictures are disappearing What confuses people is that they see a faded film on television or in a revival theater and assume that the film is dying"

Kodak says that what the public usually sees in the theater is a release print designed to be projected hundreds of times during a three- to six-month period and to be disposed of after its first run In most cases Kodak claims, the regular scratches dust, and rips knock out the film a long time before any appreciable fading can occur

But the color negative or color separations (three prints, in each primary color from which the release prints were made) are presumably in safekeeping at the movie studio Innumerable copies can be made in the future The film is not lost

Thanks to Scorsese's diatribes, Kodak, usually highly secretive has finally released information on its own tests of its color-film stock Kodak s data are impressive according to Dr Charleton C Bard supervisor of processing chemistry and image stability in Kodak's Photographic Technology Division Dr Bard says that a color negative of Kodak's standard motion picture film stored in a household refrigerator at 45°F would need 600 years to lose one fifth of its density for the cyan color—an almost-unnoticeable change If the film were stored at 14°F, the deterioration would take 8,000 years give or take a decade

(Because of the long times needed, Kodak uses accelerated tests From a test involving 200 days, Kodak estimates the effect expected in 10,000 years Obviously there is no reliable information relevant to real-life conditions.)

CONTINUED ON PAGE 148

THE ARTS

By Scott Cohen and Jack Freeman

A microchip designer at Intel Corporation was flipping through a magazine recently and saw a photograph of a Soviet memory chip that looked familiar—just like one his company made.

It was, in fact, an exact copy of the Intel chip, down to the finest detail, including the original designer's personal idiosyncrasies. Most designers are too proud to copy the fine details that don't relate to a chip's function. But on this chip only the designer's initials had been changed. Apparently the Soviet silicon spy could not distinguish between form and content. In the art world this is known as forgery.

A microchip is more than a checkerboard of circuits crammed with thousands of bits of information. Microchips are art objects designed with function in mind, the results resemble a Mondrian painting. Dazzling colors are created by the thickness and number of layers of circuits and by the materials being used.

At a time when art is moving from very large canvases to very small ones, microchips might well become giants. When it comes to minute detail, they make Indian miniatures look like billboards. An entire microchip collection could easily fit inside a matchbox. Many look like aerial views of cities, with streets and skyscrapers and a few buildings on fire, others suggest the industrial parks in which they were made. But you need a microscope to see the resemblance.

Most chips are made in Santa Clara County, California, by designer artists who work in teams and sign their creations with a corporate name. These artists work anonymously and in total secrecy, preferring not to show their work out of fear that, like Intel's chip, it will be copied.

"It's a very exacting art with a lot of physical constraints," says an Intel designer who prefers not to be identified. "The work has to be absolutely perfect. If you make a mistake in a painting or a drawing, you can fix it. But there's no tweezer tiny enough to fix a mistake in a chip." One mistake and a chip intended for some advanced missile-control system could wind up in a talking doll.

The design of a chip follows functional necessity. Composition almost always begins with a formal grid structure. More dynamic sections emerge when a specialized function is added, such as a Central Park or a Times Square popping up in a Manhattan landscape. Few chip companies can meet the demand for specialized circuits. Mass-produced "gate array" circuits, the lowest common denominator for chip designs, use specialized functions overprinted on them.

Overprinted instructions for the gates can become very complicated, depending on the chip's purpose. A chip that is 90 percent gate array may be economical, but it is far less artistic looking than more complex ones.

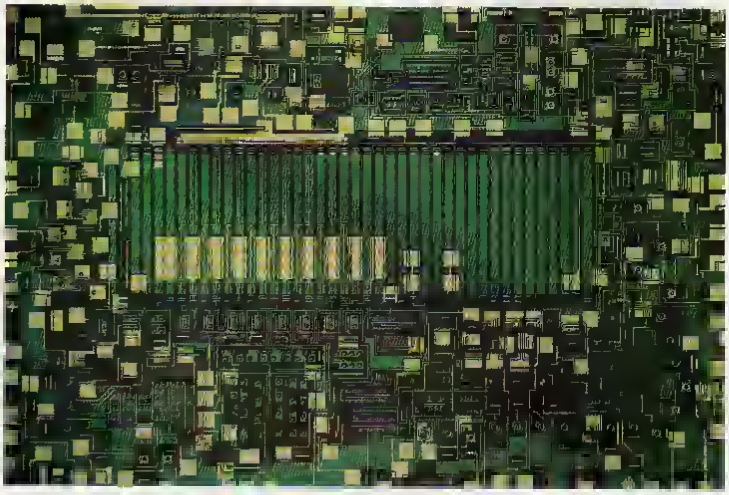
Most chips fall into two categories: memory and random-logic function. Memory chips, like the popular 16K RAM—the meat-and-potatoes chip—follow a more structured gridwork. Microprocessors—the "computer on a chip"—combine memory and random logic and are the most exciting.

About 15 American companies make one chip or another in their own peculiar style. Like Oriental-rug dealers who can classify their carpets' intricate designs into regional styles, someone with a fine eye who's been around chips can tell by style whether a chip is a product of Texas Instruments, Data Control, or Precision Monolithic.

If microchips are art, and silicon is the canvas, then Franz Ucko makes the paintbrush. "I am a microlithographic specialist," says Ucko, who works for Data Control. "My part in this technology is like that of the blacksmith who made tools a few hundred years ago."

When an artist selects a paintbrush, he chooses from a range of thicknesses and textures. In chip art he chooses what's called optical resolution. In numerous instances Ucko's paintbrush is a camera or an electron microscope. "You can call a microscope a camera," he explains, "because the optics of a microscope can really be compared to those of a camera."

Ucko has been working in microlithography since 1950. He collaborated on the color TV aperture mask in the early



AMD Inc.'s Am6012, the first 12-bit digital/analog converter, is photographed as a work of art.

1950s and helped make the first masks for William Shockley s prototype transistors before moving to Dafa Control

"I see integrated circuits as art because it's really a manifestation of physics" he comments "What we see is retractive images from very thin films When we re talking about thin films we re talking in angstroms A thousand angstroms is one tenth of a micron, and a micron is a quarter the thickness of a human hair We're dealing with a microcosmos

'Art is what you see and how you react to it,' he continues ' Our senses react to colors, especially brilliant colors, and this is what we see when we look at an Integrated circuit through a microscope We see colors and they re gorgeous Unfortunately before they package a chip they put glass over it to protect it They roll down the curtain on light reflection and there go most of the colors leaving an overall bluish gray You have either to look at this chip before the glass goes on or to strip the glass off "

Is there a Picasso of microchip art? Ucko says he doesn't like Picasso "This chip is much more ordered than Picasso ever was in his life At different times there are different designers Now it s getting so that you don t hear about them, for fear that someone might hire them away"

In 20 or 30 years Ucko believes people will collect today s chips, if not as art then as cultural artifacts the way people collect yesterday s baseball cards Fiesta Ware and Mickey Mouse ears "If somebody started this now,' the microlithographer speculates, 'he could probably do quite well. I know we re going to become more and more sophisticated, and at some point today s chips might be of real value The people who have no idea what s involved and look only at the outside of it will appreciate it most"

One of those outsiders is David Jones a short-order cook in Sag Harbor New York He s been collecting chips for ten years on the basis of availability importance and aesthetic value The chips he is most proud of are the Intel 4004, the first "computer on a chip," the Signetics NE 555 Memory 2101 (256 × 4 static RAM) an early Z-8000 microcomputer (complete with bug), and the Fairchild 709—the granddaddy of them all— the first commonly available integrated circuit "The 709 op amp was around before they called them chips" Jones says "They re basically obsolete although many of the ones available are patterned after it

Jones keeps his collection in a Sears Roebuck steel-and-plastic hardware cabinet Since most of the MOS chips were particularly susceptible to damage from static electricity, he keeps his embedded in conductive plastic foam

Jones warns the would-be collector that not all chips will be equally valuable as art in the future The Z-8000, the "Famous Amos" of chips for instance may be valuable for its technical innovations but as a work of art, it could be an aesthetic dud

Sometimes," he adds, 'the packaging is more interesting than the chip itself " He cites the Litronix DL 1416 as an example and also the Hewlett Packard HDSP 6508 which resembles an Arshile Gorky inspired silver spider web set in jet-black plastic with a silver spider magnified in a plastic bubble in the center

Jones estimates that his collection for which he paid in the neighborhood of $200 retail is now worth $50 or less There s no industry that s better at cutting costs than the microchip trade Jones however expects his collection will be worth $20,000 in 20 years

' We don't have a market for this sort of thing yet' says John J Carr director of prestigious Sotheby Parke Bernet s business systems department 'The inherent designs in semiconductors are becoming less desirable aesthetically as more is crammed into the silicon and as the networks become more complicated and the chips get thicker' Carr remarks that he himself owns lamps made of computer print rolls that are "enormously attractive and earn all sorts of compliments" Sotheby will auction a functioning computer but not one that you can hang on your wall

Ivan Karp will sell computers as art, however A few years ago artists were bringing in microcircuitry pieces collages, and constructions that use electronic devices "he says "Computer chips crop up occasionally Often they're exhibited just as they are in a compositional arrangement I absolutely see them as art They have aesthetic characteristics built into them already"

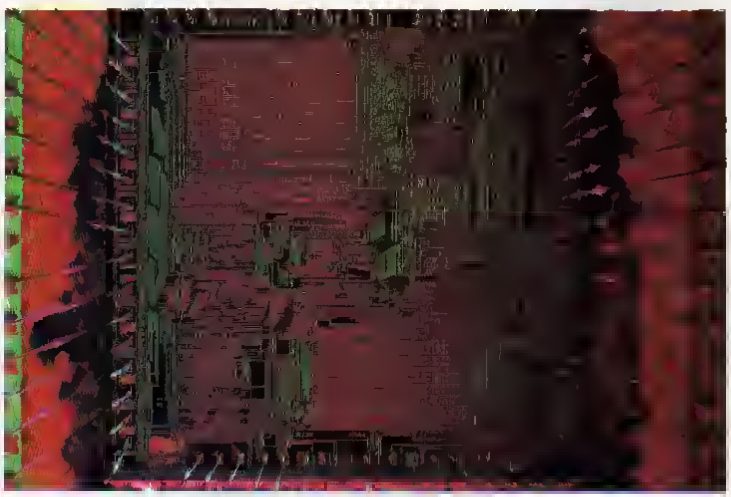
Karp, who runs the O K Harris gallery in New York City's Soho, has sold a few art chips but he doesn t recall to whom or for how much Something micro-size might go for $200 or $250

Instead of an original, says Frank Saude people may prefer a photo of the chip at a greatly reduced price Saude owns Melgar Photographers in Santa Clara The company was founded shortly after World War II by now-retired Frank Melgar who photographed the first planar transistor in 1959 Now his firm is the leading chip photographer for the semiconductor industry Most of Melgar s business is standard chip or wafer shots but lately customers have been asking for pictures with a little zip in them

"In fact," Saude says "we do one or two a week when the customer wants something artistic something that can be used for decorative purposes The majority are gray and other subtle colors You'll have a couple of layers of blue, pink salmon and green, but nothing really vivid When we punch the colors into them he adds 'they'll scream at you from all the way across the room '

Not all of Saude s customers are art lovers Some are forgers who use the photos to construct their own chips Many customers are paranoid and most of Melgar s transactions are kept in locked files Saude tells the story of one engineer who refused to allow his wafer to leave his sight even after it was photographed His weary customer took the wafer along with him to lunch, then accidentally left it on the table and it was cleared away with the dirty dishes

"A lot of designers and engineers put their initials on the chips" Saude says "One guy wrote his last name on his, but I can't tell you who I'd say the designers take pride in their work, but they don't do it as an art It comes down to how much they can squeeze into a small area I've never heard a single engineer say he was an artist, but many of them will put their initials there one place or another just as an artist signs his work '



A shot with a little zip in it" ITT 1240 microchip is photographically enhanced by Melgar studios

THE ARTS

By Jeff Rovin

It has been all of a decade since Sean Connery retired from the phenomenally successful James Bond series forsaking a fee in excess of $1 million per picture to play more diversified roles "I wanted to do films that were tougher and more exploratory both as art and as drama the actor explains I was looking for a fresh creative challenge even though I knew there might be less of a market for these films"

No one familiar with the work of the Scottish-born actor doubted that he had the ability Connery had already distinguished himself on the London stage and in BBC productions of *Requiem for a Heavyweight* and *Anna Christie* before and during his six-picture tenure as Bond he'd starred in such superb theatrical films as *The Hill* and *The Molly Maguires* Most of these efforts were lost in the luster of the 007 adventures Unfortunately even after Connery left Bond behind none of the actor's films—including the exceptional *Robin and Marian* and *The Man Who Would Be King*—came close to matching the success of the spy outings

Connery makes no secret of the frustration this impasse has caused him even while he pragmatically discusses the realities of filmmaking "Consider what the Bond films offer audiences exciting subjects exotic scenery attractive women and a likable hero He shrugs It sounds simple like baking a cake But whatever the merits and limitations of those ingredients they meshed to create an elusive screen chemistry Duplicating that kind of appeal is as much a question of good fortune and timing as it is skill Maybe the luck more than the other two

With the release of his latest film the science-fiction epic *Outland* Connery senses a break in the post-Bondian doldrums All we need is that bit of luck" he quips "*Outland* has a good dramatic story whose elements have already been proved in *High Noon* Using the best possible crew we set the story against a truly different environment and made what is virtually a space Western The guns we use look like sawed-off rifles and the men have beards The film even has the look and feel of a frontier rugged and sparse which is what director Peter Hyams specifically wanted to achieve"

True to its source *Outland* features Connery as Federal District Marshal William T O'Niel Upon arriving at Con-Am 27, a mining colony on Jupiter's volcanic moon Io the lawman finds it overrun with drugs and corruption His job to clean up the town despite the impediment of the colony's debauched General Manager Sheppard (Peter Boyle) and paid assassins who are arriving on the next shuttle

Connery is no stranger to the science-fiction and fantasy firmament having made films like *Zardoz* and *Meteor* in addition to the Bond movies However he is by no one's definition a science-fiction buff "I pretty much tend to ignore boundaries in film and literature What interests me is drama per se and the buttons that presses If the dramatic medium is science fiction fine as long as I can relate to the character I didn't find *Star Wars* exciting and couldn't understand what all the cheering was about Peter Hyams was knocked out by it not because he's mentally retarded but because he was brought up on that kind of comics thing I'm more interested in the quality of the writing than in how the subject's going to look on the screen"

Connery concedes that even with a good script he has trouble identifying with stories set in the future or in technological surroundings He succinctly defines science as a shorthand that I'm more comfortable with in longhand "and he adds that he is particularly ill at ease with computers When I made *Meteor* this wasn't a problem because we weren't dealing with machines but with a plausible hypothesis I read a report from MIT that said our world *could* be hit by something from space and I thought Christ for once I can see what they're getting at" *Zardoz* was also computer free though I had to work a bit to get through the science I played a primitive man placed in a futuristic situation where he is assaulted by new ideas I met a fellow recently who has seen the film thirty times and he knows all the lines When *he* says them they certainly sound more profound

Sean Connery as a lawman on Io In a classic confrontation with greed can he measure up?

than when I was dealing with them. Like my character Zed in the film, I was intrigued but didn't really have a grasp of that twenty-third-century mythology, certainly not the way some of the devotees of *Zardoz* seem to."

Consequently, the actor confesses that of all his science-fiction films he had the greatest difficulty easing into the milieu of *Outland*. The mines of Io are kept under surveillance by a complex video-camera/computer system, which Marshal O'Niel is forced to consult. Utilizing equipment like that will be second nature to a person of the near future, which obviously I am not. But I had to work with the computers just the same, so I reminded myself that they're only as good as the information fed to them. It still comes down to people, which made the hardware less intimidating. As long as I can see a human hand in something, there's no problem."

Given that *Outland* is fundamentally a planetbound space opera, it spends more time with O'Niel than with the computers and spaceships and scrapes around inside the lawman's head to break the mold of the stereotypical good guy.

"O'Niel's a decent man," Connery says, "but he has a big mouth, which has gotten him into trouble before. Now he's in a classic confrontation with greed, and he hopes he can measure up. The picture also says something important about what people have to do if civilization is to survive. Very few things fall at once. I don't care whether it's a society or an individual, decay is a slow process, and it's caused by people. Sometimes they may not even *know* they're causing it, which is really tragic. Little discourtesies that cause a chain reaction—someone cuts you off on the road, and when you get home, you yell at your kids. Someone in the press misrepresents you, so you're wary about doing a lot of interviews. It's a slow and relentless process that we have to reverse somehow. That's a theme in our picture. Hyams hit the nail on the head when he said, 'The problem with these guys is they're all too busy looking over their shoulders to look ahead.' That's a basic but far from shallow theme. And although it creates a situation of violence, it's not bam-wham comic books."

Though *Outland* lavishes more attention on characterization than most films of this type, much of its popular appeal will still derive from being a physically impressive piece of moviemaking. Jupiter hangs large and constant over the surface of Io, diminishing the spires and struts of the external sections of the colony. Yet the scale does not so much beggar the settlement as it does the space-suited figures that crawl through it. Seldom has a human being been shown to be as frail and diminutive a part of the cosmos as in *Outland*.

The motion picture also has a very distinctive design, grainy and ominous yet at the same time ethereal. "It's a fascinating look," Connery agrees, "one that's not been seen around. A lot of interesting effects were achieved with pink and blue gels and with fluorescent lighting."

The movie also boasts the very latest in special-effects techniques, a newly perfected process known as Introvision. Developed over a seven-year period by former television executive John Eppolito, Introvision composites actors with photographs and miniature models right in the camera. This eliminates the need to meld these images through costly laboratory methods or to construct life-size sets. For example, Introvision enabled Hyams to build the surface of the mining colony on the relatively inexpensive scale of 1:200, although his characters move through it as freely as if it were a full-size set. As a result, the $12 million film looks as if it cost many times more than that.

Connery gives inordinately high marks to Introvision, hailing it not only as a technical innovation but as a means of making the visuals serve the film rather than dominate it. "They've made enormous strides since I came to this business thirty years ago. [Connery will be fifty-one this year.] When I did *Darby O'Gill and the Little People* for Walt Disney, the effects that his people achieved were all quite clever. One thing I have learned—from Disney and from the Bond films, which was reinforced on *Outland*—is that special-effects people usually are remarkably intense. They do their work under extraordinary pressure. Let's face it, you sometimes don't know if a trick is going to work until you've tried it—if they mess up an explosion or a scene involving weightlessness, someone can be killed. Yet, as much as I've come to respect the breed as a whole, I have to admit that the *results* in *Outland* are the finest I've seen. Introvision is seamless and helps us to achieve a sense of space, not just *outer* space, but dimension. What's more, it doesn't distract you. You take for granted that what you're seeing actually exists."

> *Jupiter hangs large over the surface of Io, diminishing the spires and struts of the colony. Seldom has a human seemed as frail and diminutive a part of the cosmos as in* Outland.

While Connery is actively involved with maintaining the quality of the movies in which he appears, like an increasing number of his fellow actors, he is drawn more and more from the daily problems of filmmaking to looking after the very future of his profession.

"I admire a filmmaker like Hyams, who will keep his budget down by utilizing an untried quantity such as Introvision. We need more people who are willing to experiment like that. For example, a lot of actors, myself included, have pushed for all manners of change in films, like taking cuts in salary in return for a piece of the profits. It's a thankless effort. When a film is a success, actors who have gambled like this are obliged to take auditors in and fight court cases for money they should be entitled to without question. It's a joke, and the future of the movie industry will depend upon management's accepting equal responsibilities."

Clearly Connery brings conviction to everything he does, whether it's making a movie, looking out for the future of filmmaking, or founding an educational charity—which is what he did with the salary he earned from his last Bond film, *Diamonds Are Forever*. As for his own future, it is no surprise to find him devoted to several new projects, though one in particular is rather startling. "It's an espionage thriller called *Warhead*. I wrote the screenplay with Len Deighton, something that started out as an exercise, which I did out of curiosity. I wanted to write myself a part I knew I would enjoy."

What's extraordinary about *Warhead* is that it's the vehicle for a new James Bond adventure.

"I talked to my wife about it, and I decided that after ten years it would be interesting to go back and star in one more Bond film, get some of the texture of that ten-year gap. What specific changes would Connery make in his portrayal? "I did a bit of it in *Diamonds Are Forever*. *Warhead* would go back to the more anonymous, professional spy whom Ian Fleming created in 1952 and see where he would really be thirty years later. He's obviously not going to be as agile and active and spectacular, and would probably have to resort to cerebral instead of physical ways of dealing with things. Playing Bond like that would be a challenge for me."

At the moment Connery's return to the role is tied up in legal red tape with James Bond's current producers. Connery is discouraged, though he is not apt to brood. "This industry stumbles from one crisis to another; this is just one more. You can't be deluded into thinking that the business of creating screen fantasy is anything like a fantasy in real life. That kind of self-deception has never been my scene." Connery snickers, and there's a glimmer of the no-nonsense Marshal O'Niel. "People are going to try to push you around. You can't let them. And what you *must* believe is that as you survive, so will the industry."

THE ARTS

By Arthur Byron Cover

In this era of high inflation, exorbitant rents, and usurious taxes, the privately owned bookstore is at the mercy of a runaway economy. Add to this the competition of large bookstore chains owned by faceless conglomerates, stocked with manufactured best sellers, and staffed by automatons in need of programming, and it's a wonder that small specialty shops survive.

Theoretically, the proprietor of a science-fiction/fantasy bookshop should prepare his bankruptcy papers on opening day. Yet all over the world SF bookshops are not only surviving, they're thriving.

While most mainstream-fiction sales today are sluggish, SF store owners are scrambling to keep up with demand. They can't get popular titles in fast enough, and the turnover is fantastic. The SF Bookstore, in Edinburgh, Scotland, stocks more than 7,000 books on its premises, and Space Age Books, in Melbourne, Australia, shelves 25,000. Sherry Gottlieb, owner of A Change of Hobbit, inventories some 50,000 paperbacks to keep satiating SF appetites in Santa Monica, California.

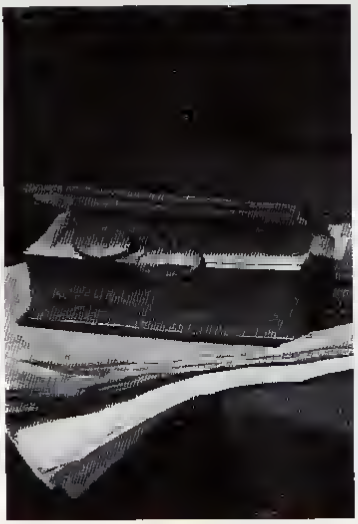
"We're *always* busy," says Martin Last, of the Science Fiction Shop, in New York.

But it takes more than avid reader interest to make an SF bookshop a going concern. Good management and good luck are also prerequisites for SF bookstore survival. One fact of life that owners and managers must cope with is the publisher's impatient credit department and rising freight costs. "We are currently being adversely affected by the rash of cheap remainder shops opening around Melbourne," says Mervyn R. Binns, of Space Age Books. "The publishers responsible for overproducing and providing stock for these shops are helping to kill the trade." The escalating cost of doing business, combined with the high-power marketing methods of paperback supermarkets, makes for a bearish business climate.

The connection between the flagging economy and the sudden, meteoric popularity of science fiction and fantasy seems clear. "As our advertising states," says Derek Stokes, owner of the London-based Dark They Were and Golden-Eyed, the first SF bookshop, now ten years old and still the largest. "We sell dreams, an escape from reality and from the depressing everyday life in this blighted isle." And colleagues across the ocean concur. "We're selling escapist literature around here," says Michelle Osborne, of Fantasy, Etc., in San Francisco. "No excuses. No apologies."

SF readers are a hard bunch to classify by occupation or age group. They are, however, a remarkably loyal and intrepid readership, famous for their close-knit fraternity and the lengths to which they'll go to scratch the SF itch. "In order to spend as much as they can on books," Stokes reports, "my clientele often go without the necessities."

What kind of person would rather skip a meal than go without the next Larry Niven or the new Harlan Ellison? Stan Nicholls, of London's Forbidden Planet, says that there is no real common factor. "My clientele are incredibly diverse," he says. "They include doctors, secretaries, garbagemen, and a rear admiral."



Gian Paolo Cossato, of Solaris, one of seven SF bookstores in Italy, says that people just walked in off the streets of Venice. "They became curious when they saw all those strange books in my window," he says.

But it is the students and college graduates who compose the core of SF readership. "It is not my nature to boast," says Philip Grossfield, of Moonstone Bookcellars in Washington, D.C., "but we have the finest and most educated clientele in the business."

Feeling the way that store owners do about their customers, it is not surprising that most of them staff their stores with people who are themselves science-fiction aficionados and participants in the strong SF subculture.

"We're a clearinghouse for publishing and convention information, as well as rumor control," Ms. Gottlieb says. "Sometimes we're a message drop. Publishers ask us about trends. We're also consulted by the film industry, though it seems they rarely pay attention."

While no one gets into the SF bookstore business to strike it rich, brisk business does translate into big bucks. Bakka Bookstore, in Toronto, for example, grossed nearly $150,000 last year. But bookstore owners seem to be motivated by loftier ideals.

Grossfield, of the successful Moonstone Bookcellars, opened his store after the company he worked for went bankrupt, leaving him without a pension. For Grossfield the business is strictly pleasure. "It's like going to the symphony every day of the week."

Some bookstore owners define their role in broader terms. Tom Whitmore, of The Other Change of Hobbit, in Berkeley, California, says his staff feels a social responsibility "to steer people toward good books and away from the clinkers."

Science fiction has meant a lot to me in my life," says Charlie Cockey, owner of Fantasy, Etc. "It's made me think about things I might not otherwise have considered. As much as any individual influences or reflects society, I'm sure these bookstores have an effect."

EXPLORATIONS

By Hal Hellman

More than 100 million people have visited Walt Disney World since it opened ten years ago in Orlando, Florida. The Disney people maintain it is the leading resort in the world today, outdrawing the United Kingdom and Germany combined. Its 43 square miles, about the size of San Francisco, includes a Magic Kingdom theme park, resort hotels, golf courses, campgrounds, a man-made 200-acre lake for recreational purposes, and an island with trails winding through a jungle chock-full of colorful tropical birds.

Of course, Disney World is not exactly everyone's idea of paradise. Some object to its "plastic" nature; others complain that it has gobbled up a bit of our increasingly scarce wilderness. Nevertheless, one advantage of the great size and economic strength of the complex—now a $700-million-plus investment and still growing fast—is that the Disney World people can afford to experiment. And, more credit to them, they do.

To an amazing extent, Disney World has become an important research center, especially in the field of applied science. It has an unrivaled record as a pioneer of new technologies for entertaining, feeding, housing, and transporting large numbers of people. Experience gained from such experimentation has already yielded valuable lessons in city planning. In many respects Disney World is emerging as an excellent model for future communities.

In the Magic Kingdom, visitors may pause to wonder why they never encounter such disturbing reminders of the outside world as garbage collection, the delivery of merchandise, or even Mickey Mice on coffee break. Yet crowds of up to 85,000 daily tromp through the park grounds. The secret is an intricate and expansive maze of tunnels and rooms that run underneath all those visitors' feet. This underground world has warehouses and refrigeration facilities along with lounges and wardrobe and dressing areas for the 12,000 to 15,000 park employees on hand each day.

All the park attractions—from rides to shops and restaurants—are connected by staircases or elevators to these cool subterranean tunnels. Electric vehicles deliver food and merchandise through them, while a 60 mph vacuum system whisks away all trash neatly and cleanly to the outskirts of the park. Imagine the impact such innovative features might have on the traffic-jammed, litter-strewn streets of our major urban centers.

As might be expected, computers coordinate a broad variety of Disney World operations. They, too, are housed below and play a key role in reducing energy consumption, automatically shutting facilities off that are not needed.

Their most creative application, however, is in the Disney *Audio-Animatronic* system. Here they are teamed up with Space Age electronics to synchronize voice and sound effects with the movement of three-dimensional animated people and cartoon characters. Disney "Imagineering" has brought together dozens of singing, chanting, and whistling tiki birds in *Tropical Serenade*, and permits amazingly lifelike replicas of our forefathers to move and speak in the *Hall of Presidents*. If these shows were performed by people dressed in costumes they would be prohibitively expensive. But beyond their economic appeal, who can resist *Fantasia* in real life?

Charlie Ridgway, a Disney spokesman, claims the park is unique. "There are amusement parks, there are theme parks, and there is Walt Disney World." I have to agree. It is hard not to be impressed by Disney World, even awed.

During the four-and-a-half years of initial construction, Disney World was easily the largest private building project in the United States, perhaps in the world. As many as 9,000 workers swarmed about at any given time. Most of the area was swampland, with difficult drainage problems. The solution led to one of the most extensive and most sophisticated schemes for water reclamation in the country. Still not complete, it will eventually include 55 miles of winding canals. ("Winding canals are prettier than straight ones," Ridgway says) and 22 automatic float gates designed to help maintain the

CONTINUED ON PAGE 126

Innovative design. Disney World's monorail glides into the resort hotel's main lobby.

UFO UPDATE

By Daniel Cohen

As the weird light passed overhead, Robert Lowen of Evanston, Illinois, trained his field glasses on it. He was able to discern four lights a short distance apart and moving in unison. The first was a bright white light and appeared to be operated like a searchlight. Behind it was a green light, [which] appeared to be operated like a searchlight. Behind [that] was a green light, and farther to the rear were green and white lights set closely together."

Is this a quotation from a recent UFO report? No, it isn't. It is an excerpt from an article that appeared in the Chicago *Times Herald* of April 10, 1897, describing the passage of a "mysterious airship" over the small city just north of Chicago, on Lake Michigan. It is just one of many thousands of "mysterious airship" reports that were made between mid-November of 1896 and the end of April 1897. The "airship" was sighted at various points from California to Indiana, from Canada to Texas. Among the witnesses were trainmen and ranchers, governors and cigar-store owners, police and firemen.

Most witnesses reported seeing a light in the night sky or, as in the case of Lowen, several lights of unknown origin moving across the sky. Others said they could see the large object to which the lights were attached. According to the Quincy, Illinois, *Whig*, "Men who saw the thing describe it as a long, slender body shaped like a cigar and made of some bright metal, perhaps aluminum, on which the moonlight glistened. On either side of the hull, extending outwards and upwards, [were] what appeared to be wings, and above the hull could be seen the misty outlines of some sort of superstructure."

This is only one of many accounts, and virtually everyone questioned seemed certain the object was an airship.

Other, more sensational tales began to surface. There were accounts of secret meetings with the unknown inventor and his crew, of rides aboard the airship, and even of a couple of abductions. A Joseph Joslin, of St. Louis, maintained that he had been hypnotized, taken aboard the airship, and held captive for two weeks. He could not recall exactly what had happened to him during those "missing weeks," nor remember how he had been returned to Earth. Joslin's story was recounted in the April 23 edition of the St. Louis *Globe-Democrat*. There were even a few suggestions that the airship might not have been built on this planet, but the majority of these reports surmised that the cause of the excitement was an airship made somewhere in the United States.

What makes these accounts so interesting is that they all appeared a full seven years before the Wright brothers' Kitty Hawk flight and well before a practical dirigible was flown anywhere in the world, as far as we know. While there had been a considerable amount of experimentation with various forms of flight at the end of the nineteenth century, no one had yet developed a workable aircraft for air travel. As far as the history of aeronautics is concerned, there was no airship in America in 1896 or 1897, and there could not have been one.

But you couldn't tell that to the people of Sacramento or Sioux City or Omaha or Chicago, where they turned out in the thousands to see the famous airship pass overhead. For six months the airship sightings generated intense excitement. "People talk of nothing else," said one newspaper. Stories about the airship appeared in virtually every newspaper in this country and it had become news in Europe as well.

Then, around the end of April 1897, sightings, or at least newspaper coverage of sightings, declined sharply. Within six weeks just about nothing was to be found concerning the mysterious airship in any American paper. What everybody was talking about became quite suddenly something that no one would discuss. The entire airship excitement cooled off as if nothing had happened at all.

From time to time a newspaperman rummaging through the files for a colorful item from "the good old days" might run across one of the original airship stories, but it would be treated as an isolated event. The May 11, 1952, edition of the Oakland, California, *Tribune* gave the details of an airship story and then

CONTINUED ON PAGE 136

Dirigibles of this type were seen in the United States years before a prototype existed

CONTINUUM

Edited by Dick Teresi

BURY THEM IN QUARKS!

More than ten years ago I visited the Soviet Union with a group of Americans under the auspices of the Citizen Exchange Corporation. During our stay in Kharkov, we spent a day at a collective farm. All day long Americans and Russians traded boasts and barbs about the merits of our respective political and economic systems—sometimes good-naturedly, sometimes not. That evening we all gathered in the small hotel lobby and watched on television as two U.S. astronauts walked on the moon.

There was no further talk about who was Number One.

Today we are again engaged in a competition with the USSR—a contest to see who can build more and better bombs. Anyone who has seen the devastation of even a small nuclear blast knows that it's no exaggeration to say that we have the power to blow Earth to smithereens several times over. One thermonuclear bomb can vaporize a good-sized city and all its inhabitants save cockroaches. We already have about 9,000 big ones aimed at the USSR, and the Russians have at least 7,000 aimed at us.

There must be more productive ways to compete. I was in elementary school when the Russians sent up *Sputnik*, and it did wonders for the quality of my science education. But now instead of shoring up science education in response to Soviet advances, the new administration is massacring what few efforts we have, including such popular National Science Foundation-supported television programs as *Nova* and *3, 2, 1, Contact*.

How are American kids supposed to clobber kids in the USSR with good old American know-how if they don't know how?

If detente is dead, I'm all for showing the Russians who's boss. But we don't have to destroy our civilization in the process. Better we should beat them at what used to be our own best game. If we could put the first man on the moon, we can put the first woman into orbit around Mars. If we could be the first in fission, we can be the first in fusion. If we can invent odor-eaters for smelly feet, surely we can invent cancer-eaters that destroy tumors.

When Nikita Khrushchev said, "We will bury you," he meant with refrigerators and other accouterments of a consumer paradise, not with bombs. Similarly, we can bury the Russians in invention and free enterprise. Imagine the kudos that will go to the country that comes up with an answer to pollution, the power that will go to the first to clone spare hearts, the profits that will go to the first to colonize space. We can be the first to see the edge of the universe, the first to find the sixth quark.

Of course, it's been a long time since the phrase "If we could send a man to the moon" has been followed by "We can do anything." These days it's more likely to precede "Why can't we seem to do anything?" But that's at least in part because we haven't tried as hard in other areas as we did to build the bomb or to reach the moon. The cost of the U.S. high-energy physics program, for example, is hardly chicken feed. In fact, it's less than chicken feed. As Stanford Linear Accelerator director Wolfgang Panofsky pointed out, "The cost of chicken feed in the United States is about ten times that amount." Will finding the sixth quark bolster our defenses against the Russians? Well, you never know about the fruits of pure science. Anybody who thought that anything of practical use would come out of nuclear fission was "talking moonshine," as Ernest Rutherford said.

Curiously, there's a lot of cooperation going on these days between us and our rivals in the exploration of both inner and outer space. The Russians are coming to use the Stanford Linear Accelerator. The Chinese are already there. Russian physicists at Caltech are helping us search for gravity waves. "If there's anything that's useless from a military applications standpoint," says Caltech President Marvin Goldberger, "that's it."

Of course, that's precisely the reason why the cooperation is able to go on. But there's another reason why it *must* go on. Certain kinds of science are getting too expensive for any one country to finance alone. The next giant steps in particle accelerators or space telescopes or fusion reactions must be international. Indeed, Enrico Fermi once proposed that the ultimate atom smasher would be a ring of magnets orbiting the earth at the equator. Panofsky recently figured out what it would cost to build it: the combined U.S. and Soviet defense budgets for just two years. U.S.-Soviet scientific cooperation also helps defuse the tensions that cause us to aim our bombs at each other in the first place. ("If it wasn't for last year," Panofsky says, "I'd say it was a little like the Olympics.")

But even if we can't cooperate, we should first stop and think what's in it for us before we start giving the Russians what for. Instead of trying to outnuke them, perhaps we should be trying to outsmart them. —*K. C. COLE*

CONTINUUM

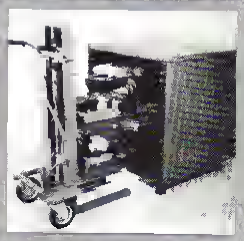
COGENERATION

Around 1900, generating one's own electricity was common. It not only powered lights, but the turbine's waste heat warmed rooms or ran industrial processes. This cogeneration was quite efficient. Two thirds of the fuel's energy was used. But the advent of utility companies meant cheaper power, by 1973, less than 10 percent of industry cogenerated.

Now this is changing. For one thing, U.S. utility plants are only half as efficient as cogenerators. The waste heat is spewed into water or into the air. To encourage more efficient use, federal incentives are now provided. Moreover, many firms buying electricity and heat separately have bristled as prices have risen. Apartment managers pay up to half their operating budgets for energy, compared with 10 percent ten years ago. More and more, they are forsaking local utilities. Ironically, utilities in Europe and in the Soviet Union have cogenerated for years.

The consulting firm of A. D. Little, in Boston, Massachusetts, says cogeneration could save more energy than the United States imports from the Mideast. A Vermont ski area spent $50,000 for its own system and cut its power bills by $35,000 a year. Starrett City, in New York City, provides power cheaply for 20,000 people in 46 apartment buildings. Fiat sells a $10,000 unit that can provide all the heat and electricity for four apartment units.

Cogenerators can run on oil, natural gas, alcohol, or gases produced from wastes. The most vocal opponent of cogenerators is



The Fiat cogenerating unit.

Consolidated Edison, the New York utility which stands to lose substantial business. But other utilities, such as the Tennessee Valley Authority and Pacific Gas & Electric, favor cogenerators and even want to buy their excess electricity. They believe it's a way to gain new generating capacity without paying the equipment costs. — Stuart Diamond

SOUL GUN

Believers in the paranormal have suggested that a weird device called the Kirlian gun can reveal evidence of the human soul. Now British doctors are using the machine experimentally for a more realistic purpose: to detect early signs of disease or injury, including heart disease and cancer.

Typical is a demonstration at London's Charing Cross Hospital. A medical researcher fires a high-energy, high-frequency beam of radio signals into the heart of a middle-aged man. Instantly the heart responds with radio signals in harmonic resonance, which are picked up by the gun and displayed on an oscilloscope screen.

After the 60-second examination, biologist Harry Oldfield tells the patient, "You have a heart abnormality."

Even though this and other Kirlian devices defy orthodox scientific explanation, Great Britain is becoming a coordinating center and proving ground for research in a number of other countries.

Kirlian electrography, as the technique is known, is based on the discovery made in the 1950s by Russian electrical engineer Semyon Kirlian, who passed his hand through a high-energy, high-frequency electromagnetic field and discovered a strange fireworks display. An aura of light flowed around his hand.

First, high-energy Kirlian cameras were produced that could photograph these auras around people's fingers and toes and around other objects. Dr. Oldfield has produced a £140 (approximately $320) radio device that captures the phenomenon on screen.

Oldfield and general physician Dr. Peter Kandela have successfully photographed undiagnosed breast tumors in five women. They plan to mount a large clinical trial at the Royal Marsden Hospital, a leading London cancer center. Cancer tissues supposedly produce an 'explosion' of ultraviolet light in Kirlian pictures.

Doctors are also using the human aura to detect hidden ailments such as arthritis, appendicitis, colitis, cystic fibrosis, and ulcers with mixed success. At the Maudsley Hospital in London, Dr. Malcolm Carruthers says Kirlian fingerprints can diagnose underlying stress that may cause cardiovascular disease. There is an impressive amount of

Dr. Oldfield aims Kirlian gun at patient. Finding hidden ailments.

evidence that electrography can be used to detect hidden diseases ' says Dr Carruthers — Michael Jeffries

POLLUTION IN PARADISE

In Jamaica tons of garbage is dumped from cliffs into the clear blue sea below In Puerto Rico raw sewage pours into harbors, sometimes fouling the beaches In Guatemala human milk has the world s highest levels of DDT the result of uncontrolled pesticide spraying

The islands of the Caribbean Sea paradise of TV ads and goal of winter vacationers are increasingly becoming polluted by a burgeoning population and new industries against a background of virtually no ecological control Though many areas still sparkle pollution has become so evident in some places that the United Nations recently launched a multimillion-dollar clean-up effort to put a halt to the deterioration

'While we cannot say that the Caribbean is highly polluted the situation is becoming worse every year the number of hot spots is increasing yearly, says Stjepan Keckes head of a U N program to clean the Caribbean

He said that only strong action will prevent the region from losing tourists fishing grounds and natural beauty not to mention the very health of its residents Already he said tourists know it's wiser to avoid certain areas

An international study of 27 Caribbean nations found that nine tenths of the sewage from 30 million people is jettisoned untreated into the sea To clear beaches, developers have destroyed mangrove swamps, an erosion barrier and shrimp breeding ground Entrepreneurs fill trinket shops by chipping away at coral reefs where numerous fish species spawn Inadequate water treatment has caused typhoid outbreaks Aluminum processing has covered the sea bottom with red mud Multiplying oil refineries and supertankers raise the specter of huge oil spills

The Caribbean Sun romance, and samples of pollution water

Pilots too may get jet lag

At a meeting in Nicaragua this past February 23 Caribbean countries proposed an $8 2 million plan to control pollution It includes environmental education, land-use programs and disaster relief Keckes praised the agreement but he believes that a full clean up program will cost a lot more probably $150 million — Stuart Diamond

JET LAG

Have you ever wondered as you munched on your prefab veal cordon bleu en route to Tokyo or Paris whether your pilot might not be a bit weary? Now fortunately NASA is wondering about it too

Oddly the effects of jet lag (or Circadian desynchronosis as the Kurt Vonnegutesque term goes) have been studied in truckers, crewmen on ships and railroad workers but never rigorously in airline pilots

NASAs Ames Research Center at Moffett Field in California is rectifying this oversight with a four part jet-lag investigation

We ve suspected that some of the plane crashes that are due to pilot error might involve jet lag says Dr Alan Chambers chief of the Man-Vehicle Systems Research Division. You know a person with jet lag may fly just as well But one of the things you don t do as well is communicate with other people You start getting irritable

It may just be that a lot of communications problems—crew to flight controllers, ground controllers to pilot —are grounded in fatigue Their personalities are shot '

Travel into different time zones is known to disrupt one s Circadian rhythms the daily ebb and flow of hormones and neurochemicals that define mealtime wak ing, and sleeping periods Fatigue short-term memory loss and lapses of attention frequently result

As part of the NASA study, scientists will continually collect biological information, such as basal body temperature and mood reports from pilots over several day periods

— Judith Hooper

'You can predict things only after they ve happened '
— Eugene Ionesco

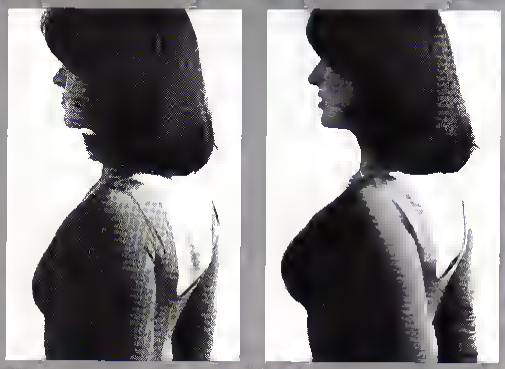
CONTINUUM

MAMMARY MADNESS

A study by a psychologist at Wheaton College in Norton Massachusetts shows that big breasted women are generally adjudged to be less competent less intelligent less moral and less modest than women with small busts This opinion was shared by both women and men polled by researchers

The study (for which we sincerely hope no large endowments were granted) included photographs of three naturally small breasted female models who were asked to stuff their busts as Dr Chris Kleinke, who headed the research project, put it, and then stuff them larger The photographs were shown to three groups each of which contained 50 male and 50 female respondents who were asked to rate the women on three aspects of personality based on first impressions

Breast size had no effect on personal appeal (subjects were asked to rate the models with a series of adjectives like 'warm cold "friendly and so on) nor did it have any effect on whether the respondents thought the models bold or dominant It was only in the third aspect of the test that the respondents concluded the best-endowed women to be immoral incompetents



When padded (right) subjects were judged to be less competent

—Ellen Bilgore

TEST-TUBE GINSENG

Ginseng Just the mention of the name conjures up hopes for a long healthy sexually satisfying life Because of the restorative and curative properties attributed to the root of this plant and because these roots take years to develop even when cultivated the demand for ginseng has far outstripped the supply

The worldwide ginseng shortage might yet be averted however as it now seems that this natural remedy can be artificially made

Botanists at the Institute of Plant Physiology of the Soviet Academy of Sciences have developed a method to mass-produce ginseng in a laboratory A few cells from the root of a living plant are introduced into a flask containing a nutrient medium The reproductive functions of these cells are stimulated in the same manner that scientists now use to grow tissue cultures In a short time they develop into a blob of undifferentiated plant material a biomass The biomass bears no resemblance to the root from which it was derived but its biochemistry is indistinguishable from natural ginseng Better yet these biomasses ripen in just one month and can be harvested all year

It's still not known whether artificial ginseng is as potent an elixir as the real thing science has never firmly established the medical benefits of the ginseng plant no matter how it's produced But the pharmaceutical industry in the USSR is already using the laboratory-grown version in the manufacture of creams and tonics, and no one s complaining

The ginseng shortage may be averted through a new process

—Nick Engler

X-RAY LASER

Physicists at the Lawrence Livermore Laboratory in California have finally achieved a long-sought goal building a laser that emits a beam of X rays

X rays are hundreds or even thousands of times more energetic than visible light so it takes much more energy to operate an x ray laser than to operate an ordinary laser In fact the Livermore physicists had to use a small nuclear bomb to produce the required energy The explosion that energizes the laser also destroys it Thus, it s strictly a one-shot device

For something like a billionth or a trillionth of a second the laser emits hundreds of trillions of watts So much power has set visions of weapons dancing in the heads at the Pentagon

The laser s authenticity is clouded by the fact it was first reported not in a scientific journal but in *Aviation Week and Space Technology* a trade magazine While it's clear the experiment did take place, Livermore s reaction was "No comment "

—Jeff Hecht

EIGHTH PLAGUE

Farmers and ranchers in the United States Africa, and Asia are again bracing for an invasion of locusts and grasshoppers, whose swarms can just about blot out the sun

In this country the insects—which belong to the same family—are expected to eat their way through millions of acres of prime cropland and rangeland destroying 20 percent of all rangeland forage alone worth $400 million Locusts have caused starvation in 50 countries, from Casablanca to Kathmandu

The modern blight can be traced to unfavorable weather and the banning of toxic pesticides The insects range from one to ten centimeters long, locusts are the largest They can eat their weight every day—seeds, flowers, fruit, even wood

We have pictures of them eating wooden fenceposts and pitchfork handles—anything with cellulose," says Homer Autry of the U S Agriculture Department One swarm that crossed the Red Sea in 1889 covered 5 000 square kilometers, blackening the sky A swarm in the Rocky Mountains in 1877 contained an estimated 124 billion insects Invading palm groves and cotton and wheat fields they devour every living plant in hours, leaving behind barren earth

A worldwide attack in 1952 sparked the use of pesticides such as chlordane, heptachlor and dieldrin But these substances were banned as cancer agents, and substitutes have not been nearly as effective Scientists are searching for grasshopper predators and parasites and for new pesticides they have even tried sprinkling fields with pesticide-coated bran flakes as bait " We need much further study" says John E Henry, of the Agriculture Department's Rangeland Insect Laboratory in Montana.—Stuart Diamond

Locusts In swarms they can block out the sun, devastate the land

COW MAGNETS

What's good for cows' digestion may also be good for gas mileage, according to a new fad The latest piece of gas-saving folklore says that if you attach two cow magnets to the gas line near your carburetor you will see your car mileage improve

What s a cow magnet? It's a small magnetic rod about two inches long and roughly a half inch in diameter Veterinarians or farmers will blow one of these into a cow's stomach through a flexible tube and leave it there Cows eat many things besides grass They ve been known to ingest all kinds of metal and even the barbs off barbed wire The magnet in the stomach holds the metal in one place and keeps it from passing through the cow s digestive tract

Agricultural supply stores in various parts of the country have been seeing a run on these magnets, and just recently the Edmund Scientific Company, the New Jersey-based scientific supply house has added cow magnets to its catalog They made the addition after people began calling the company during the fall of 1980 in search of the magnets according to Paula Domedion, of Edmund Scientific "I think the idea began in California " she notes

Magic mileage boosters? Probably not, but cow magnets sell well

How these magnets are supposed to work isn t clear Domedion says The company is not touting the magnets as a new way to improve gas mileage, it is selling the magnets only to answer a demand

When asked how long a magnet is left in a cow, one feed-store owner who sells the magnet answered, "Until it dies " So far there s no word on whether the same rule of thumb applies to a car —Douglas Colligan

"After all, it is only the mediocre who are always at their best "

—Jean Giraudoux

CONTINUUM

SURGICAL STAPLES

The timeworn method of sewing incisions shut with needle and thread is gradually being replaced by staple guns, which medical experts say are faster, safer, and usually cheaper.

Invented in 1908, the tiny steel staples did not begin to catch on until the mid-1960s when presterilized staple cartridges and lighter staple guns simplified the process. Since then their use has increased at least a hundredfold. In 1980 staples closed of a less experienced surgeon."

The staplers come in various sizes and shapes. Some resemble ray guns, others are cylindrical. Each staple is about one-thirtieth the size of its desk-top counterpart. It is shaped either like a rectangle or like a capital B. The space enclosed by the staple permits the flow of blood.

H. David Stein, a surgeon at Albert Einstein College of Medicine in New York City, says stapling an average incision takes half as much time as suturing. The amount to leave the hospital sooner. Such considerations more than offset the extra cost of the staples, she notes.

Dr. Stein says conventional suturing does hold tissues better in some acute infection cases. But staples could be used to advantage in far more operations. Why aren't they? 'Surgeons have been suturing for generations,' he replies.

—Stuart Diamond

Surgical staple gun. Quicker than sutures, and perhaps safer.

incisions in 1 million of the 20 million U.S. surgical operations, according to estimates made by United States Surgical Company, the largest domestic maker of these products.

A recent report in *Archives of Surgery* said stapled incisions cause fewer complications than conventional sutures do. Besides reducing operating time, it said, staples are safer in the hands of anesthetic needed is thus reduced, he said, and the infection rate is lowered, since internal organs are exposed for less time.

Marianne Scipione, of U.S. Surgical, says a surgeon suturing an incision might have to handle the tissues 60 times; with staples, the same incision is handled only once, lessening tissue damage. She also says patients with stapled incisions seem

"The release of atomic energy constitutes a new force too revolutionary to consider in the framework of old ideas."

—Harry S. Truman

BRAIN ANTENNAS

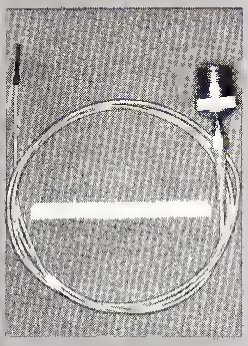
A tiny microwave antenna implanted deep in the brain may someday gain widespread acceptance as a therapeutic weapon against tumors.

Less than 1.5 millimeters in diameter, the implant has already proved safe and feasible in three patients with glioblastoma multiforme, a brain cancer.

In a pioneering operation, microwaves were beamed from bedside through a thin cable running into the scalp and connected to the antenna, inducing hyperthermia in an effort to kill tumor cells with intense heat.

Dr. Michael Salcman, an associate professor of neurological surgery at the University of Maryland, devised the new procedure with Dr. George M. Samaras, an engineer-physiologist at the Baltimore school.

Whether the operation will



Implanted end is at left.

bring about tumor remission remains uncertain at this stage. Theoretically," Dr. Salcman explains, "hyperthermia can reach eighty percent of the tumor—as much as surgery can."

Killing tumors with heat may have several advantages. It might lower dosage requirements in chemotherapy, increase tolerance of radiotherapy and, ultimately, replace radical surgery altogether. Eventually, because Salcman foresees "general applicability," surgeons could rig antennas at tumor sites virtually anywhere in the body.

For now, however, cancer specialists could use a combination of surgery, chemotherapy, radiotherapy and microwave hyperthermia.

Currently under development is a helmet with multiple antennas through which the lethal microwaves are blasted. With the helmet placed on the skull, this noninvasive technique might turn out to be the most promising method yet.

—Robert Brody

RUBBER-BAND CARS

Engineers at UCLA are working on a snappy way to save energy. They say equipping vehicles with giant rubber bands could recycle braking energy for acceleration.

"People think this is a strange idea," Dr. Andrew Charwat, director of the project, admits, "but it's the same principle as the spring that helps open and close a garage door. Basically what we're doing is attempting to store the energy now spent as heat during braking in a form that can be reused later to accelerate the vehicle.

"This is a very important problem, deserving more attention than it's being given. The amount of energy wasted through braking in urban driving is on the order of thirty percent of fuel burned. Mail and delivery trucks waste even more."

This wasted energy could be stored with rubber bands which Dr. Charwat says can store more energy per pound than springs. A device using the rubber bands would be a simple configuration, Charwat said, "with eighteen to twenty rubber bands stretched around a hydraulic piston. In braking the bands would stretch from an original eight inches to as much as 2.5 feet. The device could be a cylinder mounted along the axis underneath the car or in a retrofit situation mounted transversely in the trunk."

A hydraulic-pump motor mounted on the wheels would generate pressure during braking, and the reverse would happen when the energy was used to accelerate the vehicle.

Currently the engineers are studying various types of rubber for characteristics that such a system would require. Although the rubber bands being tested are not ordinary—they are an inch in width and eight inches in length—they do pose a common problem. "We're having some difficulty right now," Charwat said. "They break." —Allan Maurer

Mail trucks waste energy every time they brake. A UCLA researcher wants to store that energy with rubber bands to use for acceleration.

"Nuclear physics need be neither a hazardous nor a costly hobby."
—C. L. Strong, in The Scientific American Book of Projects for the Amateur Scientist

"Psychology lost first its soul, then its mind, and then its consciousness, but it still has behavior of a kind."
—E. G. Boring

BRAIN? WHO NEEDS IT?

You may regard your brain as your most precious possession, even perhaps the locus of your "self," your dreams, memories and smarts. Now a British neurologist is wondering whether you might do just as well without it.

This astonishing suggestion comes out of studies of many hydrocephalus victims who got A's or B's in school despite the fact that their brain scans revealed "virtually no brain."

Hydrocephalus, or water on the brain, is a congenital defect in which cerebrospinal fluid backs up inside the skull, crowding the brain tissue against the cranium. Often much of the cerebral cortex (the headquarters of all higher brain functions) is lost.

Neurologist John Lorber, at Sheffield University, in England, tells of one young woman hospital worker with an I.Q. of 120 but no detectable brain. And a university student with an I.Q. of 126 obtained an honors degree in mathematics, economics, and computer studies, despite the fact his cranium was filled entirely with spinal fluid.

How can this be? Lorber told the British magazine *World Medicine* that the cerebral cortex may be much less important than we have assumed. Perhaps the deeper, more primitive brain structures hold more sway over intelligence than was previously believed.

Or perhaps, since half the people with 95 percent of the brain replaced by fluid had higher-than-average I.Q.s, a tiny bit of gray matter is enough. —Judith Hooper

"Life is either a daring adventure or nothing."
—Helen Keller

"Which would you rather have, a bursting planet or an earthquake here and there?"
—John Joseph Lynch

Scan of hydrocephalic fetus

CONTINUUM

BREEDER PROBLEMS

The controversial Clinch River breeder reactor is in a state of disarray lacks direction and costs [taxpayers] hundreds of millions of dollars a year says the General Accounting Office (GAO) which monitors how public money is spent

The decade-old project in Oak Ridge Tennessee, designed to test a new reactor technology has cost $1 billion so far and construction hasn t even begun Then-President Jimmy Carter halted hearings on the needed permits in 1977 Congress has been allocating $15 million a month ever since to pay for design work, for equipment purchases and for the payroll

Carter s opposition—shared by many environmentalists—stemmed from the technology itself The reactor "breeds " or produces, plutonium fuel from ^{238}uranium, which comprises 99 3 percent of a natural uranium but which s unusable in U S reactors Only the rest ^{235}U s used and supplies of th s isotope are shrinking The breeder could extend fuel supplies for centuries But wh e ^{235}U is too low-grade for weapons without complex processing plutonium can be made directly into bombs by terrorists

The GAO says commercial-size U S breeders may be 40 years off and the economics are uncertain Clinch River s start-up cost has jumped from $700 million to $3 billion since 1972, far exceeding the price of conventional reactors

In any event the GAO says it is senseless to pour money into a project without focus But President Ronald Reagan who likes the breeder may provide the needed direction He will have to act soon though The project s funding expires this month —Stuart Diamond

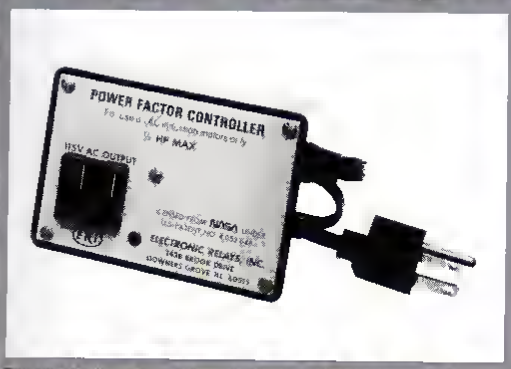
Proposed Clinch River breeder GAO wants to cut off the money

BETTER MOTORS

The billions of electric motors in the United States use two thirds of the nation s electric power much of it inefficiently Now NASA has devised a cheap, simple way to reduce a motor s energy use by as much as half for as little as $5

The device, called a Power Factor Controller (PFC), can be attached to refrigerators, washing machines, typewriters air conditioners, sewing machines swimming-pool pumps and a variety of industrial motors What it does is vary the electric current drawn by a motor, depending on the precise amount of power that the motor needs to perform its task efficiently

Most machines NASA indicates draw full power even when idling In such cases much of the power is wasted as heat For example, a washing machine needs its full power of 430 watts only when cleaning heavy loads It needs only 160 watts while it fills with water The PFC could greatly reduce the wattage saving energy and money Similarly, a department-store escalator requires much less power when carrying 2 persons than 20 but it draws the same amount of electricity in either case.



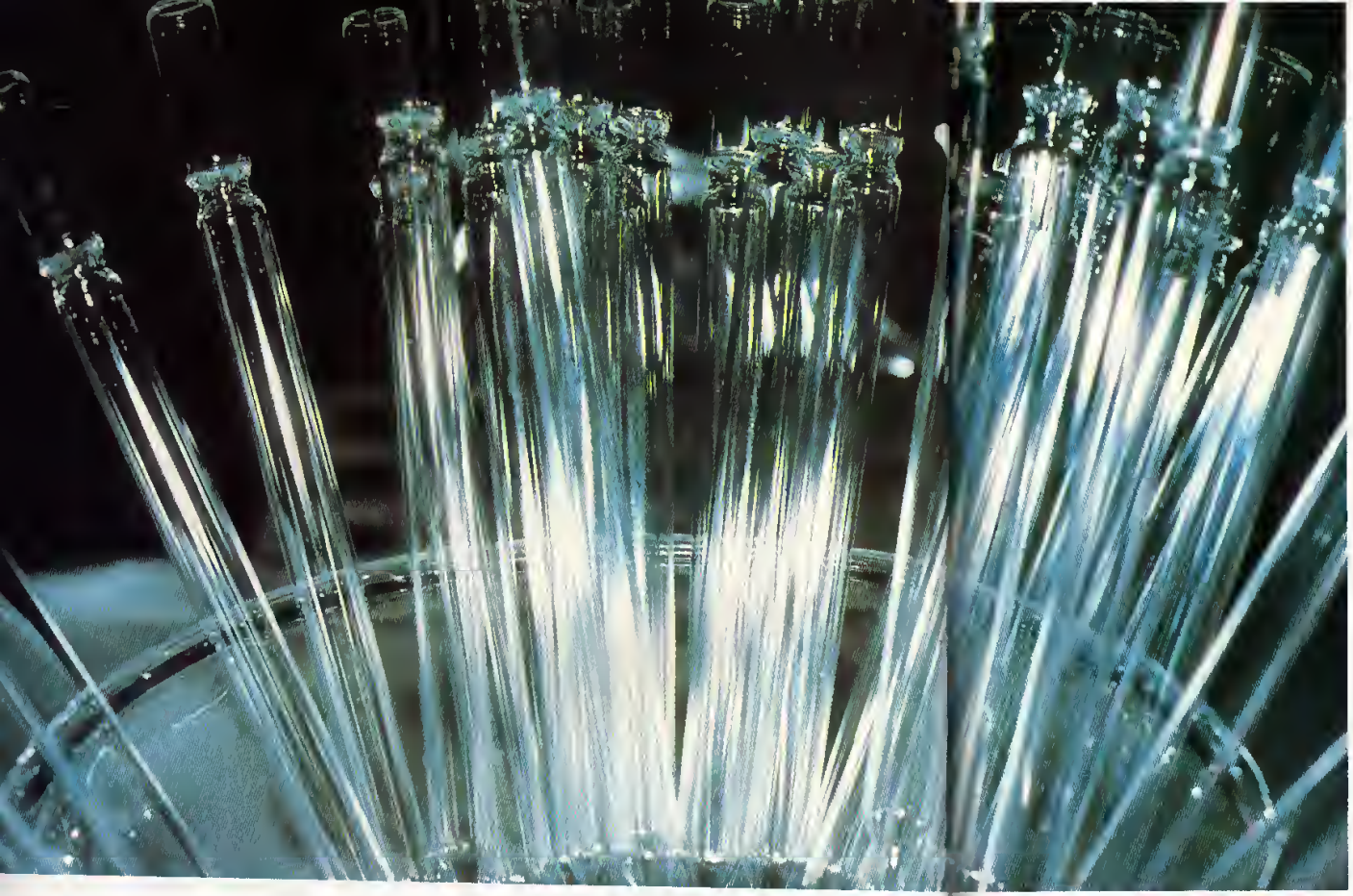
This simple device can cut an electric motor's energy use by half

NASA has licensed ten firms to produce the device, which sells for as little as $5 or as much as $100, depending on the size of the motor it controls Most PFCs are wire-filled rectangular boxes An appliance is plugged into the device which is then plugged into a conventional outlet Several hundred million common appliances would qualify with an average power saving of 20 percent and a total saving of $1 million a day

—Stuart Diamond

There is more religion in men s science than there is science in their religion "

—Henry David Thoreau



Vials of genetically engineered interferon await the first broad clinical tests with cancer victims (above). Interferon genes are extracted from human-placenta DNA (right)

CELL DEFENDER

Hopes soar as interferon finally surges to the forefront of human-cancer research

BY MIKE EDELHART

Joan Karafotas is one of the chosen few. This Illinois housewife is one of eight cancer victims to receive the world's first batches of genetically engineered interferon. Her treatment will help scientists determine whether interferon made from recombined DNA is safe enough for use in broader human experiments.

Karafotas's experience is the latest chapter in the continuing story of interferon, a substance that languished on the back shelves of science for more than two decades, but that has now been thrust to the forefront in the battle against cancer. Interferon has become a new media buzz word, its use now commonly linked to the treatment of the rich and the famous. When John Wayne was fading into his last sunset, what miracle drug did doctors consider to treat his cancer? Interferon. In the shah of Iran's final days what substance stood at the center of veiled transactions between Europe and Egypt? Interferon. Rumors like these have helped inflame speculation about the drug, scarcely diminished by the fact that both famed would-be recipients died.

But Joan Karafotas's treatment may have more substance and should shed more light on what role interferon will play in all our lives.

Interferon has followed a

roller-coaster course to its present promising status, in which it is regarded as a potential magic bullet for cancer and as a treatment for a host of other serious diseases, including the common cold and rabies. In the beginning it was lionized as the new penicillin for viral infections. It then fell to near scientific anonymity, but now it has been dusted off and given a second chance for scientific prominence. What we will try to present here is a sober evaluation of its potential in therapy.

Interferon is a virus-fighting agent of unmatched range but problematical power. It has shown itself potent against every virus that nature or man has thrown against it. But it has also displayed limitations that keep it from becoming the wide-ranging preventive once hoped for.

As an antitumor drug, interferon displays exciting abilities against an ever-expanding array of tumors. It has caused complete remission in some tumors, such as nonmalignant papilloma, and has caused cancerous tumors of at least a half dozen varieties to shrink. The scarcity of the drug, however, has kept tests so small and brief that the conclusions drawn from them must be tentative at best. Interferon's apparent abilities to combat tumors are not conclusive, but the tests performed so far are highly suggestive. They indicate a substance that doesn't so much kill cancer as control it. And it is this notion, that a natural substance from our own bodies can somehow modify the behavior of raging cancer cells, that so excites researchers.

It is unlikely that interferon will prove to be the long-sought miracle drug against cancer. Instead, it will probably be a new weapon to be added to medicine's existing arsenal. "Interferon and other biological response modifiers will not replace traditional therapies, but they will enhance them," says Jordan Gutterman, who runs the interferon test program at Houston's M. D. Anderson Cancer Center.

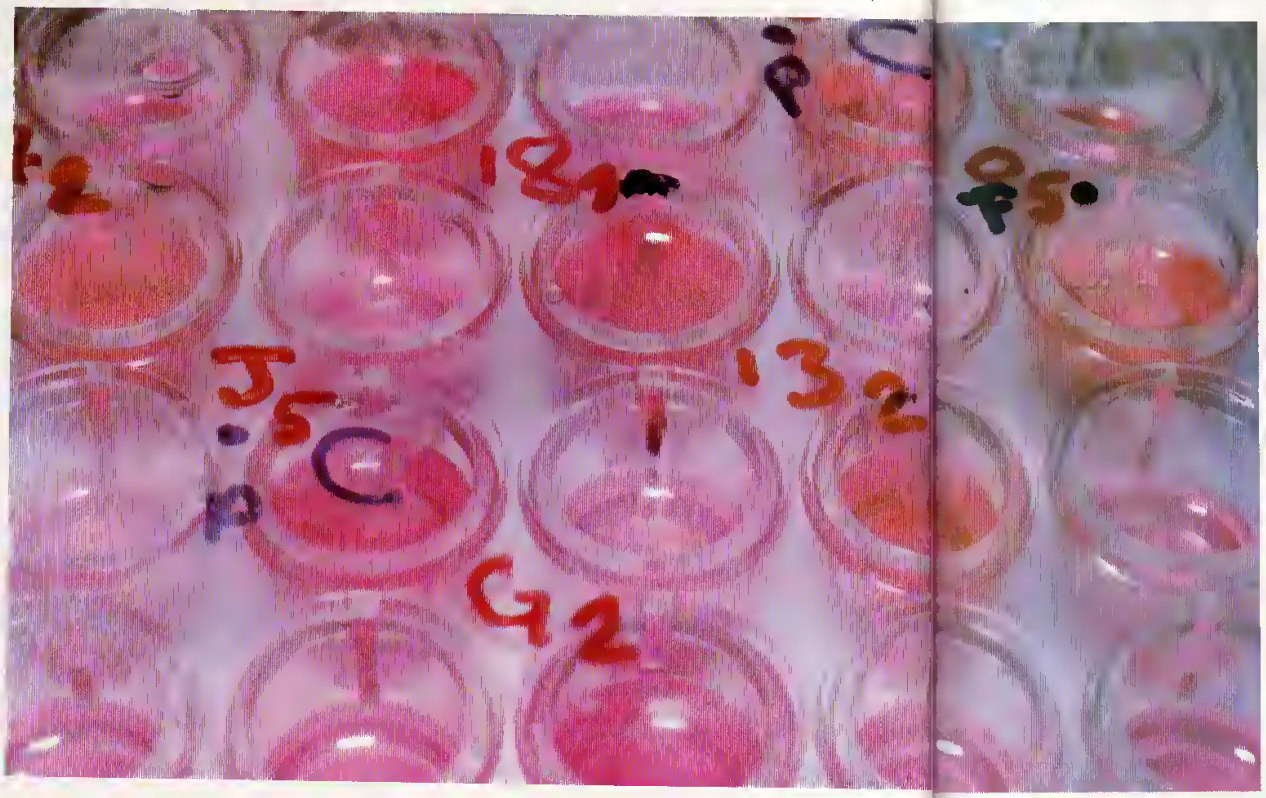
A clear, comprehensive view of expectations for interferon comes from Mathilde Krim, a dynamo behind interferon's current push to the fore in research. At her tiny desk on the eleventh floor of Memorial Sloan-Kettering Cancer Center's main lab building on Manhattan's Upper East Side, Krim earnestly expounds on her favorite subject. "I don't claim that interferon will be the magic bullet for cancer. I don't know that there is such a thing, to tell you the truth. But what other substance, at so early a stage in its development, has shown so much promising activity against different—often highly resistant—strains of cancer? And can anyone name another cancer therapy that has shown so few side effects—all of them apparently reversible?"

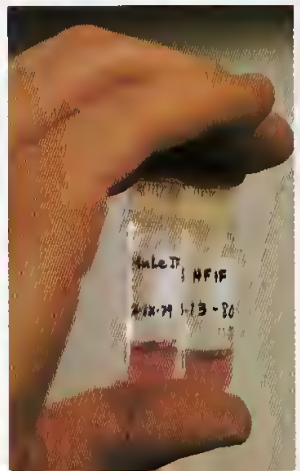
Krim accepts the fact that many scientists, even some working in the field, have serious doubts about interferon's effectiveness. What we have to determine is the level of activity," she says. "We have to improve our knowledge of the dose, the length of treatment. And it's important that we improve the purity of the material we're working with.

"Remember," she adds, "the first patients treated with penicillin died. The situations are similar. There may be different opinions, but mine is that interferon will rank at least as high as chemotherapy and radiation as a cancer treatment. And the beauty is that it can be added to the others and provide benefits they can't."

Interferon is a protein our bodies produce regularly. It protects our cells from the ravages of invasion. When cells are threatened by a virus, they turn into interferon factories, in order to save as many surrounding cells as possible. Interferon is the body's first line of defense against a concentrated assault. It can't hold off attackers forever, but it fends them off while greater forces muster for the counterattack.

The spread of malignant cells seems to be linked somehow to a suppression of the body's normal ability to fight off unnatural elements. Dr. Norman Finter of Britain's Burroughs-Wellcome Laboratory believes that cancers manage to sneak past the interferon control system. "It's an insidious change in the natural cell that the body doesn't recognize. The change from a normal cell to a cancer cell is a slight muta-





Genetic engineers from Cetus Corporation proudly display a new batch of interferon-producing microbes (above), which are first screened (far left) to identify those that generate the highest yields. Two tiny test tubes of the precious protein (left) represent the hard work of billions of bacteria.

tion," he says "Then there's another mutation and another and then the body picks it up because it has become sufficiently different but it's already too late to control without outside help The mutation has escaped the system that stimulates production of interferon until the cancer establishes itself

When this happens the answer is to use laboratory-produced interferon to trigger an immune response Interferon injections can produce significant antitumor effects in mice, apparently by heightening the body's own natural defenses against such cells, In culture dishes however the protein has little or no effect against cancer The secret? Interferon does not engage in hand-to-hand combat with malignant cells It leaves the dirty work to a strange bodily enforcer called the NK (for Natural Killer) cells How they work is not yet understood but what they do is pretty clear

NK cells float through the body on constant alert against abnormal cells Like a SWAT team they rush in with high firepower when the situation is on the verge of getting out of hand The presence of interferon in the vicinity of a tumor is believed to act like a beacon on a foggy night Patrolling NK cells pick up the distress signal and move toward the area Meanwhile the interferon slows cell division to hold down the growth of the invader until help arrives The NK cells eradicate the tumor itself though how they do this remains hazy

The NK-interferon partnership strikes down viruses in a similar manner When the body recognizes virus-infected cells as alien interferon floods the area and calls in NK cells for a massive mop-up

For all its potency interferon has little staying power in the body From an early peak interferon fades steadily away and is gone entirely the day after it was induced On the one hand this worries researchers because it raises the possibility that long-term treatment with interferon might generate dangerous side effects The body may be protecting itself from these developments by wiping interferon out of the system quickly Under some circumstances though the fading interferon pattern has been found to help treatment If some cells are given a small dose of interferon and then challenged with a second larger dose after the first has begun to fade the cells put out a startling spurt of interferon by themselves This is called superinduction Its value is that it can extend limited interferon supplies by letting the body make up some of the virus-fighting supply itself

If interferon can modulate the growth of tumors why doesn't it nip cancer in the bud? It probably does says Dr Derek Burke of Warwick University in England "You can easily say that interferon does work against cancer colonies in the body and we see only the cases where it fails We know that you need multiple events in order to initiate a tumor Each of the events is intrinsically rather unlikely This is why cancer takes so long to develop why cancer tends to be a disease of old age All of this suggests that there is a mechanism for blocking these rather rare events and that the mechanism becomes less efficient as we become older

So maybe interferon is working and what we see in tumor growth is the breakdown in some rather subtle link in the immune system that is normally modulated by interferon

Beyond cancer the natural chemical has shown hints of startling activity in other areas of medicine Immune responses that plague transplant recipients seem to be suppressed by properly applied interferon At the same time interferon can increase immune protection for patients in danger of massive infection Few medicines have demonstrated such remarkable flexibility Preliminary lab studies in animals may even lead to interferon treatments for obesity and Down's syndrome Plants make their own version of the protein to protect themselves and some people's failure to produce interferon when under attack by certain low-level viruses might hold the key to understanding many chronic conditions

"When John Wayne was fading into his last sunset, what miracle drug did doctors consider to treat his cancer? And what substance was linked to the shah of Iran's final days? Both times, interferon"

Interferon is still proving itself in the scientific boondocks but the clout of genetic engineering will soon pave the way for broad clinical tests Until the hard-core data roll in no one can be certain just how much of interferon's prowess is ingrained how much is hopeful thinking and how much is hype

To put interferon into proper perspective look back to the original wonder drug penicillin In the war-torn years of the early 1940s there were tremendous doubts about penicillin's commercial value Despite its enormous potential it was prohibitively costly to manufacture Even with massive government support, pharmaceutical companies were reluctant to take the risks involved in developing new, improved methods of production If it had not been for the needs of troops wounded in combat penicillin might also have followed a 25-year course to prominence

The doubt and trouble that afflicted penicillin a generation ago have given way to overwhelming praise and acceptance Moreover penicillin led to the creation of a whole new family of medicines many of which far outstrip their progenitor in power and range of effectiveness

In all these respects the future of interferon will likely be much the same In their later years today's young adults will almost certainly find interferon among the common treatments prescribed by physicians Some of these future patients will be given the opportunity to try new "biologicals" sophisticated hormonelike proteins being tested to supplant interferon as the sole cell-modulating medication

When these same people years hence feel colds coming on they will get prescriptions for interferon nasal spray It will be kept under prescription to protect those prone to allergic reactions

When they are stricken by chronic or unusually severe virus infections interferon will be used to hold the disease in check until a vaccine can be prepared or until the patient is better able to fight it off In a few cases interferon therapy strong enough to wipe out the infection will be used Most often doctors will want to give the patient time to develop antibodies to the disease so that it won't recur

After organ transplantations interferon will serve as a lifeline that wards off virus infections and inhibits the body's natural tendency to reject the foreign tissue Treatment may be required for days weeks or even a lifetime The side effects won't matter much Whatever they are they will be preferable to the alternative tissue rejection followed by death

The treatment for cancer will be more akin to today's approach to diabetes or several prostate problems Cancer won't ever be pleasant—not by any stretch of the imagination It will still be traumatic and dangerous but the medication will offer effective therapy without deadly or permanent side effects

A patient might still be sent into surgery or radiation for the treatment of the initial tumor Then interferon therapy will begin The protein will help prevent metastasis—the dreaded spread of cancer to other parts of the body It will also keep the patient strong and free of virus infections so that other treatments will have less sting By boosting the body's natural immune system during this critical phase interferon promises dramatically to reduce the death toll of cancer

Krim notes that the trouble with today's treatment is that we can do very little about getting rid of residual cancer cells once the primary tumor has been attacked Because of their enormous side effects we hesitate to use chemotherapy or radiation when definite signs of cancer aren't present A recurrence can get a toehold before

we go in and try to stop it. In the future, I think, we should follow surgery with interferon to strengthen the patient's defenses so he can get rid of his residual cancer cells before they can form colonies. I believe it will significantly decrease the percentage of recurrence."

When will interferon emerge from the labs and clinics and be placed on doctors' shelves? Not fast enough to make very many people happy. The development of new drugs takes time because no one—not in science, medicine, government or business—wants to let a mistake jeopardize the lives of millions of trusting patients.

Today researchers can say without hesitation that interferon works to some extent. What they must be able to say before they can bring a drug to the market is: Interferon works here and doesn't work there. Interferon performs better here than it does there. Interferon given this way is more effective than interferon given that way. Interferon should never be given to this kind of person, but it can always be safely given to that kind of person.

And most important, scientists need to know that interferon works this way for specific, identifiable reasons.

The protein must be studied and understood before it can be unleashed in the maze of situations that confront doctors in practice. This process takes years, and it can be altered by the unexpected in the long stretch ahead. Given smooth sailing, however, interferon's course should follow a timetable like this:

1981: Genetically engineered interferon is produced, examined by government agencies and approved for limited human testing. More detailed reports of clinical trials with natural interferon will appear.

1982: Results of genetically engineered interferon studies will begin to trickle out. The aggressive companies behind these tests will push for government approval to market it as quickly as possible. If the findings look good, the companies will get it. Interferon will flood the commercial arena, and its price will plummet.

1983: Drawing upon the huge supply of interferon, companies begin testing and shortly thereafter marketing interferon nasal sprays for restricted use. Interferon becomes accepted as a treatment against rabies, eliminating the painful series of injections now used to prevent the disease's deadly onset.

1984: With interferon's properties now well delineated, genetic-engineering companies will undertake the development of second-generation biological drugs. Some are more specific in action than interferon, some broader and milder. Some act only in certain parts of the body.

1985: An aging scientist in his memoirs will look back and write: Amazing as it may seem today, in the late 1970s and early 1980s there were many people, even many scientists, who doubted that interferon would ever have a role in medicine. If only they could be here now. ∞

FICTION

In a world of scarcity one will give up anything to find the Big Rock Candy Mountain

ANGEL AT THE GATE

BY RUSSELL M. GRIFFIN

Everyone was jawing about what No-Neck and the punk had found, but Rushmore's filters were clogged, and he had retreated to the place where he always slept when he passed this way, wedged into the crotch where the slope of the fill met the underside of the ruined overpass. It was a good place to scarf a ride because the occasional articulated hovertrucks had to slow to negotiate the gaps in the pavement. Also it was drier than a natural cave, had pigeons instead of bats, and if an irate farmer or a crusher came at him from one side, he could scuttle out the other. Caves usually had one exit, and Rushmore hated feeling closed in. Hated it more than anything.

He unlatched his nose shell and tipped it back against his forehead, so he could dig out the filter cartridge with his finger and tap it clean. Twenty years before, when he'd been brought in with his nose and chin and cheeks sheared away the Army doctors had given him gas team implants to ease the strain on his

PAINTING BY CRISTOBAL TORAL

seared lungs because they were under orders to recycle casualties back to the front as soon as possible. One had assured him the filter inside the plastic nose was twice as good as any mask as long as he kept his mouth shut, and he was damned lucky to have been hit by laser fire because a conventional explosion wouldn't have left enough face to work with and he'd probably have bled to death anyway.

The prostheses had looked fine, but since then the road had tanned and hardened his real skin until his leathery forty-year-old face had pulled away slightly to leave a purple seam around the firm nose and square jaw of the twenty-year-old he'd been. It was his eternally heroic plastic profile that had earned him the tag Rushmore among the hoboes and jockers.

But the nightmares hadn't changed. Always he was clawing at the hatch of the lumbering tank, lungs bursting, burning to filmy black lace as yellow gas snaked from the jammed vents, then emerging, gasping, the air outside corrupted, a roiling yellow cloud transected by laser beams refracting into sudden, thin, bright sticks of red. It was fate a gas team had found him on the desert sand in time. Fate.

He looked glumly at the cartridge. *Just about shot. Have to buy a new one soon, and they are expensive.* But without them he coughed up blood. So he did odd jobs like splitting cordwood or painting windmills when he needed replacements. Even work was better than coughing up blood, and on the road you learned to order your priorities. No use complaining about fate.

Stiffly he rose and went back down the slope to where the punk and No-Neck were talking with the others and watching the dog revolving slowly on a spit over the fire.

The trouble was that the hoboes, cut off from the network of television and computers that linked the isolated hugger homesteads, lived in a world of rumors and superstitions as primitive as Cro-Magnon man's. Moreover, Rushmore hadn't known the punk long enough to trust her, and No-Neck couldn't talk. No-Neck had been with the Hundred-First in Umm Said, but if he had nightmares like Rushmore's, fate hadn't left him a way to scream.

Rushmore paused to examine the sign No-Neck had scratched in the dirt to show what they'd seen: a half-circle peeking from behind a triangle like a sun rising or setting behind a mountain.

"You sure this is what you saw, No-Neck?"

No-Neck looked up from the dog and wagged his head and shoulders.

"It was on a fence two towns back this morning," the punk said, puffing a wisp of hair out of her eyes. She was eighteen—twenty, maybe. She'd learn. "Mechanicsville."

"You sure it wasn't some other sign that got smeared or something, like a triangle with two hands?"

No-Neck twisted emphatically.

"Guess I know the sign for a man with a gun," the punk sulked. "Just like I know a cross means a free meal if you listen to some God-talk, and two w's mean a barking dog. We saw what we saw."

"What's the problem, Rushmore?" Stumpie asked. "We found the way at last—to the Big Rock Candy Mountain." She poked at the dog's crisped and blackened flesh with the skeletons of her artificial fingers. Their plastic skin had worn away years before, and the metal armature inside had rusted into a hooked claw, but it served well enough. Stumpie's needs, like the others', were modest.

"I don't get it," the punk said. "It's just a story, isn't it? I mean, the idea of someplace where there's always food and no crushers or bum weather and whatnot. How could anybody believe that?"

"Oh, it's true, right enough," Stumpie said, licking the grease from her fingers. "Every truck barnacle knows it. Way I heard it, some corporation like IBM or Coke was building it during the war, but when they went bust in the crash, the banks boarded

"The nightmares hadn't changed. He was clawing at the hatch of the tank, lungs bursting, burning to filmy black lace as yellow gas snaked from the vents, then emerging, gasping in the corrupted air."

the place up. Afraid everybody and their mother would be beating down the doors if word ever got out."

"If you think it was that simple," Crazy said, Adam's apple jerking like a bobber with a bass at the hook, "you're dumber than mud. The government was behind it. The whole idea was a string of pleasure palaces across the country to enslave the working classes."

Rushmore smiled. Crazy was always saying things like that because he was a Communist or a revolutionary or whatever and claimed the huggers had forfeited their rights by deliberately letting welfare go down the can in the postwar crash, and anyway all wealth came from the earth, which really belonged to the whole human race. Crazy wanted to organize the hoboes to get their just deserts by force, but that was because he wasn't a true hobo. He was a submarine hiding out from the FBI, and he didn't understand hoboes for shit. The last thing a hobo wanted was to get organized. The whole point of road jocking was freedom.

They say it was left in perfect working condition," Stumpie mused. "Computer food and climate machines, three-D TVs, all *kinds* of stimulators. Enough to keep you happy forever in there."

Rushmore winced at *in there*. "But who'd want it if we found it? I didn't hit the road because I wanted a hugger armchair or twenty-four-hour TV or a computer to balance my checkbook. Crazy, you telling me you'd give up politics for some machine making you hamburgers?"

"Course not," Crazy said brusquely. "The Big Rock Candy Mountain is where all the hoboes'll be eventually, and that's the beginning of solidarity."

"Well," Rushmore said, squatting down, "all I know is, I never heard of this thing till a year or so ago."

"That's perfectly logical," Crazy said. "You've got to allow time after the war till the first hobo found it, or one of their scientists hit the road himself and started to blab. And then more time for word to get around. I heard about it from some old stiff on the coast quite a while ago."

"If there really is such a place," Rushmore snorted, "it's Eden, and there'll be an angel at the gate. The huggers are too selfish to let us get at it."

"Anybody got a knife?" the punk asked. "I think Fido's done."

There was no talking during dinner but later, warmed by the fire and bellies full, they debated what to do. Crazy thought they should travel in a group. "That way we're each other's eyes and ears," he said.

"That's like this guy told me once," Stumpie said. "A real smart customer, a professor writing this book about how we stick together and we're a separate society and everything. Said he was calling it *Invisible World* and he'd put my name in the acknowledgments if I'd—"

"*Anyway*," Crazy said loudly. "The sign No-Neck saw is probably smudged and gone by now. The best thing would be to head the way it said, toward the city."

"Even if I wanted to find this place," Rushmore burped, "I always travel alone. You can't scarf a ride behind an articulated with five people."

"So what?" Crazy said. "You can't look for signs hanging on the back of a drag by your fingers. Got to walk."

In the end Rushmore agreed, despite himself. It was always easier to go with the current, and he was still free to change his mind at any point. So the next morning, after a duck's breakfast of cold water, they set off across the fields. Trespassing was better than running into a crusher on the road. Near the outskirts of town, however, they found the road again and a sign. Not a secret hobo sign scratched on handy trees or posts, but an official one.

WARNING

PERSONS FOUND GUILTY OF VAGRANCY
SUBJECT TO FULL FORCE OF 30TH AMENDMENT

Underneath, a jocker had chalked two curved lines like the upper halves of two circles side by side and put a dot inside each, open eyes: a town on the lookout for hoboes. A town for hoboes to avoid.

"They was a rumor about a slate roundup in these parts a few months back," Stumpie said, scratching her chin with her rusted fingers.

"What happened to them?" the punk asked.

"Guess they're rotting in some hugger jail," Rushmore said.

"No, they diddle your head," Crazy said. "When you come out, you *want* to work in a factory. Call it *retooling*."

"They'd never spend the money," Stumpie said. "They sell your parts to an organ bank and grind up the leftovers for fertilizer. That's what *I* heard."

"You're scaring the punk," Rushmore said.

"But did you ever actually *meet* a stiff that came *back* from a roundup? Stumpie asked. "They just *disappear*."

"That's a dumb rumor," Rushmore said. "I've met lots of guys been in jail. Been there myself often enough."

"In the good old days, maybe," Stumpie said, "but not recently, I bet."

Behind them swelled an insectlike buzzing, and Rushmore turned to see a figure on a motor scooter tipping toward them along a side road and up across the crazed pavement of the highway into town. It was a local crusher, titted out in a helmet and uniform leathers, his belt sagging like an October apple branch with two pistols, a bo-stick, and handcuffs. A badge tugged at his shirt pocket inside his open jacket. He eased to a stop several yards from them and dropped his feet to steady himself.

"Where you scum headed?" the crusher called over the burble of his motor.

"Headed for a job a couple towns over," Rushmore said. "Helping out with the planting, you know?"

"Let's have the details," the crusher said, licking his lips nervously, his hand on one of the pistols. "You know the law."

"Over in Stratford," Rushmore said. "Farmer by the name of Mancini."

Rushmore knew the crusher could check on it but wouldn't. Even police were too busy hugging their homesteads and things; a farm two towns away was as remote and exotic to a hugger as China, computer phones or no.

"You just make sure I don't find you inside the town limits in an hour," the crusher said. "Because you lazy scarfers steal everything that's not nailed down. That's why you're vermin, and every honest person thinks you ought to be hunted down and exterminated like rats."

"I don't remember you in the war," Stumpie muttered as the crusher gunned the scooter and jerked away, making a slow circle around them before he headed toward town, his motor's chatter diminishing into a dry and distant buzz.

Rushmore watched until he had disappeared. Obviously a town bully, used to beating up on hoboes but too chicken to take on five at once. Still, there was no use tempting fate. Together they made too easy a target. Ignoring Crazy's protests, Rushmore hopped the fence behind the sign and said good-bye. At first he felt their reproachful eyes on his back, but after only a few minutes of walking it seemed a great weight had been lifted from him. Sharing a can of coffee or chow was one thing, but he was basically a loner. Mooching a meal was easier with one, and you alone decided when to rest and when to move, how fast to go and in what direction. Absolute solitude was absolute freedom. If the others wanted to bunch together like so many grapes waiting to be plucked, that was their business.

As the sun peaked in the noontime sky, Rushmore's stomach began to grumble, and it was a relief when at last he found scrawled on a gatepost the rear half of an *R* written backward, intersecting a perpendicular line and surmounted by a cross. Good food in return for work. Signs were the hoboes' answer to computers.

The farm was set on a rise about a mile from the gate. Its outbuildings were sagging and dilapidated, and the only cultivated land was a small plot beside the house. Beginning to doubt the sign, he made his way past a collapsed composter for collecting methane for use in running farm machinery. He stepped up on the back porch to knock.

The door opened the barest crack. "Get off the porch," said a frightened voice inside. An old voice, female.

Smiling and nodding, and showing he held no weapons, Rushmore backed down to the ground. Typical pokeout, scared of her shadow. "Just wondered, ma'am, if you had any chores an honest man down on his luck could do for a handout?"

'My dog died,' said the pokeout through the crack.

"Sorry to hear that, ma'am." He wondered whether she was telling him to explain why she was afraid to open the door.

"She needs a grave," the voice said.

"You just tell me where she's laid," Rushmore said, "and I'll take care of everything."

"No," she said. "I know you people. You'll steal her and eat her. You just dig the grave, and I'll do the rest after you go. There's a shovel around at the side of the house."

In the house's shadow, Rushmore found a patch of grass and began to dig, wondering whether it should be a big hole for a big dog or a small one for a little yap-yap. When he'd had enough, he leaned the shovel against the house and returned to the stoop to find a square of corn bread and some home-canned peaches in a cracked bowl. He squatted and ate, using the stoop as a table. Not much of a mooch, but better than nothing.

'You know, ma'am," he called when he was done, "there're lots of jobs that need doing around here. I could help out for a day or so for a little food and maybe some change." He was thinking of the tilters he'd be needing to replace.

A blind moved in one of the windows, but there was no answer.

"I'm a veteran, you know," he called. "Got this in your war!" He reached up and opened his nose in a show of friendship and patriotism, but the house was silent.

Hell with her. The irony was if he'd been like Crazy, he could have broken in and taken anything he wanted. But if she wanted to starve instead of trust somebody enough to accept help, that was her choice. He cut across the farmyard, hungrily eyeing the solitary bedraggled chicken roosting on the seat of a dead tractor and headed through the fields toward the highway.

As luck would have it, a five-unit drag flashed by just before he reached the road. He watched its articulated sections glinting in the afternoon sun as it snaked up the hill beyond. It could be a long wait before the next one would come by.

With a shrug, he followed up the hill. At the top of the grade the semis would be slowing with lost momentum and easiest to jock. Further, he could catch a drag in either direction. So the decision of whether to follow the signs to the Big Rock Candy Mountain would depend on which way the next truck was headed. Leave it to fate. Life was best when you kept it simple.

Halfway up the hill, he noticed the hulk of an old automobile rusting in the grass just off the pavement. He walked over to it, trying to remember whether he'd actually seen cars on the roads when he was a kid or his memory was fooling him with photos he'd seen. The doors and seats had been ripped out long ago, but a rusted tin can on the floor told him a brother or sister hobo had made this ancient artifact a temporary home awhile back.

He was about to go on when he noticed something scratched into the rust of the front fender, the triangle and half-circle of the Big Rock Candy Mountain. Shit, there was no getting away from it.

Gotcha!' said a voice behind him.

He whirled to find the crusher in his greasy leathers, face twisted in a smile and bo stick in hand. "Guess you didn't believe me," he grinned.

"Look, I've been moving all day," Rushmore said. "I *must* be outside the town limits by now."

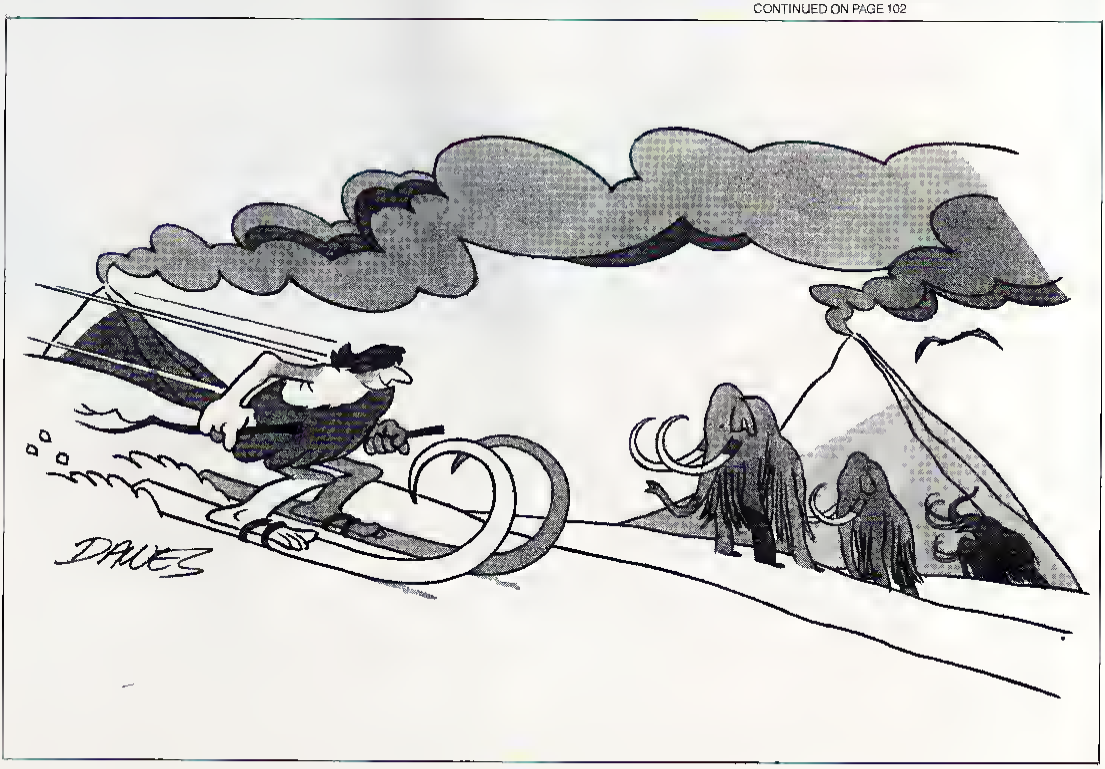
"Well, maybe you are," the crusher said, licking his lips. "But I don't think anybody's gonna complain, do you?"

Rushmore's eyes darted to either side, trying to calculate the best escape.

The crusher stepped closer. "You bought yourself a mess of trouble coming into town this morning, you want my opinion."

Rushmore feinted to the left, then sprang to the right, but the crusher was too fast and caught him a smashing blow on the calf. Rushmore's leg collapsed under him as he brought it forward to sprint away, and he toppled forward. The crusher was on him instantly, bo stick coming down hard across Rushmore's back, his arm, the side of his head, his ear burning and stinging exquisitely. All at once something heavy toppled across him. Claustrophobic af the thing covering him, Rushmore twisted

CONTINUED ON PAGE 102



Can private rocketeers in Africa survive pernicious Communist propaganda?

OTRAG

BY JAMES OBERG

Rusting rocket stages lie tangled in the vines of a jungle in Zaire. The launch-control bunker where engineers once aimed for outer space is now a home for snakes and bats. A long runway cut into the top of a lush plateau is concealed under a strip of fresh brush. These are the vestiges of a private rocket company founded by a group of West German engineers whom the Communist press has tried to link with Adolf Hitler's Peenemünde, the famed guided-missile research and testing station built on Germany's Baltic seacoast during World War II.

Begun in 1975 as a space transportation company, OTRAG (an acronym for Orbital Transport and Rockets, Aktiengesellschaft) leased a sparsely inhabited region of Zaire in exchange for an annual payment of $50 million and a cut of the profits. But OTRAG's efforts to develop a commercial space transportation system that would compete with NASA's shuttle and Western Europe's *Ariane* became ensnared in political maneuvering, international propaganda campaigns...

PHOTOGRAPH BY PETE TURNER

espionage, and outright warfare that led to the deaths of thousands of people.

Now the embattled space company opens a new arena for its unconventional rocketry. According to Théo Pirard, a European space expert, OTRAG, after being expelled from Zaire, has set up a launch site in Libya and is already test-firing its bargain-basement missile there. Within two years OTRAG may test its ability to put satellites into orbit; a year or so later service will be available to paying customers, that is, if OTRAG's connection with Libyan head of state Muammar el-Khaddafi does not turn into another disaster.

The fledgling rocket company claims it can build cheap, expendable launch vehicles that would lure private, paying customers away from government monopolies. Because there is a growing commercial market for space operations, many corporations have been buying cargo room on government space carriers. The unprofitable rocket operations are gladly left to NASA and to the European space agency. Now OTRAG's rocket engineers are designing, building, and launching test models that could offer attractive alternatives to space industrialization.

Its technical credentials beyond reproach, this little West German company nevertheless became the focus of international controversy after a massive and dismayingly effective smear campaign was unleashed by the Moscow-based disinformation bureau of the KGB. The Soviet operation managed to make fools of many leading Western journalists and editors, and ultimately tricked Western governments into trying to strangle the privately owned rocket company.

The guiding force behind OTRAG is Lutz Kayser, a talented and charismatic rocket engineer in his mid-forties. He is a spiritual successor to the German scientists and technicians who built the V-2s and the Saturn 5s. Kayser's rocket work reflects the same bold innovations without regard for politics or precedents.

While working on a West German government research grant in the early 1970s, Kayser investigated the potential of low-cost expendable rockets as an alternative to such high-cost reusable rockets as NASA's space shuttle. His study convinced him that low-cost vehicles could compete with the contemporary expendable boosters and the anticipated reusable ones too.

Kayser angered most European experts by claiming that government-built systems were overdesigned, poorly managed, and ill suited to many commercial space projects. He also inveighed vociferously against the monopoly the United States and the Soviet Union exercise over such important space applications as military reconnaissance satellites.

But when the West German government agreed to join Europe's expendable-space-booster program, Kayser's funding was canceled. He then decided to solicit money from private sources. Aided by unusually favorable West German tax provisions that encourage investment in high-risk technology, Kayser raised enough money to set up his corporation in 1975. During the next five years he spent close to $100 million in venture capital provided by some 400 investors who were never identified publicly. Such unconventional actions increased the hostility of most leading European space experts. Industry specialists came to see the project as just another tax dodge or as an ego trip for an eccentric inventor with an impossible dream.

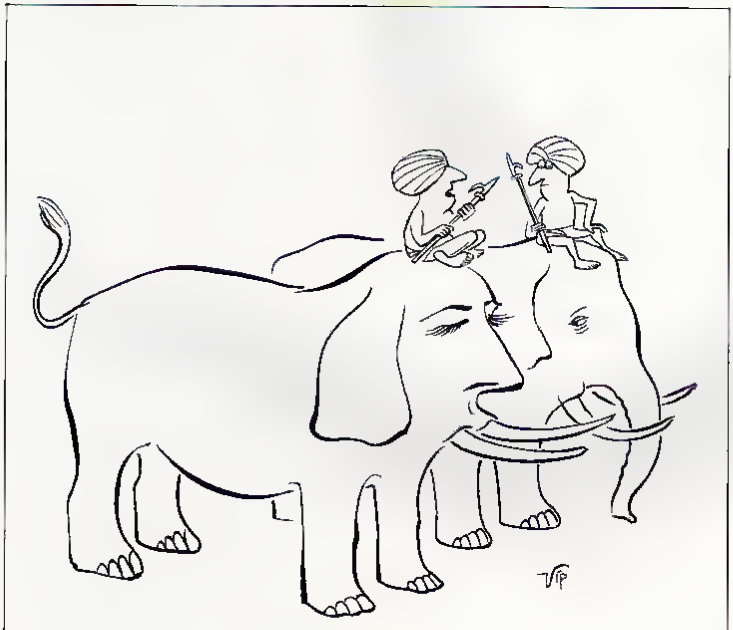
So, even before OTRAG's space hardware had been given a chance to prove itself, the rocket group was in disrepute. Established rocket engineers claimed that Kayser's concept was completely impractical, either because of honest incompetence or because it was merely a plan to bilk investors.

Some foreign officials were afraid the project could develop into a competitive space transportation system that might entice paying corporate customers away from government monopolies. Such fears were widespread in Paris and in Washington. Borrowing from the Amtrak and U.S. Postal Service experience, American bureaucrats suggested two predictable strategies. Either make such competition illegal by forbidding U.S. corporations to use less expensive alternatives to the space shuttle, or make it unprofitable by oversubsidizing monopoly programs until any private competitor went bankrupt.

If American and Soviet military authorities objected, both had reason. In order to obtain launch sites in the nonaligned countries, OTRAG proposed to loft photographic spy satellites for anyone and to publish the pictures openly. Some of OTRAG's foes did more than hope the company would fail; they drew up their plans and prepared to make their move.

The OTRAG booster concept is simplicity itself. A team of 40 engineers and technicians working near Stuttgart, West Germany, has designed, built, and tested booster modules constructed from low-cost, commercially available equipment. The tanks are steel pipe. The fuel valves are operated by windshield-wiper motors. The rocket engines are lined with ablative ceramic coatings, with a unique fuel-injector system that is OTRAG's main trade secret. The propellant combines kerosene and commercial-grade white fuming nitric acid. No complex turbines are needed; the propellant is forced into the engines with compressed air. The vehicle is steered by throttling the engines instead of by a complex gimbaling nozzle.

Boosters of nearly any size and complexity can be constructed by simply strapping these units together. Successive stages are accomplished by wrapping a picket fence of add-on units around the outside of a central cluster instead of stacking them the way other rocket engineers do. Each stage can be shed like an onion skin when its fuel



"Next, I'm going to have her teeth straightened."

is exhausted. The result is a squat, ungainly booster that resembles a bunch of asparagus but promises half the cost of any other launch system.

To ready such a rocket OTRAG required an area remote from crowded Europe. The company needed room for the spent stages to fall harmlessly back to Earth. Near-equator sites provide a velocity bonus contributed by Earth's rotation and eliminate the maneuvering needed to reach targeted space orbits, further reducing launch costs. Kayser began looking for the right place even while he was drawing up the corporation's papers. After checking with government officials in a dozen countries, he found his site in Zaire.

Construction began in the fall of 1976 with a base camp and the launch site itself some 80 miles away, atop a grass-covered plateau surrounded by thousand-foot-high cliffs. Below the plateau the Luvua River winds, and deep jungle presses in. A 6,000-foot dirt airstrip was cleared, and several prefab aluminum-and-glass buildings were airlifted in. The launchpad was constructed of logs packed with dirt, and the support gantry consisted of several tree trunks lashed into a tripod.

The first launch of a basic tank/engine section was made successfully on May 17, 1977, when the 20-foot-long module reached an altitude of seven miles. Seven miles may not seem like very much, but experts had repeatedly proclaimed that such an engine could never fly at all. The hop was only the first small step, but it demolished most of the arguments of skeptics and cynics.

After OTRAG's successful first test flight, Kayser added to his corporate credibility by hiring Kurt Debus, former head of NASA's Kennedy Space Center and a longtime colleague of Wernher von Braun, as chairman of the board. But while Kayser tried to make all the right moves, he was no match for the KGB, which put into motion a plan to turn OTRAG's activities into a tool for Soviet diplomacy.

The Moscow-directed propaganda offensive against OTRAG and Zaire began in August 1977, three months after the first launch, with the publication of what was purported to be a secret treaty between the West Germans and Zaire's President-for-Life Mobutu Sese Seko. The alleged text appeared in the leftist magazine *Afrique-Asie*, published in Paris. According to editor Simon Malley, the document had been provided by an anti-Mobutu Zairian patriot named Nathaniel M'Bumba. Some European press sources, however, claim that the original document had been stolen from Zaire's embassy in Bonn—probably by East German agents—and then modified to appear more insidious.

Relying on the allegedly stolen and forged documents and on other "informed sources," *Afrique-Asie* asserted that missiles were being developed in Africa and that OTRAG was a front for Neo-Nazis.

Once this story had been published in

France, the Soviet press began trumpeting it. Eastern European countries picked up the theme with remarkable unanimity. The new Marxist regime in Angola protested formally to the West German government. A cartoon in *Pravda* showed a NATO general and a South African colonialist, whip and all, gleefully surveying a map of Africa with a rocket marked OTRAG piercing the heart of the continent. Before Kayser realized what was happening, he had been portrayed worldwide as the leader of a Neo-Nazi faction planning to sell missiles to South Africa to carry nuclear bombs. The story was a complete fabrication, but one that turned out to be useful to Moscow.

Noticias da Beira, a newspaper in Mozambique, editorialized in December 1977 that "the tests being carried out in Zaire by OTRAG on new rockets capable of carrying nuclear warheads are evoking serious concern in African countries."

The peace-loving public justly regards OTRAG's activities in Zaire as a serious threat to peace and security in Africa." The president of the Malagasy Republic, Dr. Didier Ratsiraka, charged foreign powers with criminal intent. "A military *place d'armes* in the heart of the continent is to be used as an instrument of pressure on the neighboring African states."

"We will not carry bombs or warheads or anything like that," explained OTRAG's chief engineer, Frank Wukasch, in reply to the accusations. "We don't have the technology. And the market is not interesting."

Wukasch said that the profit motive weighed strongest and that any deals with the South African government would undoubtedly lead to a worldwide boycott that could ruin OTRAG. But OTRAG's explanations were of no avail. The political storm caught the Germans by surprise, and they reacted with puzzlement.

Kayser said, "I don't know why the Russians are ignorant of what we are really doing. Their spy planes fly over us regularly." Later Kayser asked the United Nations to inspect the launch site, but Soviet-sponsored legwork in New York scuttled any action by the world body.

The anti-OTRAG campaign gained momentum when a story almost identical to the original *Afrique-Asie* piece appeared in a prominent American magazine. In this version, the Pentagon and the CIA were implicated in the machinations against black Africa. The author sought to reveal that 37 years after Wernher von Braun's rockets rained death on London, West Germany is secretly testing deadly cruise missiles in the heart of Africa—missiles designed to carry nuclear warheads. "Tass immediately spread the story around the world. Even the American media carried items about it.

Why should the Russians promote such a campaign? Western observers have suggested several theories. The Soviet campaign helped arouse new anti-German anxieties inside the Soviet Union and new anti-Western feelings throughout Africa. It

CONTINUED ON PAGE 146

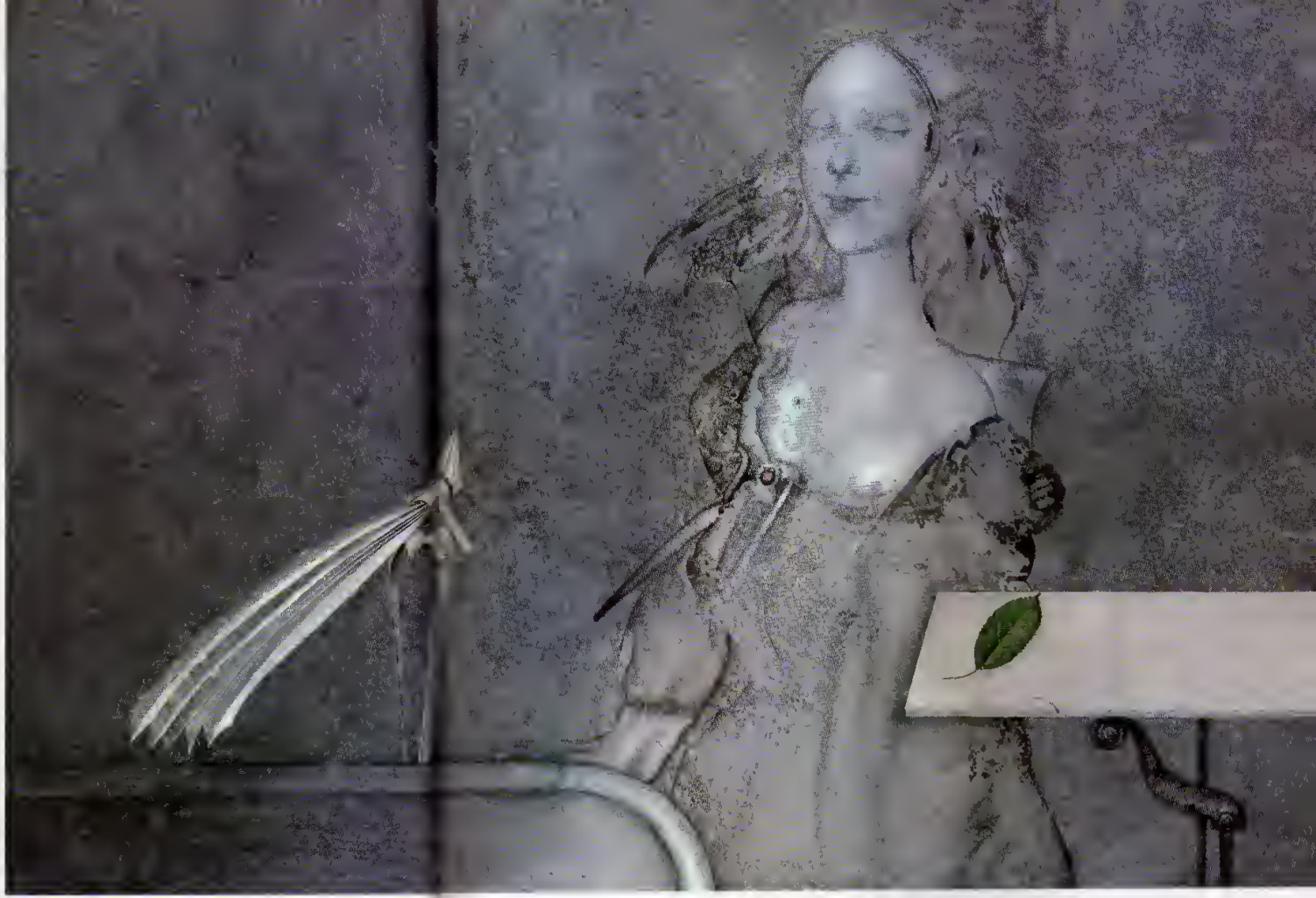
FICTION

A SEPULCHER OF SONGS

BY ORSON SCOTT CARD

A young girl's freedom depends on the love of a man and a promise from the stars

PAINTING BY ARMODIO



She was losing her mind during the rain. For four weeks it came down nearly every day, and the people at the Millard County Rest Home didn't take any of the patients outside.

It bothered them all, of course, and made life especially hellish for the nurses, everyone complaining to them constantly and demanding to be entertained.

Elaine didn't demand entertainment, however. She never seemed to demand much of anything. But the rain hurt her worse than anyone. Perhaps because she was only fifteen, the only child in an institution devoted to adult misery. More likely because she depended more than most on the hours spent outside; certainly she took more pleasure from them. They would lift her into her chair, prop her up with pillows so her body would stay straight, and then race down the corridor to the glass doors, Elaine calling "Faster, faster" as they pushed her until finally they were outside. They told me she never really said anything out there. Just sat quietly in her chair on the lawn, watching everything. And then later in the day they would wheel her back in.

I often saw her being wheeled in—early, because I was there, though she never complained about my visits' cutting into her hours outside. As I watched her being pushed toward the rest home, she would smile at me so exuberantly that my mind invented arms for her waving madly to match her childishly delighted face, I imagined legs pumping, imagined her running across the grass.

breasting the air like great waves. But there were the pillows where arms should be keeping her from falling to the side, and the belt around her middle kept her from pitching forward, since she had no legs to balance with.

It rained four weeks, and I nearly lost her.

My job was one of the worst in the state: touring six rest homes in as many counties, visiting each of them every week. I "did therapy" wherever the rest home administrators thought therapy was needed. I never figured out how they decided—all the patients were mad to one degree or another, most with the helpless insanity of age, the rest with the anguish of the invalid and the crippled.

You don't end up as a state-employed therapist if you had much ability in college. I sometimes pretend that I didn't distinguish myself in graduate school because I marched to a different drummer. But I didn't. As one kind professor gently and brutally told me, I wasn't cut out for science. But I was sure I *was* cut out for the art of therapy. Ever since I comforted my mother during her final year of cancer, I had believed I had a knack for helping people get straight in their minds. I was everybody's confidant.

Somehow I had never supposed, though, that I would end up trying to help the hopeless in a part of the state where even the healthy didn't have much to live for. Yet that's all I had the credentials for, and when I (so maturely) told myself I was over the initial disappointment, I made the best of it.

Elaine was the best of it.

"Raining, raining, raining," was the greeting I got when I visited her on the third day of the wet spell.

"Don't I know it?" I said. "My hair's soaking wet."

"Wish mine was," Elaine answered.

"No, you don't. You'd get sick."

"Not me," she said.

"Well, Mr. Woodbury told me you're depressed. I'm supposed to make you happy."

"Make it stop raining."

"Do I look like God?"

"I thought maybe you were in disguise. *I'm* in disguise," she said. It was one of our regular games. "I'm really a large Texas armadillo who was granted one wish. I wished to be a human being. But there wasn't enough of the armadillo to make a full human being, so here I am." She smiled. I smiled back.

Actually she had been five years old when an oil truck exploded right in front of her parents' car, killing both of them and blowing her arms and legs right off. That she survived was a miracle. That she had to keep on living was unimaginable cruelty. That she managed to be a reasonably happy person, a favorite of the nurses—that I don't understand in the least. Maybe it was because she had nothing else to do. There aren't many ways that a person with no arms or legs can kill herself.

"I want to go outside," she said, turning her head away from me to look out the window.

Outside wasn't much. A few trees, a lawn, and beyond that a fence, not to keep the inmates in but to keep out the seamier residents of a rather seamy town. But there were low hills in the distance, and the birds usually seemed cheerful. Now, of course, the rain had driven both birds and hills into hiding. There was no wind, and so the trees didn't even sway. The rain just came straight down.

"Outer space is like the rain," she said. "It sounds like that out there, just a low drizzling sound in the background of everything."

"Not really," I said. "There's no sound out there at all."

"How do *you* know?" she asked.

"There's no air. Can't be any sound without air."

She looked at me scornfully. "Just as I thought. You don't *really* know. You've never *been* there, *have* you?"

"Are you trying to pick a fight?"

She started to answer, caught herself, and nodded. "Damned rain."

"At least you don't have to drive in it," I said. But her eyes got wistful, and I knew I had taken the banter too far. "Hey," I said. "First clear day I'll take you out driving."

"It's hormones," she said.

"What's hormones?"

"I'm fifteen. It always bothered me when I had to stay in. But I want to scream. My muscles are all bunched up, my stomach is all tight. I want to go outside and *scream*. It's hormones."

"What about your friends?" I asked.

"Are you kidding? They're all out there, playing in the rain."

"*All* of them?"

"Except Grunty, of course. He'd dissolve."

"And where's Grunty?"

"In the freezer, of course."

"Someday the nurses are going to mistake him for ice cream and serve him to the guests."

She didn't smile. She just nodded, and I knew that I wasn't getting anywhere. She really was depressed.

I asked her whether she wanted something.

"No pills," she said. "They make me sleep all the time."

"If I gave you uppers, it would make you climb the walls."

"Neat trick," she said.

"It's that strong. So do you want something to take your mind off the rain and these four ugly yellow walls?"

She shook her head. "I'm trying not to sleep."

"Why not?"

She just shook her head again. "Can't sleep. Can't let myself sleep too much."

I asked again.

"Because," she said, "I might not wake up." She said it rather sternly, and I knew I shouldn't ask anymore. She didn't often get impatient with me, but I knew this time I was coming perilously close to overstaying my welcome.

"Got to go," I said. "You *will* wake up." And then I left, and I didn't see her for a week, and to tell the truth I didn't think of her much that week, what with the rain and a suicide in Ford County that really got to me, since she was fairly young and had a lot to live for, in my opinion. She disagreed and won the argument the hard way.

> *"Weekends I live in a trailer in Piedmont. I live alone. The place is spotlessly clean because cleaning is something I do religiously. Besides, I tell myself, I might want to bring a woman home."*

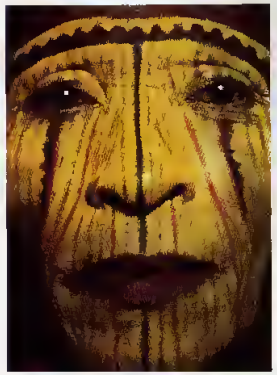
Weekends I live in a trailer in Piedmont. I live alone. The place is spotlessly clean because cleaning is something I do religiously. Besides, I tell myself, I might want to bring a woman home with me one night. Some nights I even do, and some nights I even enjoy it, but I always get restless and irritable when they start trying to get me to change my work schedule or take them along to the motels I live in or once only get the trailer-park manager to let them into my trailer when I'm gone. To keep things cozy for me. I'm not interested in "cozy." This is probably because of my mother's death, her cancer and my responsibilities as housekeeper for my father, probably explain why I am a neat housekeeper. Therapist, therapy thyself. The days passed in rain and highways and depressing people depressed out of their minds, the nights passed in television and sandwiches and motel bedsheets at state expense, and then it was time to go to the Millard County Rest Home again, where Elaine was waiting. It was then that I thought of her and realized that the rain had been going on for more than a week, and the poor girl must be almost out of her mind. I bought a cassette of Copland conducting Copland. She insisted on cassettes, because they stopped. Eight-tracks went on and on until she couldn't think.

"Where have you been?" she demanded.

"Locked in a cage by a cruel duke in Transylvania. It was only four feet high, suspended over a pond filled with crocodiles. I got out by picking the lock with my teeth. Luckily, the crocodiles weren't hungry. Where have *you* been?"

CONTINUED ON PAGE 106

Basic declarations of competition, status, age, and gender underlie all modes of dress



MAN AS ART

BY SCOT MORRIS

Smear on charcoal, brilliant ocher and yellow clay, add an apron fringed with pigs' tails, a dagger at the waist made of cassowary bone, and a shiny mother-of-pearl neckpiece; top these off with a wig of human hair lined with lorikeet feathers and bird-of-paradise plumes. The result: A man becomes a vision that commands attention, that inspires awe and respect in the community.

Body painting, or decoration of self, is perhaps the oldest art form of the human species. How people modify their bodies is an important aspect of social communication. Adornment establishes a persona, which carries messages of age, sex, and status. Decoration can reflect one's individuality while it reaffirms one's membership in the group.

The painted faces of these New Guinea natives are metaphors for nonverbal communication. On the second-largest island in the world, where more than 700 languages are spoken, individuality presumes a

PHOTOGRAPHS BY MALCOLM KIRK

"Body decoration is a reflection of the collective values and aspirations of the tribe"

silent eloquence. Ritualized faces bring recognition, familiarity, and order. They serve to remind us that the very word *cosmetic* derives from the Greek word *kosmos*, meaning the harmony and order of the universe.

"In any society," as pop anthropologist Desmond Morris observed, "the application of careful makeup means three things: time, materials, and services. Time means money, and materials mean money, and where specialized services are needed, the cost is even higher. So on these three counts, makeup equals affluence equals status. On this basis makeup has always been, and will always be, a facial signal saying 'I have money to burn.'"

Just as someone in the West might wear fine jewelry or expensive suits to tell the world of his or her status, these tribe members display their status for all to see. Crescent-shaped mother-of-pearl and tiny nassarius shells—both forms of currency in the recent past, until the first Europeans discovered these tribes in the 1930s—are now worn as jewelry.

Leadership here is not conferred by heredity or appointment; it is earned, as in the West. Battle skill, oratory and, most important, the subtle manipulation of an elaborate ceremonial exchange system determine who rises to the top. Prestige comes not from the possession of goods but from the act of bestowing them on others. There is a driving strategy, of course. Recipients of the gifts must return in kind at the next

"They wear their status for all to see. The pearl shells were formerly used as money."

ceremony, and they will lose stature if they fail to give back more.

The self-made leader is a "big man" who displays his generosity for all to see. The man on the last page of this gallery wears a breastplate called an *omak*, each bamboo strip symbolizing a donation of ten sets of pearl shells. In a land where status is measured by the possessions one bestows on others, the nonverbal signal is clear. "I am a very important man with many friends. See how much I have been able to give away."

These body decorations have another, deeper function. Western cosmetics almost always serve to enhance an individual's appearance of health, youth, and attractiveness. In New Guinea good makeup acts as a disguise. If a man or a woman can be identified under the ceremonial costume, this is said to be a bad omen. When the disguise is foolproof, the ceremony is successful and good fortune will redound on the tribe. Decoration enables a person to act out the role assigned to him by myth and magic. He assumes a dramatic new identity, which has a covert set of associated meanings. We see a similar attitude in the Westerner who doesn't feel comfortable in his role until the "look" is right, be it a special three-piece suit, a lab coat, or some favorite piece of jewelry.

Although women may take part in the gift-giving ceremony, called *moka* by one tribe, it is predominantly a male affair. The resemblance to courtship rituals of birds is more than coincidental. Prized decorations

"In this island society a man's status is measured by the value of what he gives away."

are the russet-colored plumes of the Raggiana bird of paradise, which tribesmen consider the most beautiful creature in the forest. Though, like a man, the bird is not powerful, it cuts a fine figure. Hunters tell of being mesmerized and unable to shoot as they watched these creatures.

Anthropologist Andrew Strathern, of University College, London, reports that tribesmen have told him that when men dance, they imitate the actions of birds of paradise in the forest. One participant told him: "The bird dances only when its plumage is fully grown, and we dance only when our pigs are fully grown and we are ready to make *moka*."

The male bird of paradise struts his stuff when his plumes are at their most colorful. His purpose is to compete with other males, to be the most impressive, the most desirable. The winner of this contest attracts the choosiest females—and passes his genes on to a new generation that will carry on the tendency toward ritual display.

In New Guinea the ritual dancer sends the same primal nonverbal signals. His objective is to outdo the other males by putting on his best face and thus entice and captivate the females. The dancer struts and jumps to the beat of the drum, his feathers flash in the sun. As he hops and bows in a tight circle, his tail feathers fluff out excitedly, and he becomes the regal bird in his courtship display. He inspires awe and respect in all who see him. He is man as art. ∞

2081

A guided tour of the American Dream in the 21st century

Last month Princeton physicist Gerard K. O'Neill introduced his "drivers of change," five technologies that will alter daily life in the next 100 years: computers, automation, energy, space colonies, and communications. In this second excerpt of his forthcoming book 2081, the futurist creates a scenario that depicts a society that is in full control of its "drivers," or those technological advances being developed in laboratories today.

In the next century Earth may receive extraterrestrial visitors, but not necessarily aliens. O'Neill speculates that human beings born and raised in remote space colonies will voyage to the distant planet of their ancestors. Eric Rawson is one such visitor, a journalist from the asteroid colony Fox Cluster. After traveling for two years, Rawson is on the last leg of his interplanetary homecoming. Transferring to a space shuttle at an orbiting space station, he nears his final destination: Waterford, Pennsylvania. Following Rawson's account, O'Neill concludes the narrative with a factual commentary of his own.

BY GERARD K. O'NEILL

Once the shuttle had touched ground in Cincinnati and slowed to moderate speed, the main engines shut down, and we taxied silently to the terminal under electric power. A jetway extended toward the plane as soon as we stopped. It led to a waiting room.

I was looking for someone I'd never met, my distant relative Ellen Tehaney. As soon as I gave her name, the computer told me that it would inform her of my arrival. Then the cart went off with my carry-on baggage. It was programmed to remain close to its traveler. Whatever my walking speed, it never left my sight. Within a few minutes the controller buzzed, and when I held it to my ear, a computer voice told me Ellen Tehaney was ten meters ahead. At that moment a light on my controller began giving quick triple flashes, and ahead I saw through the slow-moving crowd a young woman whose controller was flashing in the same way.

Ellen explained that we would travel on an underground high-speed, cylindrical vehicle called a floater, which traveled in vacuum through a tunnel, supporting itself on magnetic fields.

As we waited in the lobby, other passengers arrived to stand in the squares next to us, and a few minutes later, at 15:32, an overhead sign flashed: "15:32 Arrival—Columbus; 15:33 Departure—Erie and Buffalo." At that moment a soft, hissing sound of escaping air sounded from the

PHOTOGRAPH BY TONY GUCCIONE

air lock, and the door swung wide. Ellen remarked that the floater companies were able to make a special point of their on-time arrivals because they never had to worry about the weather.

After all the boarding passengers got settled in the floater, a voice with the perfect diction of a computer warned us that acceleration was about to begin and advised us to consult the video for the services available during our flight. A message flashed. Distance to Erie, Pa., 260 miles/419 kilometers. En route time, 21 minutes. I took out my calculator and concluded we must be cruising at 800 miles per hour, well above the speed of sound.

As Ellen answered my questions, there was a gentle swaying, but no noise and none of the bumpiness that occurs in atmospheric flight. Sometimes the car rolled a little, and then I would feel my weight increase slightly as we took a banked curve. Because our compartment was entirely private, I could have reclined my seat, turned off all the lights, and rested comfortably during the flight.

We passed under Cleveland without even slowing down, and a few minutes later a bell chimed and the video flashed: "Arrival in Erie, Pa., in five minutes. Deceleration begins in three minutes." I could feel the steady deceleration by my tendency to slide forward just a little in my seat. There were no seat belts, because there could be no bumps or panic stops in the totally predictable environment of the floater's vacuum tunnel. My sensation of slowing down ended as we began coasting into the Erie terminal area.

We left our seats and took a baggage cart from a row in the boarding area. Ellen used the cart's controller to call in the license number of her car, so that it would be waiting for us, and then asked for the local weather. A voice told us there was a snowstorm in progress, with possible snow accumulation of 20 centimeters. The temperature was ten degrees below zero, and a northwest wind was gusting to 80 kilometers per hour. Evidently the few kilometers to our destination would be far more difficult than the much greater distance we had covered by floater.

In contrast to the streamlined shape of the jet airplane, the last vehicle I'd seen from the outside, the car was a chunky little box, square at the back, slanted at the front, with four small rubber-tired wheels at the corners. Ellen told the car she wanted to leave at once for her home in Waterford, and the screen confirmed the order by showing the street address, the routing, and the estimated time en route.

We moved immediately, and I heard the faint hum of electric motors. As we left the bright lights of the station platform, our way led between sloping, ivy-covered banks, then to a wide road. Above it arched a glass roof, which admitted a dim and gray sunlight, filtered through miles of cloud. Cars were traveling three abreast, and the space between us and the cars in front and in back was less than a car length.

During the passage, I heard the hiss of air jets playing on the car from all sides. Ellen told me they formed curtains of moving air called airwalls, to keep the weather away from Erie's controlled climate. When we passed the final airwall, the fading afternoon light showed driving snow and sleet. The car began to bump and pitch, and I could see patches of beaten snow on the ground.

Fortunately we were close to our turnoff. I was amazed to see no general glow of lights, but Ellen told me that I should expect none. Waterford was totally enclosed.

The car slowed on a side street, a small sunken roadway bordered by hedges and flowering shrubs and an occasional stone gateway. We turned into one of them and came through to a curving driveway set in a green lawn.

There was a riot of color in the flowers and shrubs set all around. Ellen's parents were waiting for us outside the door—there must have been some automatic communication between the car and the house during the last few minutes—and as we got out, a blast of warm, moist air with a fragrance of flowers washed over me. Ellen's father stepped forward to open my door when the car stopped, and he welcomed me to Waterford. Bill Tehaney had graying hair and a deep tan and moved with athletic grace. I learned later that he was past sixty, but I would have guessed him to be a good deal younger. Jeannette also looked young, too young to be Ellen's mother, and I concluded that both Bill and Jeannette must have taken full advantage of diet, exercise, and antiaging drugs.

"The train began to accelerate. A message flashed: 'Erie, Pa., 260 miles. En route time, 21 minutes.' I quickly calculated that we were cruising at 800 miles per hour, well above the speed of sound."

I was about to take my bags out of the car, but Jeannette told me that Arthur would carry them. At that moment a short, broad figure emerged from the house, looking absurdly like a giant panda dressed in a butler's black suit with a white shirt and black tie. Its round panda face had a spotlight for a nose, two eye lenses, and a speaker for a mouth. Jeannette directed Arthur to carry my bags, and he answered politely and with the perfect diction I'd come to expect from computers' voices.

The house seemed much like those in one of our Polynesian-climate colonies, with plenty of open space, high ceilings, and thick roof beams of natural wood. We climbed the stairs with a carved wooden railing to a carpeted level where Jeannette showed me to my suite, with bedroom, balcony, bath, and exercise room. She showed me the controls for the stereo, the video, and the lights and added that if I just spoke in a normal tone in any room, the house computer would hear me and carry out my instructions.

After I'd unpacked and showered, I found Jeannette in the kitchen, by far the most complex installation of built-in machinery that I'd seen at the Tehaneys'. There was an open grill in an island at the center of the room and, above it, a hood with pots hanging from hooks. One wall was of glass, looking foward the garden. The others were lined with cabinets, appliances, and hardwood counters. One cabinet had doors of black glass through which I could see row on row of wine bottles kept at "cellar" temperature.

Jeannette led me to a desk, sat down, and said "Desk, give me the cube please."

It gave me an eerie sensation to see a featureless amber cube slide upward at her command from the back part of the desk. It was an insubstantial thing, constructed holographically of light rays. Jeannette was so used to it that she paid no attention, but she saw my surprise and explained that this was merely the grocery shopping cube, a standard appliance.

Demonstrating, she touched the key marked PANTRY INVENTORY, and an alphabetized list appeared with quantities beside each item. She chose an item, TERIYAKI SAUCE, and at a command the amber cube became transparent, and a line of bottles appeared in it, all of different brands. Jeannette studied the three-dimensional holographic images of each, rotated them to read the ingredients and other writing, and noted their weights and unit prices, shown digitally on the desk top. She selected one, touched another key, and led me over to a bare counter beside a small door. In less than one minute a gentle chime sounded, then a small tray slid out with a bottle of teriyaki sauce on it.

I was led to Bill's office on the second floor, and its heavy, soundproof door slid open as we approached. Bill smiled and invited me to look around at what he called the tools of his trade. He was, he said, an engineering consultant who also occasionally did a sophisticated kind of selling, and he did most of his work from his office. The large room was commanded by an L-shaped desk, partly slanted to form a control-and-video panel. His chair, a comfortable executive model, had more controls than I'd seen on any chair so far.

It was time for Bill to go to work, but I

asked whether I could stay and observe He seemed pleased by my interest He spent a few minutes selecting and arranging data in his computer and editing a presentation he was about to make Then he keyed an address and his computer locked on to that of a businessman in the Boston area The room darkened but accent lights overhead strengthened to spotlight Bill and the top of his desk so he could be picked up by video cameras I was startled by a sudden movement at the opposite side of the room and turned to see what appeared to be a man full size stepping out of the wall and walking forward to take a seat facing Bill at his conference table I concluded it must be a remarkably lifelike holographic image representing in real-time the movements and gestures of Bill's client several hundred kilometers away

As I was taking my leave of Bill Ellen arrived, ready with plans for the rest of my visit Jeannette suggested tactfully that I might like to get some rest

The lights in my bedroom came on when I entered and then Arthur's voice asked whether I wanted anything At my request he came up to show me the controls for my bed hard or soft tilt contour temperature vibrator and background environmental sounds When he left I spoke the words "Lights off please" I'd have none of the usual strange-room problems of searching for light switches in the middle of the night I wasn't long getting to sleep but my body rhythm had been left somewhere in orbit and within three hours I was awake again None of the advances in transportation had done anything to cure jet lag

In this brief introduction to Waterford and to the Tehaney family I have portrayed only the final result of the history that is likely to bring Waterford's conversion over the middle part of the next century from a quiet Pennsylvania town exposed to wind and bad weather to an enclosed area whose citizens will choose the climate and the weather they prefer Waterford, located near the shore of Lake Erie has a natural climate that is typical of much of the northern temperate zone on both the American and Eurasian continents Winters are damp and biting with a significant amount of rain and snow and summers are hot and humid with much rain In a world where travel is becoming easier all the time it's unlikely that people will continue to tolerate weather that's only occasionally to their liking Yet normal economic and environmental pressures will act against the continued crowding of people into those few areas that have right now the closest natural approximation to good climates With such pressures at some point it will pay developers to build enclosed "new towns" on low-cost land in severe climates Controlling Earth's weather is not a practical alternative The weather system is so complex that one could never predict with certainty the consequences of meddling with it

Though the Tehaneys live in a separate, single-family dwelling, most of Waterford's residential areas are likely to be townhouses or apartments In keeping with a trend that is already clear in our suburban areas The shape of Waterford's enclosure will be dictated by the realities of snow removal and of solar energy Its town plan is apt to be a rectangle with a flat roof

In the private home of 2081, many of the futuristic devices Eric encounters are manifestations of an existing trend in technology, carried forward in a realistic way over another century beyond our era If we survey the modern home in a contemporary industrial nation we find that automation has progressed furthest in the kitchen, these days a cook uses machines for every chore, and with varying degrees of automatic control Since automation has already transformed the kitchen there are no limits to how much change is to come

In his tour of the Tehaney home, Eric observes several of the happy consequences of the drivers of change. Given my predictions about the world of 2081, at best they can be right only in broad outline Yet they're consistent with the histories both of technology and of social interaction

It's an exciting future I'm predicting even more different from the late twentieth century than our own time is from 1880 The opportunities that now lie before us to shape this next century better than the last depend to a great extent on science and its applications through engineering

Quickly as our world is changing I find it reassuring that humankind has weathered the changes brought about during this past century Whatever happens, I'll bet that we'll be able to cope with the next

A thinker who understands numbers better than anyone since Euclid delivers a ringing indictment of modern mathematics

INTERVIEW

MORRIS KLINE

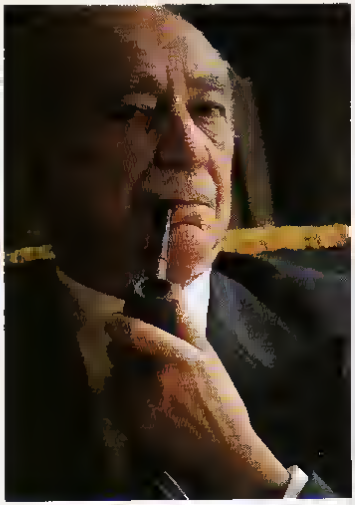
Morris Kline is a slender man, soft-spoken, polite, cultured. For most of his seventy-three years he has been a mathematician in pursuit of what Alfred North Whitehead called "a divine madness of the human spirit." Yet Kline does not display the madness so often paraded by his fellow mathematicians. He is a champion of common sense, but, as Lord Kelvin put it, "Mathematics is merely the etherealization of common sense." That connection eludes many of Kline's colleagues.

Kline has pursued and taught mathematics since 1930, but he is an outspoken critic of both activities. "Most of the mathematical research done today is a waste of time," he says, sorrowfully about his profession. His indictments of mathematics education stretch from elementary school to graduate school.

Kline's specialty is the mathematics of electricity and magnetism, a high-voltage field that led him into secret research for the U.S. Army during World War II, and then to head a research division in electromagnetics at New York University's Courant Institute of Mathematical Sciences. Now a professor emeritus at the Courant Institute, Kline has been a Guggenheim fellow and Fulbright lecturer in Germany and has taught at Stanford University and the Technische Hochschule, in Aachen, West Germany. He was, for 11 years, chairman of undergraduate mathematics at New York University and later a Visiting Distinguished Professor at Brooklyn College of the City University of New York.

Despite his stellar career as an applied mathematician and educator, Kline's major contribution to society may well be his writing. He is a graceful, lucid writer with a poetic style and, in only a half-dozen or so books, has provided us with what may be the clearest, most accessible window on the nether regions of higher mathematics since Plato.

Perhaps his most widely known book, *Why Johnny Can't Add: The Failure of the New Math*, appeared in 1973, after the so-called new math had been introduced (Kline would say "railroaded") into the nation's elementary schools. For those of you who don't re-



"No matter how ingenious a man is at playing chess, it isn't going to change this world one iota. Mathematics may probe deeper problems, but it's the same thing."

member, the important thing in the new math as comedian-mathematician Tom Lehrer put it, "is to understand what you are doing, and not to get the right answer." Kline's outcry was heard, and today new math is only a relic. "There are bits and pieces of it here and there," says Kline, "but the big thing now is 'back to basics.'" (Kline has troubles with the back-to-basics movement too.) He followed *Why Johnny Can't Add* with an indictment of university education in the United States, entitled *Why the Professor Can't Teach*. This book was not so well received, especially in the publish or perish groves of academe. Kline believes that a good scholar and a good teacher are not necessarily one and the same thing.

The success of Kline's latest book, *Mathematics: The Loss of Certainty*, which may well surpass that of *Why Johnny Can't Add*, attests to the public's perception of the importance of mathematics. "There are tragedies caused by war, famine and pestilence," Kline writes, "but there are also intellectual tragedies. This book relates the calamities that have befallen man's most effective and unparalleled accomplishment, his profound effort to utilize human reason—mathematics."

The book has generated discussions in such diverse publications as *U.S. News & World Report*, the *New York Review of Books*, and *New Scientist*. It is an intellectual history, tracing a complicated line of mathematical thought from the ancient Greeks to the day in 1931 when a paper by Kurt Gödel, the foremost logician of the century, pulled the ethereal mathematicians down from their ivory towers. Gödel's paper not only humbled the mathematicians but proved that the ivory towers themselves were foundationless—fictions. Kline's book, though the story it tells ended some 50 years ago, has touched an exposed nerve of the 1980s. It is one more proof of the atomization of our culture, another proof that, as W. B. Yeats put it, "Things fall apart, the center cannot hold."

The following interview was conducted by former *Omni* executive editor Frank Kendig in Professor Kline's office at NYU.

Omni: Your new book has been extremely well received, though it is about a complex and difficult subject. Do you think the subtitle, *The Loss of Certainty*, has anything to do with the book's success?

Kline: Yes. I must credit Oxford University Press for having fixed on that title after I suggested other possibilities. One reason for the interest is that we are living in a new cultural world. We have passed through the Age of Reason, in which people were sure mathematicians especially that we could discover the *truth* about science, about nature, about political and economic systems, all through mathematics. That is no longer the case, and so "the loss of certainty" applies.

Omni: Where should we begin trying to understand this loss of certainty?

Kline: Well, mathematics begins with the Greeks, although one can find a few predecessors. The early literature is unfortunately scanty. The Greeks believed the universe was mathematically designed. Plato, for example, would say that even if there were no human beings, mathematics would exist. Aristotle differed. He believed that human beings were necessary to *abstract* the mathematics from physical reality. But both men did say that mathematics itself was truth.

Omni: Where does God fit into the picture?

Kline: Oh, the Greeks had gods—which the Romans took over, only changing the names—but the gods didn't play a role in mathematics and its relationship to nature. God enters the mathematical picture probably in medieval Europe and carries into the Renaissance and then into the seventeenth and eighteenth centuries. The idea was that God designed the universe, a *mathematical* universe. This belief is very strong in Galileo, in Newton, in Descartes. Not that these men agreed entirely on physical principles, but they agreed that God designed the universe mathematically and that we can discover the mathematical laws if we search hard enough.

Omni: If the universe is mathematical, and you know the mathematics, then can't you extrapolate in either direction—know the past and predict the future?

Kline: Oh, yes. There's a famous statement to that effect. I couldn't quote it verbatim, but basically it says that if you knew all the mathematical laws and the initial conditions—for example, the initial velocities of the objects—you could predict the future.

Omni: Doesn't that leave God with very little to do?

Kline: Well, there are different views on that. Some philosophers have said that what God has done is done forever. Others believe that God is free to intervene at any time and change the structure of the universe for any reason.

Omni: That would be Newton's watchmaker.

Kline: That's correct. Newton said that God had to intervene to keep the world functioning according to plan. I think it was Leibniz who said that God can change the design of the world at any time. But the Greek and the Christian mathematicians believed basically the same thing. The Greeks said the universe is mathematical, the Christians said that God made it mathematical.

Omni: So when did the loss of certainty begin? Where did we take a wrong turn?

Kline: It began around 1800, and it began with geometry. I usually like to quote Mark Twain about this. He said that man is the only animal that has the one true religion—several of them. And that is just what happened with geometry.

The geometry that came from the Greeks is usually called Euclidean geometry, after Euclid. But suddenly at the beginning of the nineteenth century other geometries

continued on page 123

His space art captures Japan's celestial spirit

EASTERN STAR

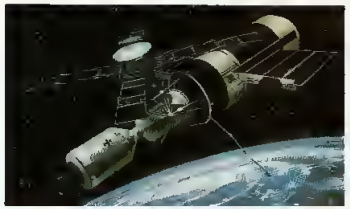
BY F. C. DURANT III

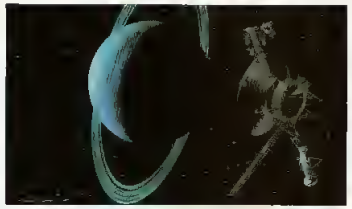
"I am determined not to bring disgrace to the name 'Bonestell of Japan.'" So wrote leading space painter Kazuaki Iwasaki to the great American astronomical artist Chesley Bonestell. It was their first contact. Yet in its formal Japanese way this was Iwasaki's acknowledgment of the ancient Oriental master-pupil relationship that for him exists between the ninety-three-year-old Bonestell and the Osaka man half his age. As a ferociously independent boy, Iwasaki taught himself painting and graphic design and, at thirteen, won highest honors in

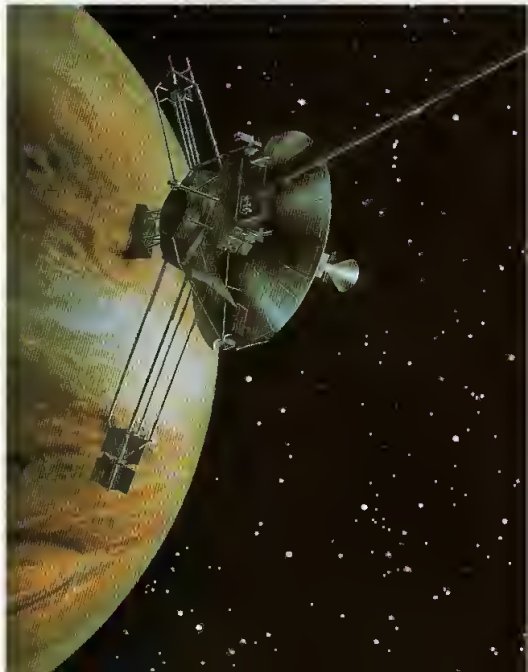
Clockwise from above: Saturn's ring contains rocks and dust; moon's far side; Earth above the lunar landscape; crescent moon in Iwasaki watercolor; Phobos circling planet Mars

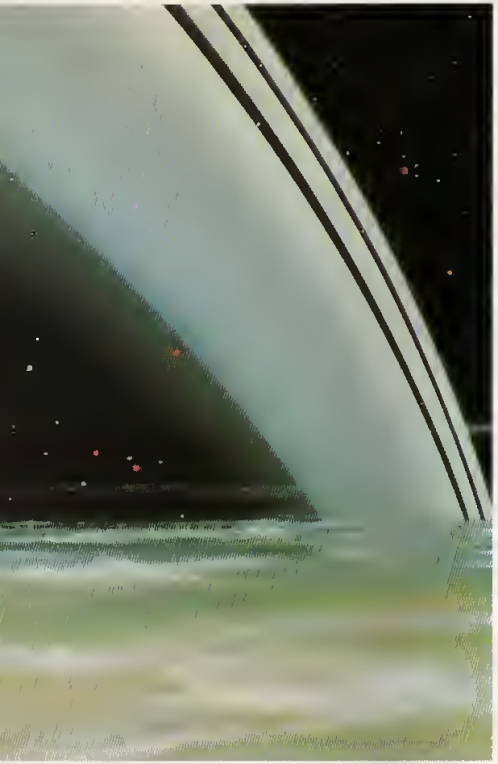
watercolor composition. Star-struck even then, he obtained a copy of *The Conquest of Space*, illustrated by Bonestell. The powerful photorealist renderings of planets and their moons captured him totally, and henceforth Bonestell—in absentia and unaware—became Iwasaki's visionary mentor. Today Iwasaki's art in its serene yet dynamic style pays homage to Bonestell's star-blazing innovation. For Iwasaki there were other fortuitous events. When a significant meteorite fell near his family garden, he knew his fate was in the stars. "The planets became my teachers," he says, "and to observe them I built my own telescopes." He studied with the world's authority on lenses, Shigamaro

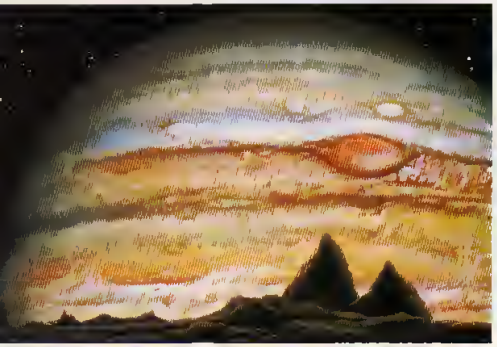
Clockwise from below: Pioneer 11 observes Saturn's ring; Skylab orbits Earth; Voyager nears Uranus; Viking changes orbit over Mars; Pioneer flies above Jupiter's red spot.

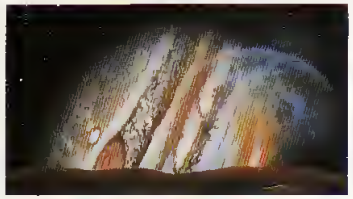


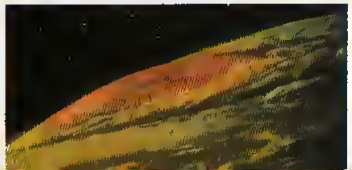












Kibe who lived nearby and at the same time toiled on road crews for 400 yen a day to buy parts He built many fine wooden telescopes, using lenses he constructed and polished himself "I felt compelled to paint what I saw" Today Iwasaki continues his nighttime observations, using telescopes of his own design His new 17-inch equatorial telescope simple and elegant, is considered one of the finest in Japan My large telescope is my powerful ally" he says "The telescope is one of the most inflexible of scientific instruments It shows us reality as it is Unlike Bonestell who uses oil paints, Iwasaki prefers a water-based medium allowing him fine brush movement for detail and ethereal effects "I use ivory-coated stock," he explains "first painting the whole surface black" He also uses a specially designed airbrush The airpiece, as he calls it "is very delicate and has often put me out in my dealings with it But once it gets on well with me it performs what may be called miracles But only when no fault can be found Iwasaki summarizes do I call a painting a work after my own heart

Clockwise from above Iwasaki's vision of an early Earth Jupiter, as seen from Io, rendering of Jupiter's giant spot, an Amalthean view of Jupiter, a close depiction of Saturn

ANGEL

CONTINUED FROM PAGE 66

desperately and heaved it aside.

The crusher rolled beside him faceup, unblinking eyes staring at the sky. Crazy stood at his feet, a rock in his hand.

"Where'd you come from?" Rushmore gasped, his ear ringing.

"Just following the signs," Crazy said. Behind him appeared No-Neck and Stumpie and the punk.

Rushmore looked over at the unmoving crusher again. "You didn't kill him, did you?" he asked.

Crazy prodded the man with his foot. "Looks like it."

"But we *never* kill anybody." Rushmore was kneading his calf to unknot the terrible cramp. "It's like a code—"

"We did in the war," Crazy said. "And they hate us because we remind them of it." He bent over to take the crusher's bo-stick and guns. "That's why this is a war now. It's kill or be killed, and you don't stand a chance without your buddies. That's what I've been trying to tell you." From the crusher's leg pouch he extracted a long, heavy-duty flashlight. "Stumpie, you and No-Neck help me drag this crud into the bushes. You going to stick with us now, Rushmore?"

Rushmore stared glumly at his leg, then at the sign scratched on the car. "Got no choice," he said. "It's fate."

They kept to stream banks and roads that had been abandoned and overgrown, and it took two days to reach the railless ties of what had been the train tracks on the outskirts of the city. Most hoboes came by way of the old railroad classification yard because there were still some derelict boxcars and empty yard buildings good for sleeping or trading news.

But this time the yard seemed empty. A solitary scrap of paper or tarp rolled forward in the wind, like a manta ray drifting over the ocean floor.

"Where'd everybody go?" Rushmore asked of nobody in particular.

"Roundup, maybe," Stumpie said. "*Something* scared them off."

"Maybe not," the punk said, pointing to a lineman's shack nearby. The paint had long ago been scoured away by wind and rain, but across the silvery gray of the weathered wood had been scrawled with a burned stick the triangle and half-circle.

"Sweet Jesus, we're on the track!" Stumpie exulted. "*That's* where they've all gone—the Big Rock Candy Mountain!"

They followed the arrow under the sign to a second sign scratched through the blistered paint of a decommissioned mailbox at the station. A third was soaped on the window of an empty store across the street. Farther and farther the signs led them in toward the populated center of the city. Once they even saw a city crusher in blue, but he was far up a side street and looking the other way.

There were perhaps a dozen more signs

before they found the last of them halfway down an alley behind what had been an elegant hotel chalked on the brick over a huge brass-sheathed door Beside it was a circle with a line through it for a good road and an arrow pointing downward

Crazy's hand trembled as he reached forward and tried the old-fashioned handle It took all his strength to pull the door open Inside was blackness "It's a stairway," he said, peering in "Must lead down to the tunnels under the city"

"You really think this is it?" Stumpie breathed

"Of course " Crazy chuckled "Don't you get it? Those Washington types—they must have figured down there was the safest place in the world Never even guessed hoboes have been living here for generations! What a laugh!

"Maybe it never rains down there," Rushmore said, "but that doesn't make it the Big Rock Candy Mountain " He stared at the horrible cell of darkness inside the door as Crazy and then the punk, stepped in, and then he felt a tugging at his sleeve It was No-Neck, pleading with him to follow "All right " he managed "I guess I've come this far"

Heart racing Rushmore followed Stumpie and No-Neck their footsteps echoing hollowly down through the miles of metal stairs between which now flickered the crusher's flashlight in Crazy's hand below them its bright beam swirling with the dust they'd disturbed At the first landing they found an old shoe planted against the wet and oozing stone wall and farther down an ancient felt hat trampled into the slime of wet concrete crumbs A roach stilted hurriedly behind its monstrously elongated shadow to escape the light as Crazy found the sign scratched into the rough wall and an arrow pointing downward still

At the bottom, perhaps five stories beneath the street a door stood open and the flashlight showed them a slice of endlessly twisting tunnel Along its ceiling ran an arterial maze of small pipes dripping sudden diamond flashes of water through the beam, and on either side were huge steam pipes fat with asbestos wrappings

Crazy led the way into the pounding heat Sometimes they waded up to their ankles through urine-warm puddles quivering to drips from the pipes above occasionally the passage fogged with steam from a small break and they ran with their hands up to protect their faces from the hot mist's sting, and Rushmore contracted with the horrible gagging claustrophobia of the yellow gas cloud of his memories Sometimes at ceiling level the walls opened into crawl spaces and recesses that echoed with scratchings and squeakings while along the edges bright and hungry eyes glittered in the flashlight like a star field stretching into infinity

They found the next sign scratched in spidery white scars with a concrete chip across the grimy brick of a square column at the intersection of three tunnels the

arrow directed them down a descending passage to the left

"It's funny," Stumpie whispered. "You figure these was dug before the buildings, right? So they ought to be laid out neat and square like what's above. But they curve around like—"

"Like worm holes," Rushmore said, biting his lip.

They heard the rushing hiss of the steam break before the flashlight actually found it. The passage was choked with mist that swirled and glowed in the light. *No,* Rushmore thought. *Can't breathe. can't breathe.*

But Crazy was already plowing into it, head down, the cloud brightening as it swallowed his light, the ragged shadows of Stumpie and No-Neck and the punk following. Rushmore plunged after them, afraid to be left in the darkness, but touching his nose shell to reassure himself. However, the steam wasn't hot and wet; it was cold and dry. He nearly tripped on No-Neck's lagging heel. No-Neck was staggering, his face drawn up in an unearthly smile.

"You okay?" Rushmore grabbed him by the shoulders to steady him and found himself bumping into Stumpie's back. He realized that the cloud was no longer glowing with Crazy's flashlight but with a strong, light pink as a Colorado sunrise, that came from the far end of the tunnel.

"Okay?" Stumpie beamed. "'Course he's okay. It's great!" She began to giggle.

Rushmore pushed past them and found the punk sagging on Crazy's arm. Crazy reeled under her weight and dropped the flashlight, and Rushmore stopped angrily to pick it up. *Didn't Crazy think he'd need it to get out again?*

In another moment they were out of the cloud in a vast, low-ceilinged room. On all four walls video screens glowed with endless meadows beneath perfectly blue skies, and there were just enough wisps of white cloud to add depth without threatening anything but eternally fair June weather.

"But will you look at the *food*!" Stumpie was crowing. "A goddamned endless *feast*! Dig in!"

Here and there about the room were folding caterer's tables on which had been piled wrapped sandwiches and cupcakes and soft-drink tubes; some were gnawed by rats that looked back contemptuously at the newcomers, others crawled with roaches and black beetles.

Rushmore stared up at the ceiling, hung from the pipes were theatrical spotlights, shining through pink gels. "What's the matter with you all?" he called as they stumbled toward the tables, scattering the rats and insects. "It's like a goddamned mission—stale food and hard chairs. It's all soft lights and TV screens."

Crazy was giggling and trying to unwrap a pink-frosted cupcake topped with a bright red cherry.

"And where *is* everybody?" Rushmore demanded. "Where are the hoboes from the railroad yard? Where's the one that left us the signs? Tell me, where the hell is *he*?"

"Aw," Stumpie said, "he's out making more signs to show the way. Hell of a swell guy, right? Hell of a swell—"

"Philanthrogist," Crazy said thickly, mouth full of frosting. "Philanthrokist, phurandro—"

Rushmore suddenly felt light, his head spinning. He grabbed the edges of a fable and shook his head to try to clear it. He looked up to see that several figures had appeared at the far end of the room with strange, insectlike faces.

Gas masks, he thought groggily. The steam in the tunnel—a gas of some kind. His nose filters had protected him from what had happened to the others, but he'd still absorbed some through his skin and was feeling its effects.

Now one of the figures was beside No-Neck. He raised a club and brought it down sharply, connecting with a loud crack, and No-Neck spun away, fell stiffly across the table, and spilled to the floor.

"Rushmore feinted to the left, then sprang to the right, but the crusher was too fast and caught him a smashing blow on the calf. His leg collapsed under him, and he toppled forward."

A hugger trap to get rid of hoboes. Whole thing a big rat cage, a Venus's flytrap filled with sticky sweets. *Should have known.* Rushmore struggled to open his mouth. It felt as if it had marbles in it. "Run!" he gasped.

The figures looked up, surprised by his voice. Then one lashed out, and Stumpie slumped onto a folding chair that collapsed with her and clattered on the floor. Crazy and the punk glanced dreamily toward the sound, indifferent. For an instant longer Rushmore watched helplessly. Then he spun on his heel and bolted back into the passageway from which he and the others had emerged.

"One's getting away!" came a muffled shout from behind him.

"He won't get far!"

Back through the billowing doorway of blinding gas he ran, back along the beam, the flashlight stabbed into the darkness, floor stretching like rubber under him, panting, feet splashing through puddles on the stone floor. The dark walls closed in on every side, the glittering rats' eyes above expanded into burning suns. He felt as if he was in the tank again, and he ran.

He didn't remember getting out. When he awoke, he found himself sprawled on a matted compost of mattresses, cushions, and newspapers, refuse from the hotel that had been decomposing for years. What better place for him, he thought. Human refuse. Used up in the war, tossed aside and forgotten.

His skull throbbing, he managed to get himself into a sitting position and finally to stand unsteadily. His head was still light, but he was better, much better. Thank God for the war and the doctors! Fate again, that's what it was.

He was only a block away from the brass door he'd entered—an hour ago? A day? A week? He had no idea. Warily he approached it and gazed up at the triangle and half-circle above it.

Stumpie. No-Neck. Crazy the punk. No telling what had happened to them, no way to gauge how deep the hugger fears and resentments had grown. Would they be given lobotomies and sent off to work in factories? Would their organs be saved and the leftovers ground into fertilizer? Maybe once Rushmore had understood the hugger mind well enough to guess, but he had been cut off from their world too long, and things had changed.

No use mourning, he thought. Fate had gotten him out, and it was time to hit the road again, alone and independent, just like before.

He paused. He'd never been independent, not really. The signs that had steered him away from danger and pointed him toward mooches and places to bunk had been scratched for him on posts and buildings by nameless hoboes who'd gone that way before. They had always been beside him, even when he'd imagined he was alone. He owed them.

And the huggers. He'd thought he could coexist with them by staying out of their way, but they had reached out after him, had even gone so far as to appropriate and pervert the signs he and every other hobo had learned to stake their lives on. And in creating that shabby, fake Eden of stale sandwiches and rancid sweets under the city they had shown their contempt for the hoboes' dreams and myths. He would pay them back for that.

He rose to his toes and rubbed his sleeve slowly and deliberately across the chalk until it had blurred into the rough brick. Then, with a chip of fallen cornice from the ground, he scratched three horizontal lines: danger here.

The huggers would be back to replace it, to lure more hoboes to desfruction. No matter how many signs he obliterated, he knew there would always be more. But, lurking in doors and alleyways, he would outlast them, for the sake of No-Neck and the rest. He would trade his freedom to repay those who had left their marks to guide him along the roads and highways he had followed for the last twenty years. It was simply what fate had always meant for him to be: the angel at the gate. ∞

SEPULCHER

CONTINUED FROM PAGE 76

"I mean it. Don't you keep a schedule?"

"I'm right on my schedule. Elaine. This is Wednesday. I was here last Wednesday. This year Christmas falls on a Wednesday, and I'll be here on Christmas."

"It feels like a year."

"Only ten months. Till Christmas. Elaine, you aren't being any fun."

She wasn't in the mood for fun. There were tears in her eyes. "I can't stand much more," she said.

"I'm sorry."

"I'm afraid."

And she was afraid. Her voice trembled. "At night, and in the daytime, whenever I sleep, I'm just the right size."

"For what?"

"What do you mean?"

"You said you were just the right size."

"I did? Oh. I don't know what I meant. I'm going crazy. That's what you're here for, isn't it? To keep me sane. It's the rain. I can't do anything. I can't see anything, and all I can hear most of the time is the hissing of the rain."

"Like outer space," I said, remembering what she had said the last time.

She apparently didn't remember our discussion. She looked startled. "How did you know?" she asked.

"You told me."

"There isn't any sound in outer space," she said.

"Oh," I answered.

"There's no air out there."

"I knew that."

"Then why did you say 'Oh, of course'? The engines. You can hear them all over the ship. It's a drone, all the time. That's just like the rain. Only after a while you can't hear it anymore. It becomes like silence," Anansa told me.

Another imaginary friend. Her file said that she had kept her imaginary friends long after most children give them up. That was why I had first been assigned to see her, to get rid of the friends. Grunty, the ice pig; Howard, the boy who beat up everybody; Sue Ann, who would bring her dolls and play with them for her, making them do what Elaine said for them to do. Fuchsia, who lived among the flowers and was only inches high. There were others. After a few sessions with her I saw that she knew that they weren't real. But they passed time for her. They stepped outside her body and did things she could never do. I felt they did her no harm at all, and destroying that imaginary world for her would only make her lonelier and more unhappy. She was sane, that was certain. And yet I kept seeing her, not entirely because I liked her so much. Partly because I wondered whether she had been pretending when she told me she knew her friends weren't real. Anansa was a new one.

"Who's Anansa?"

"Oh, you don't want to know." She didn't

want to talk about her that was obvious.

I want to know."

She turned away. "I can't make you go away but I wish you would. When you get nosy."

"It's my job."

"Job!" She sounded contemptuous. "I see all of you running around on your healthy legs doing all your *jobs*."

What could I say to her? "It's how we stay alive," I said. "I do my best."

Then she got a strange look on her face, *I've got a secret* she seemed to say, *and I want you to pry it out of me*. "Maybe I can get a job too."

Maybe," I said. I tried to think of something she could do.

"There's always music," she said.

I misunderstood. "There aren't many instruments you can play. That's the way it is." Dose of reality and all that.

"Don't be stupid."

"Okay. Never again."

"I meant that there's always the music. On my job."

"And what job is this?"

"Wouldn't you like to know?" she said, rolling her eyes mysteriously and turning toward the window. I imagined her as a normal fifteen-year-old girl. Ordinarily I would have interpreted this as flirting. But there was something else under all this. A feeling of desperation. She was right. I really would like to know. I made a rather logical guess. I put together the two secrets she was trying to get me to figure out today.

"What kind of job is Anansa going to give you?"

She looked at me, startled. "So it's true then."

"What's true?"

"It's so frightening. I keep telling myself it's a dream. But it isn't, is it?"

"What. Anansa?"

"You think she's just one of my friends, don't you. But they're not in my dreams, not like this. Anansa—"

"What about Anansa?"

She sings to me. In my sleep."

My trained psychologist's mind immediately conjured up mother figures. "Of course," I said.

"She's in space, and she sings to me. You wouldn't believe the songs."

It reminded me. I pulled out the cassette I had bought for her.

"Thank you," she said.

"You're welcome. Want to hear it?"

She nodded. I put it on the cassette player. *Appalachian Spring*. She moved her head to the music. I imagined her as a dancer. She felt the music very well.

But after a few minutes she stopped moving and started to cry.

"It's not the same," she said.

"You've heard it before?"

"Turn it off. Turn it off!"

I turned it off. "Sorry," I said. "Thought you'd like it."

"Guilt, nothing but guilt," she said. "You always feel guilty, don't you?"

"Pretty nearly always." I admitted cheerfully. A lot of my patients threw psychological jargon in my face. Or soap-opera language.

"*I'm* sorry," she said. "It's just—it's just not the music. Not *the* music. Now that I've heard it, everything is so dark compared to it. Like the rain, all gray and heavy and dim, as if the composer is trying to see the hills but the rain is always in the way. For a few minutes I thought he was getting it right."

"Anansa's music?"

She nodded. "I know you don't believe me. But I hear her when I'm asleep. She tells me that's the only time she can communicate with me. It's not talking. It's all her songs. She's out there, in her starship, singing. And at night I hear her."

"Why you?"

"You mean, Why only me?" She laughed. "Because of what I am. You told me yourself. Because I can't run around. I live in my imagination. She says that the threads between minds are very thin and hard to hold. But mine she can hold, because I live completely in my mind. She holds on to me. When I go to sleep, I can't escape her now anymore at all."

"Escape? I thought you liked her."

"I don't know what I like. I like—I like the music. But Anansa wants me. She wants to have me—she wants to give me a job."

"What's the singing like?" When she said *job*, she trembled and closed up. I referred

back to something that she had been willing to talk about to keep the floundering conversation going.

"It's not like anything. She's there in space and it's black just the humming of the engines like the sound of rain, and she reaches into the dust out there and draws in the songs. She reaches out her—out her fingers, or her ears, I don't know. It isn't clear. She reaches out and draws in the dust and the songs and turns them into the music that I hear. It's powerful. She says it's her songs that drive her between the stars."

'Is she alone?'

Elaine nodded. "She wants me."

'Wants you. How can she have you, with you here and her out there?'

Elaine licked her lips. "I don't want to talk about it," she said in a way that told me she was on the verge of telling me.

"I wish you would. I really wish you'd tell me."

She says—she says that she can take me. She says that if I can learn the songs she can pull me out of my body and take me there and give me arms and legs and fingers and I can run and dance and—

She broke down crying.

I patted her on the only place that she permitted: her soft little belly. She refused to be hugged. I had tried it years before, and she had screamed at me to stop it. One of the nurses told me it was because her mother had always hugged her, and Elaine wanted to hug back. And couldn't.

'It's a lovely dream, Elaine.'

"It's a terrible dream. Don't you see? I'll be like *her*."

'And what's she like?'

"She's the ship. She's the starship. And she wants me with her, to be the starship with her. And sing our way through space together for thousands and thousands of years."

'It's just a dream, Elaine. You don't have to be afraid of it.'

"They did it to her. They cut off her arms and legs and put her into the machines."

'But no one's going to put you into a machine."

"I want to go outside," she said.

"You can't. It's raining."

'Damn the rain.'

"I do, every day."

'I'm not joking! She pulls me all the time now, even when I'm awake. She keeps pulling at me and making me fall asleep, and she sings to me, and I feel her pulling and pulling. If I could just go outside, I could hold on. I feel like I could hold on, if I could just—"

'Hey, relax. Let me give you a—'

"No! I don't want to sleep!"

'Listen, Elaine. It's just a dream. You can't let it get to you like this. It's just the rain keeping you here. It makes you sleepy, and so you keep dreaming this. But don't fight it. It's a beautiful dream in a way. Why not go with it?'

She looked at me with terror in her eyes.

"You don't mean that. You don't want me to go."

"No. Of course I don't want you to go anywhere. But you won't, don't you see? It's a dream, floating out there between the stars—'

"She's not floating. She's ramming her way through space so fast it makes me dizzy whenever she shows me."

'Then be dizzy. Think of it as your mind finding a way for you to run."

"You don't understand, Mr. Therapist. I thought you'd understand."

'I'm trying to.'

"If I go with her, then I'll be dead."

I asked her nurse, 'Who's been reading to her?'

"We all do, and volunteers from town. They like her. She always has someone to read to her."

'You'd better supervise them more carefully. Somebody's been putting ideas in her head. About spaceships and dust and singing between the stars. It's scared her pretty bad.'

The nurse frowned. "We approve everything they read. She's been reading that kind of thing for years. It's never done her any harm before. Why now?"

"The rain, I guess. Cooped up in here, she's losing touch with reality."

The nurse nodded sympathetically and said, 'I know. When she's asleep, she's doing the strangest things now.'

"Like what? What kind of things?"

"Oh, singing these horrible songs."

"What are the words?

"There aren't any words. She just sort of hums. Only the melodies are awful. Not even like music. And her voice gets tunny and raspy. She's completely asleep. She sleeps a lot now. Mercifully I think. She's always gotten impatient when she can't go outside."

The nurse obviously liked Elaine. It would be hard not to feel sorry for her, but Elaine insisted on being liked, and people liked her, those that could get over the horrible flatness of the sheets all around her trunk.

"Listen," I said. "Can we bundle her up or something? Get her outside in spite of the rain?"

The nurse shook her head. "It isn't just the rain. It's cold out there. And the explosion that made her like she is—it messed her up inside. She isn't put together right. She doesn't have the sfrength to fight off any kind of disease at all. You understand—there's a good chance that exposure to that kind of weather would kill her eventually. And I won't take a chance on that."

"I'm going to be visiting her more often then," I said. "As often as I can. She's got something going on in her head that's scaring her half to death. She thinks she's going to die."

"Oh, the poor darling," the nurse said. "Why would she think that?"

"Doesn't matter. One of her imaginary friends may be getting out of hand."

"I thought you said they were harmless."

"They were."

When I left the Millard County Rest Home that night, I stopped back in Elaine's room. She was asleep, and I heard her song. It was eerie. I could hear, now and then, themes from the bit of Copland music she had listened to. But it was distorted, and most of the music was unrecognizable—wasn't even music. Her voice was high and strange, and then suddenly it would change, would become low and raspy, and for a moment I clearly heard in her voice the sound of a vast engine coming through walls of metal, carried on slender metal rods, the sound of a great roar being swallowed up by a vast cushion of nothing. I pictured Elaine with wires coming out of her shoulders and hips, with her head encased in metal and her eyes closed in sleep, like her imaginary Anansa, piloting the starship as if it were her own body. I could see that this would be attractive to Elaine, in a way. After all, she hadn't been born this way. She had memories of running and playing, memories of feeding herself and dressing herself, perhaps even of learning to read, of sounding out the words as her fingers touched each letter. Even the false arms of a spaceship would be something to fill the great void.

Children's centers are not inside their bodies; their centers are outside, at the point where the fingers of the left hand and the fingers of the right hand meet. What they touch is where they live; what they see is their self. And Elaine had lost herself in an explosion before she had the chance to move inside. With this strange dream of Anansa she was getting a self back.

But a repellent self, for all that. I walked in and sat by Elaine's bed, listening to her sing. Her body moved slightly, her back arching a little with the melody. High and light, low and rasping. The sounds alternated, and I wondered what they meant. What was going on inside her to make this music come out?

If I go with her then I'll be dead.

Of course she was afraid. I looked at the lump of flesh that filled the bed shapelessly below where her head emerged from the covers. I tried to change my perspective, to see her body as she saw it, from above. It almost disappeared then, with the foreshortening and the height of her ribs making her stomach and hint of hips vanish into insignificance. Yet this was all she had, and if she believed—and certainly she seemed to—that surrendering to the fantasy of Anansa would mean the death of this pitiful body is death any less frightening to those who have not been able to fully live? I doubt it. At least for Elaine, what life she had lived had been joyful. She would not willingly trade it for a life of music and metal arms, locked in her own mind.

Except for the rain. Except that nothing was so real to her as the outside, as the trees and birds and distant hills, and as the breeze touching her with a violence she permitted to no living person. And with that reality, the good part of her life, cut off from her by the rain, how long could she hold out against the incessant pulling of Anansa and her promise of arms and legs and eternal song?

I reached up, on a whim, and very gently lifted her eyelids.

Her eyes remained open, staring at the ceiling, not blinking.

I closed her eyes, and they remained closed.

I turned her head, and it stayed turned. She did not wake up. Just kept singing as if I had done nothing to her at all.

Catatonia, or the beginning of catalepsy. *She's losing her mind,* I thought, *and if I don't bring her back, keep her here somehow, Anansa will win, and the rest home will be caring for a lump of mindless flesh for the next however many years they can keep this remnant of Elaine alive.*

"I'll be back on Saturday," I told the administrator.

"Why so soon?"

"Elaine is going through a crisis of some kind," I explained. An imaginary woman from space wants to carry her off—that I didn't say. "Have the nurses keep her awake as much as they can. Read to her, play with her, talk to her. Her normal hours at night are enough. Avoid naps."

"Why?"

"I'm afraid for her, that's all. She could go

catatonic on us at any time. I think. Her sleeping isn't normal. I want to have her watched all the time."

"This is really serious?"

"This is really serious."

On Friday it looked as if the clouds were breaking, but after only a few minutes of sunshine a huge new bank of clouds swept down from the northwest, and it was worse than before. I finished my work rather carelessly, stopping a sentence in the middle several times. One of my patients was annoyed with me. She squinted at me. "You're not paid to think about your woman troubles when you're talking to me." I apologized and tried to pay attention. She was a talker, my attention always wandered. But she was right in a way. I couldn't stop thinking of Elaine. And my patient's saying that about woman troubles must have triggered something in my mind. After all, my relationship with Elaine was the longest and closest I had had with a woman in many years. If you could think of Elaine as a woman.

On Saturday I drove back to Millard County and found the nurses rather distraught. They didn't realize how much she was sleeping until they tried to stop her; they all said. She was dozing off for two or three naps in the mornings, even more in the afternoons. She went to sleep at night at seven-thirty and slept at least twelve hours. "Singing all the time. It's awful. Even at night she keeps it up. Singing and singing."

But she was awake when I went in to see her.

"I stayed awake for you."

"Thanks," I said.

"A Saturday visit. I must really be going bonkers."

"Actually no. But I don't like how sleepy you are."

She smiled wanly. "It isn't my idea."

I think my smile was more cheerful than hers. "And I think it's all in your head."

"Think what you like, Doctor."

"I'm not a doctor. My degree says I'm a master."

"How deep is the water outside? Deep?"

"All this rain. Surely it's enough to keep a few dozen arks afloat. Is God destroying the world?"

"Unfortunately no. Though He has killed the engines on a few cars that went a little fast through the puddles."

"How long would it have to rain to fill up the world?"

"The world is round. It would all drip off the bottom."

She laughed. It was good to hear her laugh, but it ended too abruptly and she looked at me fearfully. "I'm going, you know."

"You are?"

"I'm just the right size. She's measured me, and I'll fit perfectly. She has just the place for me. It's a good place, where I can hear the music of the dust for myself, and learn to sing it. I'd have the directional engines."

I shook my head. "Grunty the ice pig was cute. This isn't cute, Elaine."

"Did I ever say I thought Anansa was cute? Grunty the ice pig was real, you know. My father made him out of crushed ice for a luau. He melted before they got the pig out of the ground. I don't make my friends up."

"Fuchsia the flower girl?"

"My mother would pinch blossoms off the fuchsia by our front door. We played with them like dolls in the grass."

"But not Anansa."

"Anansa came into my mind when I was asleep. She found me. I didn't make her up."

"Don't you see, Elaine, that's how the real hallucinations come? They feel like reality."

She shook her head. "I know all that. I've had the nurses read me psychology books. Anansa is—Anansa is other. She couldn't come out of my head. She's something else. She's real. I've heard her music. It isn't plain like Copland. It isn't false."

"Elaine, when you were asleep on Wednesday, you were becoming catatonic."

"I know."

"You know?"

"I felt you touch me. I felt you turn my head. I wanted to speak to you, to say good-bye. But she was singing, don't you see? She was singing. And now she lets me sing along. When I sing with her, I can feel myself travel out, like a spider along a single thread, out into the place where she is. Into the darkness. It's lonely there, and black, and cold, but I know that at the end of the thread there she'll be, a friend for me forever."

"You're frightening me, Elaine."

"There aren't any trees on her starship, you know. That's how I stay here. I think of the trees and the hills and the birds and the grass and the wind, and how I'd lose all of that. She gets angry at me, and a little hurt. But it keeps me here. Except now I can hardly remember the trees at all. I try to remember, and it's like trying to remember the face of my mother. I can remember her dress and her hair, but her face is gone forever. Even when I look at a picture, it's a stranger. The trees are strangers to me now."

I stroked her forehead. At first she pulled her head away, then slid it back.

"I'm sorry," she said. "I usually don't like people to touch me there."

"I won't," I said.

"No, go ahead. I don't mind."

So I stroked her forehead again. It was cool and dry, and she lifted her head almost imperceptibly to receive my touch. Involuntarily I thought of what the old woman had said the day before. *Woman troubles*. I was touching Elaine, and I thought of making love to her. I immediately put the thought out of my mind.

"Hold me here," she said. "Don't let me go. I want to go so badly. But I'm not meant

for that. I'm just the right size, but not the right shape. Those aren't my arms. I know what my arms felt like."

"I'll hold you if I can. But you have to help."

"No drugs. The drugs pull my mind away from my body. If you give me drugs, I'll die."

"Then what can I do?"

"Just keep me here, any way you can."

Then we talked about nonsense, because we had been so serious, and it was as if she weren't having any problems at all. We got on to the subject of the church meetings.

"I didn't know you were religious," I said.

"I'm not. But what else is there to do on Sunday? They sing hymns, and I sing with them. Last Sunday there was a sermon that really got to me. The preacher talked about Christ in the sepulcher. About Him being there three days before the angel came to let Him go. I've been thinking about that, what it must have been like for Him, locked in a cave in the darkness, completely alone."

"Depressing."

"Not really. It must have been exhilarating for Him, in a way. If it was true, you know. To lie there on that stone bed, saying to Himself, 'They thought I was dead, but I'm here, I'm not dead.'"

"You make Him sound smug."

"Sure. Why not? I wonder if I'd feel like that, if I were with Anansa."

Anansa again.

"I can see what you're thinking. You're thinking, Anansa again."

"Yeah," I said. "I wish you'd erase her and go back to some more harmless friends."

Suddenly her face went angry and fierce.

"You can believe what you like. Just leave me alone."

I tried to apologize, but she wouldn't have any of it. She insisted on believing in this star woman. Finally I left, redoubling my cautions against letting her sleep. The nurses looked worried, too. They could see the change as easily as I could.

That night, because I was in Millard on a weekend, I called up Belinda. She wasn't married or anything, at the moment. She came to my motel. We had dinner, made love, and watched television. She watched television, that is. I lay on the bed, thinking. And so when the test pattern came on and Belinda at last got up, beery and passionate, my mind was still on Elaine. As Belinda kissed and tickled me and whispered stupidity in my ear, I imagined myself without arms and legs. I lay there, moving only my head.

"What's the matter, you don't want to?"

I shook off the mood. No need to disappoint Belinda—I was the one who had called *her*. I had a responsibility. Not much of one, though. That was what was nagging at me. I made love to Belinda slowly and carefully, but with my eyes closed. I kept superimposing Elaine's face on Belinda's.

He's learned a lot. The other day he corrected Edwin Newman.

Woman troubles. Even though Belinda's fingers played up and down my back, I thought I was making love to Elaine. And the stumps of arms and legs didn't revolt me as much as I would have thought. Instead, I only felt sad. A deep sense of tragedy, of loss, as if Elaine were dead and I could have saved her, like the prince in all the fairy tales: a kiss, so symbolic, and the princess awakens and lives happily ever after. And I hadn't done it. I had failed her. When we were finished, I cried.

"Oh, you poor sweetheart," Belinda said, her voice rich with sympathy. "What's wrong—you don't have to tell me." She cradled me for a while, and at last I went to sleep with my head pressed against her breasts. She thought I needed her. I suppose that, briefly, I did.

I did not go back to Elaine on Sunday as I had planned. I spent the entire day almost going. Instead of walking out the door, I sat and watched the incredible array of terrible Sunday morning television. And when I finally did go out, fully intending to go to the rest home and see how she was doing, I ended up driving luggage in the back of the car to my trailer where I went inside and again sat down and watched television.

Why couldn't I go to her?

Just keep me here, she had said. Any way you can, she had said.

And I thought I knew the way. That was the problem. In the back of my mind all this was much too real, and the fairy tales were wrong. The prince didn't wake her with a kiss. He wakened the princess with a promise. In his arms she would be safe forever. She awoke for the happily ever after. If she hadn't known it to be true, the princess would have preferred to sleep forever.

What was Elaine asking of me?

Why was I afraid of it?

Not my job. Unprofessional to get emotionally involved with a patient.

But then, when had I ever been a professional? I finally went to bed, wishing I had Belinda with me again, for whatever comfort she could bring. Why weren't all women like Belinda, soft and loving and undemanding?

Yet as I drifted off to sleep, it was Elaine I remembered. Elaine's face and hideous, reproachful stump of a body that followed me through all my dreams.

And she followed me when I was awake, through my regular rounds on Monday and Tuesday and at last it was Wednesday, and still I was afraid to go to the Millard County Rest Home. I didn't get there until afternoon. Late afternoon, and the rain was coming down as hard as ever, and there were lakes of standing water in the fields, torrents rushing through the unprepared gutters of the town.

"You're late," the administrator said.

"Rain," I answered, and he nodded. But he looked worried.

"We hoped you'd come yesterday, but we couldn't reach you anywhere. It's Elaine."

And I knew that my delay had served its

damnable purpose exactly as I expected.

'She hasn't woken up since Monday morning. She just lies there singing. We've got her on an IV. She's asleep.'

She was indeed asleep. I sent the others out of the room.

'Elaine,' I said.

Nothing.

I called her name again several times. I touched her, rocked her head back and forth. Her head stayed wherever I placed it. And the song went on, softly high and then low, pure and then gravelly. I covered her mouth. She sang on, even with her mouth closed, as if nothing were the matter.

I pulled down her sheet and pushed a pin into her belly, then into the thin flesh at her collarbone. No response. I slapped her face. No response. She was gone. I saw her again, connected to a starship, only this time I understood better. It wasn't her body that was the right size, it was her mind. And it was her mind that had followed the slender spider's thread out to Anansa, who waited to give her a body.

A job.

Shock therapy? I imagined her already-deformed body leaping and arching as the electricity coursed through her. It would accomplish nothing except to torture unthinking flesh. Drugs? I couldn't think of any that could bring her back from where she had gone. In a way, I think, I even believed in Anansa, for the moment. I called her name. 'Anansa, let her go. Let her come back to me. Please, I need her.'

Why had I cried in Belinda's arms? Oh, yes. Because I had seen the princess and let her lie there unawakened, because the happily ever after was so damnably much work.

I did not do it. In the fever of the first realization that I had lost her. It was no act of passion or sudden fear or grief. I sat beside her bed for hours, looking at her weak and helpless body, now so empty. I wished for her eyes to open on their own, for her to wake up and say, 'Hey, would you believe the dream I had! For her to say, 'Fooled you, didn't I? It was really hard when you poked me with pins, but I fooled you.'

But she hadn't fooled me.

And so, finally, not with passion but in despair, I stood up and leaned over her, leaned my hands on either side of her and pressed my cheek against hers and whispered in her ear. I promised her everything I could think of. I promised her no more rain, forever. I promised her trees and flowers and hills and birds and the wind for as long as she liked. I promised to take her away from the rest home, to take her to see things she could only have dreamed of before.

And then, at last, with my voice harsh from pleading with her with her hair wet with my tears, I promised her the only thing that might bring her back. I promised her me. I promised her love forever stronger than any songs Anansa could sing.

And it was then that the monstrous song fell silent. She did not awaken, but the song ended, and she moved on her own, her head rocked to the side, and she seemed to sleep normally, not catatonically. I waited by her bedside all night. I fell asleep in the chair, and one of the nurses covered me. I was still there when I was awakened in the morning by Elaine's voice.

'What a liar you are! It's still raining.'

It was a feeling of power to know that I had called someone back from places far darker than death. Her life was painful and yet my promise of devotion was enough, apparently, to compensate. This was how I understood it, at least. This was what made me feel exhilarated, what kept me blind and deaf to what had really happened.

I was not the only one rejoicing. The nurses made a great fuss over her, and the administrator promised to write up a glowing report. 'Publish,' he said.

'It's too personal,' I said. But in the back of my mind I was already trying to figure out a way to get the case into print, to gain something for my career. I was ashamed of myself for twisting what had been an honest, heartfelt commitment into personal advancement. But I couldn't ignore the sudden respect I was receiving from people to whom, only hours before, I had been merely ordinary.

'It's too personal,' I repeated firmly. 'I have no intention of publishing.'

And to my disgust, I found myself relishing the administrator's respect for that decision. There was no escape from my swelling self-satisfaction. Not as long as I stayed around those determined to give me cheap payoffs. Ever the wise psychologist, I returned to the only person who would give me gratitude instead of admiration. *The gratitude I had earned*, I thought. I went back to Elaine.

'Hi,' she said. 'I wondered where you had gone.'

'Not far,' I said. 'Just visiting with the Nobel Prize committee.'

'They want to reward you for bringing me here?'

'Oh, no. They had been planning to give me the award for having contacted a genuine alien being from outer space. Instead, I blew it and brought you back. They're quite upset.'

She looked flustered. It wasn't like her to look flustered—usually she came back with another quip. 'But what will they do to you?'

'Probably boil me in oil. That's the usual thing. Though maybe they've found a way to boil me in solar energy. It's cheaper.' A feeble joke. But she didn't get it.

'This isn't the way she said it was—she said it was—'

She. I tried to ignore the dull fear that suddenly churned in my stomach. *Be analytical*, I thought. *She could be anyone.*

'She said? Who said?' I asked.

Elaine fell silent. I reached out and touched her forehead. She was perspiring.

'What's wrong?' I asked. 'You're upset.'

'That's my present wife, and the other's my wife from a previous life.'

'I should have known.'

Known what?"

She shook her head and turned away from me.

I knew what it was. I thought. I knew what it was, but we could surely cope. 'Elaine,' I said, "you aren't completely cured, are you? You haven't got rid of Anansa, have you? You don't have to hide it from me. Sure, I would have loved to think you'd been completely cured, but that would have been too much of a miracle. Do I look like a miracle worker? We've just made progress, that's all. Brought you back from catalepsy. We'll free you of Anansa eventually."

Still she was silent, staring at the rain-gray window.

You don't have to be embarrassed about pretending to be completely cured. It was very kind of you. It made me feel very good for a little while. But I'm a grown-up. I can cope with a little disappointment. Besides, you're awake, you're back, and that's all that matters." Grown-up, hell! I was terribly disappointed, and ashamed that I wasn't more sincere in what I was saying. No cure after all. No hero. No magic. No great achievement. Just a psychologist who was, after all, not extraordinary.

But I refused to pay too much attention to those feelings. Be a professional, I told myself. She needs your help.

"So don't go feeling guilty about it."

She turned back to face me, her eyes full. 'Guilty?' She almost smiled. "Guilty. Her eyes did not leave my face, though I doubted she could see me well through the tears brimming her lashes.

"You tried to do the right thing," I said.

'Did I? Did I really?' She smiled bitterly. It was a strange smile for her, and for a terrible moment she no longer looked like my Elaine, my bright young patient. 'I meant to stay with her,' she said. 'I wanted her with me, she was so alive, and when she finally joined herself to the ship, she sang and danced and swung her arms, and I said, This is what I've needed, this is what I've craved, all my centuries lost in the songs. But then I hear *you*.'

Anansa," I said, realizing at that moment who was with me.

'I heard *you*, crying out to her. Do you think I made up my mind quickly? She heard you, but she wouldn't come. She wouldn't trade her new arms and legs for anything. They were so new. But I'd had them for long enough. What I'd never had was—you.'

Where is she?" I asked.

'Out there," she said. She sings better than I ever did." She looked wistful for a moment, then smiled ruefully. 'And I'm here. Only I made a bad bargain, didn't I? Because I didn't fool you. You won't want me now. It's Elaine you want, and she's gone. I left her alone out there. She won't mind, not for a long time. But then—then she will. Then she'll know I cheated her.'

The voice was Elaine's voice, the tragic little body her body. But now I knew I had not succeeded at all. Elaine was gone, in the infinite outer space where the mind hides to escape from itself. And in her place—Anansa. A stranger.

You cheated her?" I said. "How did you cheat her?"

It never changes. In a while you learn all the songs, and they never change. Nothing moves. You go on forever until all the stars fail, and yet nothing ever moves.'

I moved my hand and put it to my hair. I was startled at my own trembling touch on my head.

"Oh, God," I said. They were just words, not a supplication.

You hate me," she said.

Hate her? Hate my little, mad Elaine? Oh, no. I had another object for my hate. I hated the rain that had cut her off from all that kept her sane. I hated her parents for not leaving her home the day they let their car drive them on to death. But most of all I remembered my days of hiding from Elaine, my days of resisting her need, of pretending that I didn't remember her or think of her or need her, too. She must have wondered why I was so long in coming. Wondered and finally given up hope, finally realized that there was no one who would hold her. And so she left, and when I finally came, the only person waiting inside her body was Anansa, the imaginary friend who had come, terrifyingly, to life. I knew whom to hate. I thought I would cry. I even buried my

face in the sheet where her leg would have been. But I did not cry. I just sat there, the sheet harsh against my face, hating myself.

Her voice was like a gentle hand, a pleading hand touching me. "I'd undo it if I could," she said. "But I can't. She's gone, and I'm here. I came because of you. I came to see the trees and the grass and the birds and your smile. The happily ever after. That was what she had lived for, you know, all she lived for. Please smile at me."

I felt warmth on my hair. I lifted my head. There was no rain in the window. Sunlight rose and fell on the wrinkles of the sheet.

"Let's go outside," I said.

"It stopped raining," she said.

"A bit late, isn't it?" I answered. But I smiled at her.

"You can call me Elaine," she said. "You won't tell, will you?"

I shook my head. No, I wouldn't tell. She was safe enough. I wouldn't tell because then they would take her away to a place where psychiatrists reigned but did not know enough to rule. I imagined her confined among others who had also made their escape from reality and I knew that I couldn't tell anyone. I also knew I couldn't confess failure, not now.

Besides, I hadn't really completely failed. There was still hope. Elaine wasn't really gone. She was still there, hidden in her own mind, looking out through this imaginary person she had created to take her place. Someday I would find her and bring her home. After all, even Grunty the ice pig had melted.

I noticed that she was shaking her head. "You won't find her," she said. "You won't bring her home. I won't melt and disappear. She *is* gone, and you couldn't have prevented it."

I smiled. "Elaine," I said.

And then I realized that she had answered thoughts I hadn't put into words.

"That's right," she said. "Let's be honest with each other. You might as well. You can't lie to me."

I shook my head. For a moment, in my confusion and despair, I had believed it all, believed that Anansa was real. But that was nonsense. Of course Elaine knew what I was thinking. She knew me better than I knew myself. "Let's go outside," I said. A failure and a cripple, out to enjoy the sunlight, which fell equally on the just and the unjustifiable.

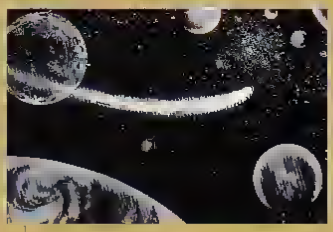
"I don't mind," she said. "Whatever you want to believe, Elaine or Anansa. Maybe it's better if you still look for Elaine. Maybe it's better if you let me fool you after all."

The worst thing about the fantasies of the mentally ill is that they're so damned consistent. They never let up. They never give you any rest.

"I'm Elaine," she said, smiling. "I'm Elaine, pretending to be Anansa. You love me. That's what I came for. You promised to bring me home, and you did. Take me outside. You made it stop raining for me. You did everything you promised, and I'm home again, and I promise I'll never leave you."

NEXT OMNI

ELEVATORS



ASIMOV

FICTION

SPACE ELEVATORS— Today we all know that the once-scorned rocket became the favored method to achieve space travel. In fact, rockets are so successful that other ways of getting to the stars are fast receding from the technological spectrum. Taking a cannon to the stars (*a la* Jules Verne) is still too dangerous to consider, but can we build a stairway to the heavens? Or, if not a stairway, how about an elevator? Scientists Robert L. Forward and Hans P. Moravec speculate on the possibilities of stretching cables from orbiting satellites to Earth, creating a theoretically simple skyhook or "beanstalk." Attaching capsules or cable cars to this mega-wire would generate a whole new space transportation system. In the July *Omni* we see how monstrous rockets must ultimately give way to the cable cars of space.

BABIES ON ICE— The researcher dips a tube into a glass chamber and removes a tiny, frozen sphere. He handles it with supreme care because it holds a human embryo that has been plunged into cryogenic suspended animation until its sterile mother is capable of bearing it. The July *Omni* reports that researchers in England today are working toward the goal of preserving embryos from couples who might otherwise never be able to have normal families. Using Space Age freezing techniques perfected with lab animals, scientists can store embryos for years, carrying us to the brink of startling new possibilities for human creation and longevity.

ASIMOV'S COSMIC TALE— 'If we took a motion picture of the expanding universe and ran it backward long enough, the universe would contract to a point,' writes Isaac Asimov in 'The Very Large Lion and the Very Small Mouse.' At some distant date will the expanding universe begin to collapse back into a point? The key to this mystery may be the neutrino, a neutrally charged, massless particle that is capable of going through more than 20 light-years of lead without being stopped. Read why the tiniest mouse, the neutrino, may finally tame the largest lion, our universe.

PSSSSST! HAVE YOU HEARD ? Did you know that no astronauts ever went to the moon? The famous "landing" was filmed at a secret government base in Nevada. Also, a UFO crashed recently and the alien green bodies are being kept on ice at Wright-Patterson Air Force Base in Ohio. Furthermore, alligators are taking over the New York City sewer system, and *Omni* mixes sex pheromones in its ink. A good unconfirmed rumor has a life of its own, whether it's borne out or not. We asked readers to send in their favorites. Watch for these amazing "facts" in our next issue.

SCIENCE FICTION— Our stories for July include Robert Silverberg's "The Palace at Midnight," a tale of political intrigue in postindustrial America, and Jayge Carr's "Blind Spot," which explores the complex relationship between a skilled but stubborn surgeon and his headstrong patient, a famous artist who is going blind.

She hasn't left me. I come to see her every Wednesday as part of my work, and every Saturday and Sunday as the best part of my life. I take her driving with me sometimes, and we talk constantly, and I read to her and bring her books for the nurses to read to her. None of them know that she is still unwell—to them she's Elaine, happier than ever, pathetically delighted at every sight and sound and smell and taste and every texture that they touch against her cheek. Only *I* know that she believes she is not Elaine. Only *I* know that I have made no progress at all since then that in moments of terrible honesty I call her Anansa, and she sadly answers me.

But in a way I'm content. Very little has changed between us, really. And after a few weeks I realized, with certainty, that she was happier now than she had ever been before. After all, she had the best of all possible worlds for her. She could tell herself that the real Elaine was off in space somewhere, dancing and singing and hearing songs, with arms and legs at last, while the poor girl who was confined to the limbless body at the Millard County Rest Home was really an alien who was very, very happy to have even that limited body.

And as for me. I kept my commitment to her, and I'm happier for it. I'm still human—I still take another woman into my bed from time to time. But Anansa doesn't mind. She even suggested it, only a few days after she woke up. "Go back to Belinda sometimes," she said. "Belinda loves you, too, you know. I won't mind at all." I still can't remember when I spoke to her of Belinda, but at least she didn't mind, and so there aren't really any discontentments in my life. Except—

Except that I'm not God. I would like to be God. I would make some changes.

When I go to the Millard County Rest Home, I never enter the building first. She is never in the building. I walk around the outside and look across the lawn by the trees. The wheelchair is always there. I can tell it from the others by the pillows, which glare white in the sunlight. I never call out. In a few moments she always sees me, and the nurses wheel her around and push the chair across the lawn.

She comes as she has come hundreds of times before. She plunges toward me, and I concentrate on watching her so that my mind will not see my Elaine surrounded by blackness, plunging through space, gathering dust, gathering songs, leaping and dancing with her new arms and legs that she loves better than me. Instead I watch the wheelchair, watch the smile on her face. She is happy to see me, so delighted with the world outside that her body cannot contain her. And when my imagination will not be restrained, I am God for a moment. I see her running toward me, her arms waving. I give her a left hand, a right hand, delicate and strong, I put a long and girlish left leg on her, and one just as sturdy on the right.

And then, one by one, I take them all away. ∞


171
MISS SOLAR WIND
BOB CURRY

INTERVIEW

CONTINUED FROM PAGE 94

were developed—non-Euclidean geometries. Who gets the credit for this is sometimes disputed among historians, but I would say Carl Friedrich Gauss. He was the man who said flatly that we can no longer be sure that Euclidean geometry describes the physical world correctly. The various geometries conflict although one of them, according to thousands of years of tradition, should describe the truth. You can see the problem.

Omni. Can you give me an example of an alternative geometry?

Kline. Well, one can cite as an example the theorem of Euclidean geometry that the sum of the angles of a triangle is one hundred eighty degrees. In one of the non-Euclidean geometries, called hyperbolic geometry, the sum is less than one hundred eighty degrees; in another, called double elliptic non-Euclidean geometry, the sum is always larger than one hundred eighty degrees. Yet all of these geometries are equally accurate insofar as man can measure the sums of angles of triangles.

Omni. Are you saying these other geometries work just as well in measuring out a plot of land or constructing a triangle in the living room?

Kline. Yes. Gauss would have considered these as small triangles and, according to the several geometries, the sum of the angles of all triangles approaches one hundred eighty degrees as the triangles get smaller. The departure from one hundred eighty degrees would be there, but it would be too small to measure. Gauss predicted that if we worked with a very large triangle, say the triangle formed by the earth, the sun, and Jupiter, the difference would be quite noticeable. He didn't have the data. Nobody did in the nineteenth century. But he did say we have to allow for the possibility.

Omni. What did the mathematicians do when the bottom dropped out of geometry, so to speak?

Kline. Many mathematicians tried to rescue and maintain as truths the portion of mathematics built on arithmetic, which by 1850 was far more extensive and vital for science than the several geometries. Unfortunately, other shattering events were to follow. Arithmetic and algebra were the next to go by the board.

The best example of this I could give in a semipopular book was the creation of what are called quaternions, in 1843, by the great mathematical physicist William Rowan Hamilton. Now in the algebra of quaternions, a kind of number known as a hypernumber, multiplication is not commutative. In other words, if I were talking quaternions, I could not say that three times four is the same as four times three. Other strange algebras were created, and it made people start to worry about the laws of ordinary arithmetic. (The one I just stated

Music and Art Cross Paths at the Computer

is known as the commutative law of multiplication.) And if we can have perfectly good algebras in which the old familiar laws don't work, then how do we know they work in the case of the real numbers? That's where a mathematician named Hermann von Helmholtz stepped in and told us we don't know it at all. They work in some situations, but not in all.

Omni: Are there any elementary examples of these sorts of algebras, where two plus two equals six, or where five times seven is thirty-five, but seven times five is only thirty-four?

Kline: I can think of several. Take a quart of water at forty degrees and mix it with another quart of water at fifty degrees. Do you get two quarts at ninety degrees? You do not. It's more like forty-five degrees. So you can't just say I'm going to add forty and fifty and automatically get ninety. It depends on the physical situation.

Consider music: a simple musical tone with a unique frequency and amplitude, say one hundred cycles per second. Now suppose on top of that you impose another note at two hundred cycles per second. Do you get a note at three hundred cycles? Again you do not. It is a note of two hundred cycles, the first harmonic above the one hundred-cycle note. It is the highest harmonic that determines the pitch—two hundred cycles. This is an important factor in the design of musical instruments.

Omni: So algebra and arithmetic went the way of geometry. Did the mathematicians regroup?

Kline: Yes. In the nineteenth century mathematicians finally realized that mathematics, whatever it may say in and for itself, is not necessarily the truth about the physical world. But they still believed that mathematics was a correct, sound, logical development in itself. What followed has been called the axiomatization of mathematics. Errors were discovered in past proofs, and those errors were rectified. By 1900, mathematicians believed they could say that they had a wonderful, perfectly logical development. What it has to say about the real world, well, that is up in the air.

But then the mathematicians—you can date it from about 1900—discovered contradictions within mathematics itself. In other words, what they thought was a perfect, logical structure led to contradictions within any one branch of mathematics. Now that is intolerable. If mathematics is not a perfect body of reasoning, if there are contradictions within any particular branch, then *you can prove almost anything*. If you don't want to use one side of the contradiction, you can use the other. Bertrand Russell was instrumental in pointing out these contradictions.

Omni: So did the mathematicians regroup again?

Kline: Yes, they did, this time into four distinct schools. Each sought to rebuild the foundations of mathematics so that these contradictions would be removed.

Omni: Is that the problem of consistency? Can you explain the difference between *consistency* and *completeness*? I believe those are the important terms.

Kline: *Consistent* means that there are no contradictions within any particular branch of mathematics and that none can ever arise. That brings us to Godel's 1931 paper. If Godel's proof is correct, and it seems to be, then we can never establish the *consistency* of any significant branch of mathematics. We can never prove that there will not be contradictions.

Now *completeness* is not a matter of contradictions. If a branch of mathematics is complete, you can prove or disprove any meaningful statement belonging to that branch of mathematics. The axioms of that branch contain enough information to deduce any significant assertion from those axioms. Godel proved that there will always be meaningful statements within a branch of mathematics that cannot be either proved or disproved. He called them undecidable statements.

> *"Math professors get little training in science. So, many don't use textbooks that introduce scientific problems for fear some bright student might ask a question the professor can't answer."*

So this was the prime reason for the loss of certainty. Godel's proof was the final debacle.

Omni: If mathematics has no underlying truth, if it is filled with contradictions and uncertainties, why does it work?

Kline: There is no definitive answer to that. It just works. The only test we have that mathematics is reliable—not certain, but reliable—is that one can apply its laws to physical problems and make predictions. If the predictions come through, then we can say that mathematics has some substantial basis, but not certainty.

I think people can't help being impressed by what mathematics achieves. Consider the problem of sending a spaceship to the moon and bringing it back. It is entirely mathematical. Of course there is a tremendous amount of engineering involved in the production of the ship, but the entire plan for it is mathematical. We have a theory about the sun, the planets, and more distant heavenly bodies. We say that what makes them behave as they do is the force of gravity. But nobody knows whether there is such a thing as gravity. We have no physical understanding of it. The theory is mathematical; gravity is a scientific fiction.

Omni: The same could be said about electricity and magnetism, couldn't it?

Kline: That's exactly right. Everybody today knows what a radio is, and what a TV is, but nobody knows what a radio wave or a TV wave is. You can't smell one or hear one or taste one. But we do have a wonderful mathematical theory, developed in the nineteenth century by the mathematical physicist James Clerk Maxwell. The evidence for this wonderful theory is the performance of our radio and TV sets. So we have to accept the fact that mathematics works, or else abandon our radios and our TV sets.

Omni: Are most mathematicians, since the loss of certainty, now working on these physical problems?

Kline: No, they aren't. Most of the mathematics created today, maybe ninety percent of it, is a waste of time. That is an opinion, but one that authorities who are far more creative and far better known than I share with me.

Omni: Can you give us an example of mathematics you consider a waste of time?

Kline: Some problems now being considered in the theory of numbers, for example, are a waste of time. Take pairs of primes called double primes. These are prime numbers in a sequence, eleven and thirteen, for example. No even numbers, of course, are primes. Are there an infinite number of these pairs? Are there triple primes? Endless papers are written about these subjects. Who cares?

Speaking of papers, I made the suggestion in one of my books that every paper published in a respectable journal should have a preface by the author stating *why* he is publishing the article, and what value he sees in it. I have no hope that this practice will ever be adopted.

Omni: So you feel that the publish-or-perish system is responsible for this kind of mathematics?

Kline: In part it is. It would be hard today to find a really good, active mathematician who is not associated with a university. That was not always the case. Leibniz never had a university job. Descartes never had a university job. But universities today operate on a publish-or-perish system. Mathematicians, like all college professors, are under tremendous pressure to publish, and it is easier to publish in "pure" mathematics because you don't have to know science. You can limit your investigation to a very small area, and mathematics is divided into hundreds of specialties.

If you confront these people and say they are publishing without regard to value, they retort that mathematics is exciting, beautiful, and challenging. But I doubt whether even ten percent of those who devote themselves to pure mathematics are really concerned with beauty, intellectual challenge, or interesting ideas in themselves.

Omni: It makes mathematics sound a lot like playing chess or bridge. Exciting, beautiful, challenging: the same words

apply to all three kinds of activity

Kline: That's right I m glad you suggested it because it makes the point sharper People enjoy playing chess Some people even devote their lives to it But no matter how ingenious a man is at playing chess or bridge it isn't going to change this world one iota Now mathematicians may probe deeper problems but it is the same thing

Omni. Are there still physical problems to be solved?

Kline: Oh, yes I can mention one that has not yet been solved and is not likely to be solved in the near future—the three-body problem In other words, if you take the earth the sun and the moon and try to predict their motions mathematically you can t do it with precision You have to write down a system of differential equations that would incorporate in mathematical form the motions of all three bodies and such a system has not yet yielded to a solution Some of the best mathematicians have worked on this problem for nearly three centuries

Another problem is elasticity Galileo worked on this problem some three hundred years ago and it is now a branch of mathematics We need mathematics to determine the strength of beams and columns—when they will snap, when they will collapse It is amazing to me that engineers have the courage to put up an eighty-story building with what little we know of elasticity Again it is a problem involving differential equations

Omni: I d like to ask you about mathematics education Is publish-or-perish the main problem in the universities?

Kline: It s certainly one of them Teachers or people who should be teachers are pressed to publish and this takes enormous time and energy Some simply ignore the teaching They will prepare inadequately or not at all walk into a class and just talk off the top of their heads often about things they are working on rather than about the course material Moreover the universities have been using graduate students to do most of the undergraduate teaching Some universities have large lecture classes where a student can see a graduate assistant for tutorial help This is not teaching

Take calculus which is an applied subject There is almost no beauty in it it is a series of techniques for solving scientific problems But mathematics professors get little training in science Some of them as a result are afraid to use a textbook that brings in scientific problems for fear that some bright student might ask a question the professor can t answer They are afraid of being embarrassed They will not take the time to learn the science

Omni: What about mathematics education at the elementary and high-school levels?

Kline: I think that mathematics education the curriculum especially has been horrible in this country from the time we first started teaching mathematics in elementary schools Incidentally mathematics used to be taught only in the colleges even arithmetic There s been a gradual sifting down of the topics sometimes for the good sometimes not

My main criticism is that the curriculum is not meaningful to the student The teachers are trained only to teach mathematical techniques and they're not too secure even about that I think a student has to be convinced that anything beyond computing the price of three pieces of candy if candy sells for five cents apiece is worthwhile Problem solving ought to play a significant role but the problem has to be of interest to the student There is a particular type of problem that one used to find in the textbooks and that is now returning One man can dig a ditch in six days another man can dig the same ditch in eight days How long would it take for the two men to dig the ditch together? Now what the heck s the interest in that?

This sense of usefulness of being worthwhile is extremely important in high school where the students are asked to learn algebra geometry trigonometry What for? I challenge these teachers by asking them whether they ever in their lives had to solve a quadratic equation outside the classroom The answer is always no

Omni: Didn t the new math people change the curriculum?

Kline: They did and they were right in saying we must improve mathematics education They just did it the wrong way The leaders of the new math were college professors who had no experience teaching in elementary or secondary schools There were a few exceptions They presented mathematics as they understood mathematics and it was much too sophisticated for the students and that s why the movement failed That s why I opposed it right from the start Now it is back to basics which is really the old curriculum with a little new math thrown in here and there But it is still not meaningful

Omni: Does it boil down to the fact that mathematics is simply a difficult subject?

Kline: It is perhaps the most difficult subject One of my favorite quotations comes from the great mathematician Hermann Weyl He died in 1955 Weyl said that mathematics is not a natural concern of men It has the inhuman quality of starlight brilliant and sharp but cold I think he's right Sure some people perhaps influenced by a very good teacher take to mathematics without asking why they have to learn it They are what we call good students but are they if they accept unquestioningly what is not meaningful to them? But most students don't behave that way They react against mathematics or suffer through it glad to be rid of it once they have finished their required courses If the values and relevance of mathematics were presented along with the mathematics however I believe that almost all students would take to it very quickly and maybe even enjoy it

CONTINUED FROM PAGE 10

we must wait until our investment in the future will show positive returns.

Rick Erickson
Millinocket, Me.

G. Harry Stine's article on solar-power satellites [SPS] is indicative of the technician's approach to solar energy. "Necklace in the Sky" extols the practicality and benefits of SPS, but it fails to mention costs.

The capital necessary to finance SPS would prove as cost-ineffective as nuclear-power generation. The project would drain resources from more practical, cost-effective, decentralized energy alternatives such as conservation, district energy supply, cogeneration, etc.

SPS reflects a mentality that bigger is better, that increasing the scale of an energy system increases its efficiency. Unfortunately, the Department of Energy's insight into energy potentials leans toward megaprojects.

Solar-power satellites could send practical solar activities hurtling back to the Dark Ages, not into the future.

Steven Stepan
Austin, Tex.

Population Control

Isaac Asimov's population-control proposal [Last Word, October 1980] was a disappointment. Dr. Asimov resorted to the old, worn-out idea that overpopulation is solely the fault of women. I note he does not propose tampering with men's hormones or their sex drive.

Let's approach the problems of sexuality and reproduction from a different perspective. Which sex is fertile 365 days a year and cannot have an orgasm without making a contribution to the population explosion? Certainly not the female sex.

Human females are infertile about 20 days out of every month, and they can enjoy sexual relations whether they are fertile or not. It isn't women who need to evolve. When are you guys going to get your act together?

Karen Roothaan
Bar Harbor, Me.

Equal Time

The clamor for equal time coming from creationists puzzles me [Forum, January 1981]. Until a century ago creationists had about 99 percent of the time. If they don't get any time for the next century, they still will have had much more time than the evolutionists.

I have a hunch that creationists are highly vocal. A reader poll might well show a heavy preponderance of evolutionists.

If I were the only believer in, for example, life on Mercury, would you be willing to give *me* equal time as opposed to the several billions of nonbelievers?

Dick Cooke
Copenhagen, Denmark

CONTINUED FROM PAGE 40

level and flow of water even during a heavy winter rainfall.

In 1976 Disney technologists began looking into alternative water-treatment systems. The objective was to develop a cheap, natural method of processing sewage. One approach they considered, and are still working on, involves the use of the water hyacinth, a fast-growing weed that chokes rivers and gets caught in the propellers of powerboats. Engineer Andy Kruzic explains, "The water hyacinth flourishes on the very nutrients we seek to remove from wastewater in order to prevent other weeds and algae from proliferating. It seemed reasonable to grow it in a controlled environment as a water-cleansing system." The project, which is partly funded by the Environmental Protection Agency, may eventually lead to a useful method of treating sewage in small communities and undeveloped nations.

In collaboration with the Department of Energy, Walt Disney World is working on another type of waste-treatment plant. This one will incinerate as much as 77 metric tons of solid refuse each day and will generate about 15 percent of the Magic Kingdom's energy needs in the bargain. That would equal about 1 million gallons of oil annually. The same facility will also serve as a pilot operation for a "slagging pyrolysis" incinerator capable of handling low-level radioactive wastes, though no radioactive material will actually be handled there. The final product is an inert, rocklike slag acceptable at a federal repository.

In the field of transportation, Disney World is unquestionably a trendsetter. A train type ride propelled by a linear induction motor (LIM) has become the prototype for a similar system being built at Houston International Airport. Several urban areas are considering it for mass transportation systems. The chief advantage of the LIM is that it contains no spinning parts. This unusual feature reduces wear. And because there is no centrifugal force, the motor's speed is virtually limitless. The LIM may one day find use in mass drivers, electromagnetic guns that could shoot mined ores off the surface of the moon for processing in orbit or here on Earth.

What are these advanced systems doing in an amusement park? Leroy Gordon Cooper, Jr., former astronaut and vice president for research and development at WED Enterprises, the design arm of Walt Disney Productions, thinks he has the explanation for this incongruity.

"People are always seeking new experiences," he replies, "and a new technology can certainly provide a new experience. The monorail at Disney World, for instance, can be viewed simply as a way to get from one place to another. Yet for many of the visitors the ride itself is an exciting experience, particularly when the train glides right into the lobby of the Contemporary Resort Hotel."

But probably the most intriguing use of technology at Walt Disney World is something quite different. Problem: Thunderstorms burst forth in the Orlando area with frightening speed. The moment one is spotted approaching, the Skyway cable car must be closed down, the lakes cleared of people and boats, and the computers put on critical power so that a lightning strike won't cripple the attractions. Obviously, the sooner park managers can be alerted, the better. Solution: Disney meteorologists have installed their own radar system on top of the Contemporary Resort Hotel to help them monitor the weather conditions.

A couple of years ago Disney World was hosting a large and important international meeting. Ridgway explains what happened: "As a major outdoor function was coming to an end, one of our radar people came over to me and whispered that a storm was forming and that it would be on us in twenty minutes. The guests were astounded when we handed out three thousand umbrellas just as the first drops of rain hit the ground. One Italian woman even muttered something about *magico*.

"But of course," he adds, "there was no magic involved—just a judicious use of some modern technology and a good stock of umbrellas." DO

MIND

CONTINUED FROM PAGE 26

According to scientific studies the population of lonely souls that crave outlets like the Apology Line transcends geographic or social boundaries There appears to be no significant difference between the frequency of loneliness in a metropolis and that in the country. No age group is immune to the condition But according to Weiss, "Loneliness is fiercest during late adolescence afterward it tapers off."

There are two distinct forms of loneliness, the study finds social and emotional Emotional loneliness more common in men is caused by the inability to satisfy the biological need to form personal intimate attachments Weiss claims, "This is exacerbated by situations of stress both objective and subjective And it is often work related" Men are more prone to emotional isolation because they tend to form fewer casual platonic relationships than women do However, in extremely stressful situations, such as war or imprisonment men do form emotional relationships with other men in order to avoid loneliness

Women however, experience heightened social loneliness a sense of detachment from the community more often than men do "Women, especially housewives who stay home or who have moved into a new unfamiliar area, are more apt to feel socially isolated," Weiss says For the socially lonely the divisions in the day become increasingly meaningless Sleep cycles may be reversed with the woman dozing in the middle of the day but remaining wide awake most of the night.

Normally and much to the chagrin of scientists studying the phenomenon, loneliness is a fleeting sensation unlike chronic depression Weiss says, "The difference between depression and loneliness, among other things is that the lonely person feels a pressure and a desire to change the situation A depressed person feels there is nothing he or she can do They feel helpless about the situation " The Apology Line is one way they can grope for the change they desperately need

The deluge hitting Apology Line indicates an enormous society-wide need for anonymous confession In the not-too-distant future other psychological tools may be developed to deal with the problem We may have loneliness workshops, community loneliness lines on which faceless humans can communicate with others free from the fear of meeting them and, ultimately, antiloneliness drugs to alleviate the physical side effects Until then we can talk to an empty phone connection in Soho

It is 10 PM Crickets can be heard on the end of the line "If I lived in New York City like you, I'd have a lot to apologize for But down here, in one of the most beautiful sections of Mississippi we have nothing to apologize for"

Touché ◘◘

CONTINUED FROM PAGE 44

commented No one seems to have seen the mysterious craft after that Balloon airplane—or flying saucer? You pays your money and you takes your choice In 1952 flying saucer fever was running high

The Oakland *Tribune* was mistaken After excitement died down in California sightings proliferated elsewhere

It wasn't until the mid-1960s that the mysterious-airship story really began to surface again People who were interested in UFOs such as Jerome Clark Jacques Vallee Lucius Farish and Loren Gross began digging into old newspapers and bringing the story out in bits and pieces at first in specialized UFO publications like *Flying Saucer Review* or in privately printed booklets Two individual cases one in Texas, the other in Nebraska received national publicity however this coverage was highly sensationalized and generally inaccurate and did not add anything to our understanding of the airship mystery

Some popular UFO books devoted a few pages or a chapter to the mysterious craft But the public even that segment of the public that has more than a passing interest in UFOs generally remains unaware of the scope of this late-nineteenth-century phenomenon

In recent months I've examined much of the evidence collected over the last 15 years or so relating to that airship This consists primarily of newspaper stories from 1896 and 1897 There are an enormous number of them from papers large and small (Much of this evidence by the way is fast disappearing as financially strapped libraries and historical societies abandon their old newspaper files)

What strikes one—this one anyway—is the almost eerie parallelism between what happened during the six months or so of the mystery-airship excitement and what was to happen a half century later in 1947, when the flying-saucer fever began In both historical periods—at the turn of the century and since the end of World War II—what most people reported seeing were strange lights in the night sky Many publications then as now ridiculed the accounts of witnesses but nevertheless continued to give the topic a lot of publicity and to foster the excitement The scientific and technical community was largely unimpressed attributing the sightings to misidentifications of Venus or some star or other or to just plain fraud You can take it from me that this is pure fake grumped Thomas Edison when he was asked his opinion of the airship

Dozens of individuals were identified as the inventor of the strange aircraft There were numerous announcements that the inventor was just about to come out of hiding and put his airship on public display at some exhibition or other Some said he would fly to Washington D.C to take out a patent But no one ever stepped forward

The "mystery" was never really solved However it does present certain problems for those who believe that extraterrestrial vehicles exist

Many of the airship sightings were unquestionably misidentifications Venus was prominent in the sky during the six months of the excitement There were hoaxes aplenty Journalism was a bit more unbuttoned in those days, and respectable newspapers regularly printed stories that today would appear only in checkout counter tabloids in the sleazier UFO magazines and on some of the sensationalized TV shows

Owing to the nature of the evidence which is almost exclusively newspaper stories and often rather vague ones it is not possible to identify confidently each and every airship report either as a misidentification or as a hoax So there may be an unexplained and unexplainable residue just as supporters of UFOs say exists among modern UFO reports

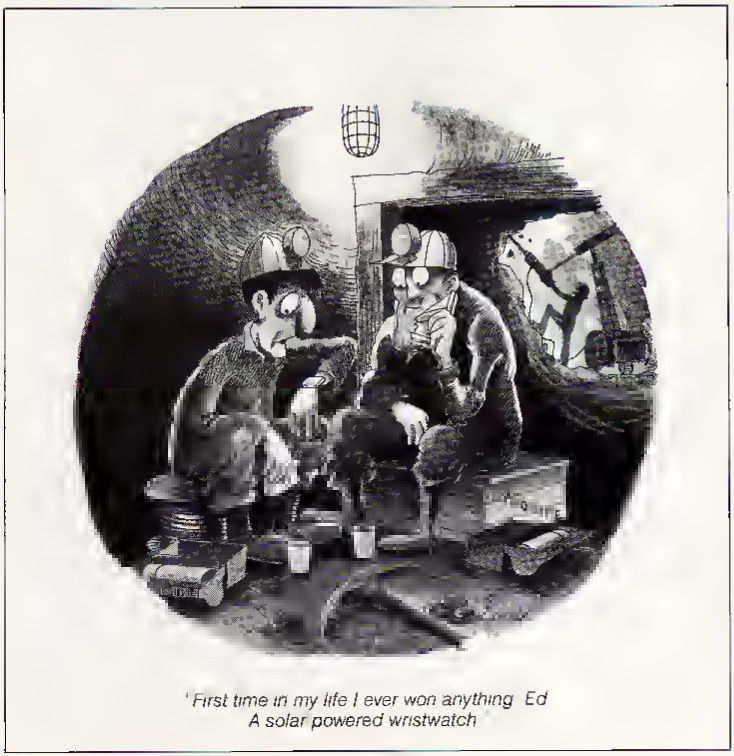
One need not be accused of indulging in speculative flights of fancy who says flatly that UFOs are not a modern phenomenon The unconfirmable mystery airship pushes UFOs back at least to 1896 And they may go back much further than that

The years between 1897 and 1947 were not devoid of UFO reports either Mysterious airships were reported over Great Britain in 1909 and 1910 Late in 1910 there were real and unmysterious airplanes and dirigibles but none that could have accounted for those sightings Early in 1913 there were sightings of mysterious airships over Britain once again and war-jittery Englishmen construed them to be German zeppelins but they weren't There were the foo fighters during World War II and the Scandinavian "ghost rockets" of 1946 From all of this one comes to suspect that UFO activity—whatever it is—is a fairly constant element of our history and the "waves" or "flaps" are really artifacts of publicity and data-gathering techniques

If UFOs are indeed extraterrestrial spaceships why did they appear to be *fin de siecle* visions of an airship in 1896 and 1897 zeppelins in 1913 and disc-shaped spaceships only after 1947?

Is the whole UFO business simply a psychological and sociological reaction to the misidentification of prosaic objects fanned by sensational publicity and outright fraud? Are mysterious airships and flying saucers merely the reflections of the hopes and fears of different eras? Or must we plunge into the misty world of Jungian symbols alternate realities and cosmic deceptions? As the Oakland *Tribune* once said "You pays your money and you takes your choice"

At the very least the now-well-documented mysterious-airship excitement of 1896 and 1897 must be dealt with in any serious attempt to explain UFOs ∞



"First time in my life I ever won anything Ed A solar powered wristwatch"

Our third invitation
Images from A D 2000

PHOTO CONTEST

By Geoffrey Golson

Our Cover Photography Contest announced last January drew nearly 1 500 entries We asked readers to capture *Omni* s unique editorial focus in a single photograph Robert Kittila of Anaheim, California best met that challenge by combining sculpture, special effects and darkroom techniques in one poignant image this month's cover Kittila received a gold-embossed diploma, a $500 check and the opportunity to showcase his work on thousands of newsstands around the world Look for a gallery of more finalists in the July *Omni*

The increasingly superior quality of submissions prompts us to announce *Omni* s third in a series of photography invitationals For this competition, the photographer is asked to portray the year 2000 How do you take a picture of the future? No one has yet invented a camera that can do it But the photographer s imagination combined with the appropriate technology, can produce visual simulations of a future setting Use your imagination to travel through time and photograph the world a generation from now

Pete Turner is an artist who can deftly conceptualize the future on film The examples on this page (from "Plains of Forever" March 1981) show how Turner peers through his lens to record a graphic statement of his own personal vision

We're looking for similar statements that act as crystal balls opening windows to A D 2000 showing us a society at the threshold of the next millennium

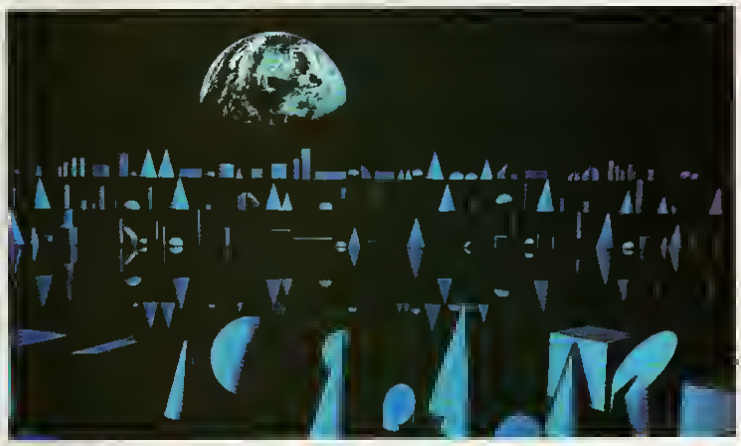
To the photographers who can best present the future in one picture we award the following prizes

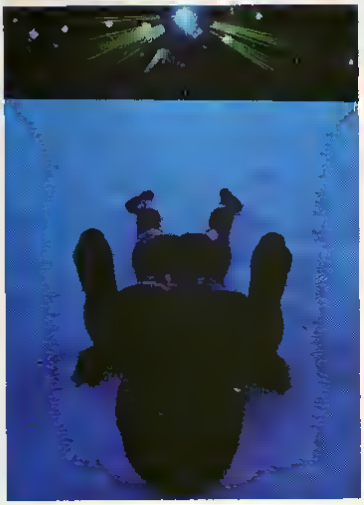
The First Prize winner will receive a gold-embossed certificate from *Omni* $500 in cash and guarantee of publication in a subsequent issue

The Second Prize winner will be presented a silver-embossed certificate The Third Prize winner will receive a bronze-embossed certificate

Here are the rules

1 All photographs submitted for judgment must be original previously unpublished and solely your property





2 You may enter more than once but each entry must be submitted separately

3 The competition is open to everyone except employees of Omni Publications International Ltd and their families

4 Color slides Print your name and address on the slide's border as well as on an accompanying letter explaining the subject of the photo and how specifically, the photo was made

5 Prints Print your name and address on a small slip of paper, and tape it to the back of the print Put your name and address on the accompanying letter

6 We cannot return any photos If you wish to keep the original have a duplicate of your slide or print made, and send that

7 Photo Contest finalists will be chosen by the contest editors Scot Morris and Geoffrey Golson *Omni* Art Director Frank DeVino and *Omni* Editor, Publisher, and Design Director Bob Guccione

8 *Omni* will have the right to reproduce all entries in *Omni*, its advertising promotion and displays and in shows and exhibits without limitation *Omni* will pay its standard fees for editorial use of any entries for purposes not connected with the Photography Contest

9 Prizewinning contestants may not permit publication or display of prize-winning photographs without the prior written consent of *Omni*

10 Entries must be postmarked no later than August 1 1981 Pack them carefully and send them to Omni Photo Contest 909 Third Avenue New York NY 10022

PSYCHIC TATTOOS

PEOPLE

By Dick Teresi

It totally scares me that people might be marked with something trivial on their bodies for the rest of their lives," **Jamie Summers** told *Omni* at the recent World Tattoo Convention in Philadelphia.

Summers works in a world dominated by motorcycles, muscles, and machismo where painting is done on the skin and meant to last forever. However, as a thirty-two-year-old graduate of the San Francisco Art Institute, she has no interest in incising the usual battleships and blonde bombshells on your biceps. She thinks tattoos should be not only works of art but talismans as well—as they were in primitive cultures—that reflect any given person's psyche.

To do this, Summers spends weeks, and sometimes months, conducting personal consultations and preparing sketches for her subjects before executing the final, tattoo. She sees her role as somewhat psychic; she told *Omni* writer David Monagan, and acts as a medium, trying to bring out on the skin what is within.

Meeting with one prospective client for months, Summers kept envisioning a double cocoon with a butterfly above trying to pry the silken package open. When told of this, the woman was stunned. Born seven minutes before her twin sister, she suffered from a lifelong anxiety that she may have tried too hard to control her younger sister's life.

Summers became involved in tattooing four years ago after hearing a lecture by Ed Hardy, the Californian generally regarded as the most technically adept tattooist in this country. Instead of ending her own technical artistic training with a Master of Fine Arts degree, she began a two-year apprenticeship with Hardy in San Diego. Now working strictly by herself, in the San Francisco Bay Area and in New York City, she usually executes a long series of exquisitely detailed drawings and watercolors before rendering the talismanic tattoos that are destined to grace another person's body for a lifetime. For her own artistic ego, she creates sculptures that have won her critical acclaim in shows in New York.

Jamie Summers. Talismans on the skin.

Dan Slater amid cosmic surplus. A quarter ton of Viking gear for less than $500.

With the proliferation of satellites and expended rocket stages, many experts have begun to worry about hardware cluttering up space. For **Dan Slater**, an engineering consultant in La Habra, California, space junk has taken on a more immediate importance. It's cluttering his three-bedroom home.

Slater recently purchased from Jet Propulsion Laboratories, for a modest $444, a quarter ton of leftover Viking equipment that didn't make it to Mars.

Among his prized objets d'art: a television camera from the unmanned Surveyor moon project, half of a backup *Mariner 2* space probe, an Apollo hatch, and a *Skylab* vacuum cleaner. He also has sundry flight recorders, solar panels, and 20 to 30 rocket engines. Slater combs government lists in search of cosmic surplus. "The Apollo program seems to have the largest quantity of leftover equipment. Things from the Mercury, Gemini, and *Skylab* projects are rare finds," he points out. "Inflation is another problem. Stuff used to be really cheap. Now prices are truly astronomical."

OMNILOG

By Geoffrey Golson

Special activities in the realms of science and speculation during the summer of 1981 expand our awareness of the future. *Omni*'s datebook alerts readers to the following events.

• Earth passes aphelion on July 3. At this distance from the sun—94,479,300 miles—the earth receives 7 percent less sunlight than it did in January.

• Partial lunar eclipse on July 16 and 17 belongs to a series that began in A.D. 917 and ends in 2396. More than half of the moon will move into the umbral shadow of the earth. The eclipse may be seen anyplace the moon rises, including most of the North American continent.

• Perseid meteor shower peaks on the night of August 11 with as many as 50 meteors per hour. Astronomers say the shower has been showing fireballs recently and some should be visible.

• *Voyager 2* spacecraft arrives near Saturn on August 25 to test and photograph the ringed planet before traveling on to Uranus in 1986 and Neptune in 1989.

• The Smithsonian Institution announces up-to-date reports on solar-flare activity, Earth's magnetic field, planet conjunctions, moon phases, and other space/Earth phenomena. Call Dial-a-Phenomenon at 202-357-2000.

PARTICIPATORY EVENTS

Opens June 1. "Deep Sea Dives to Biological Frontiers" focuses on the exploration of the Galápagos Rift and the East Pacific Rise, where scientists have discovered giant clams, worms, and crabs and other previously unknown animals. Many of these creatures are on display along with an explanation of how they derive energy from sulfur compounds in geothermal springs. Also on display is a large-scale model of the Navy research submersible *Alvin*. Contact the National Museum of Natural History, in Washington, D.C., at 202-357-2458.

June 10–September 15. "Cosmic Catastrophes" visits sites in our galaxy where icy comets hurtle among the planets, rocky meteoroids bombard worlds, stars act like cosmic whirlpools, and exploding stars spray deadly radiation into space. The show portrays colliding galaxies and violent eruptions from quasars. Call the Adler Planetarium, in Chicago, at 312-322-0304.

A total eclipse of the sun on July 31 will be visible in Russia, China, and the western Pacific.

June 13–15. Advention '81. Frank Herbert, whose speculative intellect has few rivals in modern science fiction, is the guest of honor at the Australian SF convention. Contact Advention '81, P.O. Box 98, Rundle Street, Adelaide SA 5000, Australia.

June 16–August 16. "The Moving Image" is an exhibition of artwork used in the production of animated films. A history of the medium will include the work of such classic animation studios as Disney, McCay, Hanna-Barbera, Fleischer and Bakshi. Contact the Cooper-Hewitt Museum, in New York City, at 212-860-6868.

Continuing in the summer. "Space Shuttle Update" examines the ongoing progress of NASA's shuttle project. A history of the program will be illustrated with films and photographs. Flight tests and experiments planned for the mid-1980s are outlined. Contact the National Air and Space Museum, in Washington, D.C., at 202-357-1552.

July 1–5. The National Air and Space Museum celebrates its fifth anniversary with an after-hours birthday party open to the public. Other special attractions include model-building workshops and free concerts. Contact the National Air and Space Museum, in Washington, D.C., at 202-357-1552.

July 3–5. Westercon 34. C. J. Cherryh, an American writer of romantically conceived but gracefully paced adventures, is the guest of honor at the Sacramento SF convention. Contact Westercon 34, P.O. Box 161719, Sacramento, CA 95816.

July 11–August 9. "Artists and Space Flight" is a collection of art commissioned by NASA to chronicle the development of space exploration. Thirty-five watercolors, drawings, and prints by such artists as Tom O'Hara and Robert T. McCall are on

exhibit. Contact the Fernbank Science Center in Atlanta at 404-378-4311.

July 13–20 Space enthusiasts celebrate a week of public events to commemorate this nation's accomplishments and to direct the country toward a more vigorous space program. Activities include multimedia presentations, balloon and rocket launches, exhibitions, parades, banquets, stargazing parties, speeches, colloquiums and concerts. For further information and a list of cities participating in Space Week '81, see this month's Space column, on page 22. Contact Troy Welch, Space Week National Headquarters, P.O. Box 58172, Houston, TX 77058.

July 18–September 4 A one-man exhibition of holographic works by New York artist Sam Moree is scheduled. Holograms are three-dimensional art forms that combine art and science to create fascinating optical effects. The Museum of Holography operates an information service to answer requests for data on holography. Films about the medium are shown continuously during gallery hours, and the museum's bookstore has the largest selection of holography- and light-related books and products in the world. Contact the Museum of Holography in New York City at 212-925-0526.

July 24–26 Mark of Paracon, William Tenn, a genuinely comic and incisive science-fiction writer, is the guest of honor at the Pennsylvania SF convention. Contact Bob Castro, 425 Waupalani Drive, #24, State College, PA 16801.

August 10–14 and 17–21 The Massachusetts Institute of Technology conducts special summer sessions on those technologies that integrate film, video, graphic design, image processing, human factors, psychology and telecommunications. The first session of the program explores the interaction between humans and machines in fields such as 3-D imaging, home information systems, computer-aided design, teleconferencing and speech synthesis. The second session focuses on an example: the optical video disc. Contact the Director of Summer Sessions, Room E19-356, MIT, Cambridge, MA 02139.

August 14–16 Stucon 1. Marion Zimmer Bradley, a writer of action science fiction with swashbuckling galore, is the guest of honor at the German SF convention. Contact Jürgen Mercker, Eichenweg 24, D-7016 Gerlingen, West Germany.

August 31–September 4 The British Association for the Advancement of Science holds its annual meeting and celebrates its 150th anniversary. The program features many symposia on all aspects of science ranging from zoology to physics. Special events are scheduled for Celebratory Day, on September 2, to commemorate the founding of the BAAS at York in 1831. Contact Miss J. H. Dring, BAAS, 23 Savile Row, London W1X 1AB, England. ∞

SPACE

CONTINUED FROM PAGE 22

N W Suite 1303 Washington DC 20006 or call (202) 347-5187, for details

District of Columbia The National Air and Space Museum will display a new exhibition entitled America s Space Truck—the Space Shuttle, which will feature a 16-foot model of *Columbia* on the launchpad The shuttle model will be on view for an indefinite period On July 16 at noon a free planetarium show Noontime with the Stars, will be presented at the Albert Einstein Spacearium For additional information write the National Air and Space Museum Washington, DC 20560 or call Visitor Information (202) 357-2700

The American Society for Aerospace Education is sponsoring a short-essay contest for students across the country The essay theme is the future in space Awards will be presented during Space Week Wayne Matson, 1750 Pennsylvania Avenue N W Washington DC 20006 (202) 347 5187, has details

A model-rocketry contest is scheduled in the nation's capital for mid-July For information contact Beth Goetz Washington National Space Week Committee 2424 Pennsylvania Avenue, N W., Suite 100 Washington DC 20037 (703) 536-6938

Special events, cosponsored by *Omni* will be held on the Mall during Space Week To learn what they are contact Beth Goetz at the above address and phone number

United for Space a nonprofit educational organization promoting greater understanding of, and involvement in space exploration and development will participate in Space Week activities Contact Harrell Graham PO Box 2085 Washington DC 20013 (202) 822-9700

Maryland The University of Maryland at College Park is planning to hold a series of films and lectures during Space Week. Lecture topics include obtaining energy from space space industrialization and living in space Beth Goetz can answer all inquiries

Utah Beginning July 16 and continuing through July 23 at Zion Cooperative Mercantile Institute Center, 36 South State Street Salt Lake City UT 84111 exhibitions prepared by high school and junior-high-school students NASA and local aerospace corporations will be on public display Details can be obtained by writing to Pam Bendio Hansen Planetarium, 15 South State Street Salt Lake City UT 84111 or by calling (801) 535-7007 The AIAA Utah section will display Thiokol Corporation exhibits from July 16 through July 24 and will show NASA films at the Golden Spike National Historical Site To obtain more details contact Evan Day PO Box 524-Mail Stop 53 Wasatch Division, Brigham City, UT 84302 (801) 863-3470

The Utah Space Association is promoting a national commemorative day called Space Exploration Day on July 20 each

year. For further information write to Ken Randall, 1753 Millcreek Circle, Salt Lake City, UT 84106, or call (801) 539-5470.

Texas: During Space Week and the week following, organizers of the Lunar Rendezvous Festival plan to sponsor events of popular appeal in Houston. For correct dates and times contact Carolyn Conley, NASA, Johnson Space Center, Mail Code CG5, Houston, TX 77058, (713) 483-5871.

Missouri: There will be special events during Space Week in the Kansas City area. For details write to Carol Nevins, 13252 Manchester Street, Grandview, MO 64030, or call (816) 966-8553.

Nebraska: On July 15 and 16 there will be a viewing of a videotape about great moments in space history showing how the space program can help mankind in the future, at Crossroads Shopping Center Mall, Seventy-second and Dodge streets, Omaha, NE 68124. The same videotape will be shown at Westroads Shopping Center, 112th Street and West Dodge Road, Omaha, NE 68124, on July 18 and 19. On July 20, from 10 A.M. to 5 P.M., there will be a space rally at the downtown outdoor mall, Fifteenth and Howard streets, Omaha, NE 68124. Throughout the week there will be a model-rocket meet; the date and place are to be decided. Write to Mark Jensen, Nebraskans for the Advancement of Space Development, P.O. Box 14105, Omaha, NE 68124, or call (402) 397-8567.

Hawaii: Special events during Space Week are planned on the island of Hawaii. Details can be obtained from Maria Muhlmann, Box 356, Kailua-Kona, HI 96740, (808) 322-3002.

Illinois: The Society for Space Settlement is in the process of deciding what events to schedule in the Chicago area. Direct all inquiries to John Hipsky, Society for Space Settlement, 4N186 Walter Drive, Addison, IL 60101, (312) 991-1909.

The Adler Planetarium, the oldest planetarium in the Western Hemisphere, plans an event on the anniversary of the moon landing. Information can be obtained from Sondra Thorson, Adler Planetarium, 1300 South Lake Shore Drive, Chicago, IL 60605, (312) 322-0328.

The events listed in this article are subject to change.

People interested in learning what specific events are in their area should contact their local space activist group. For a complete list of groups that promote interest in space, see our February 1981 issue.

Omni plans to produce a cable-television program telling how people can get involved in the national space program. The program will be telecast in California, Illinois, Indiana, Ohio and Texas. *Omni* also is arranging other Space Week activities in New York with the American Museum–Hayden Planetarium and in Los Angeles with the Griffith Observatory.

People desiring more information on Space Week '81 should write to Troy Welch, Space Week National Headquarters, P.O. Box 58172, Houston, TX 77058. DC

EARTH

CONTINUED FROM PAGE 16

To prove the point, a prominent scientist swallowed lab *E. coli* in a milk shake. *E. coli* are very stable bacteria found naturally in human intestines. But by checking his feces and taking stomach cultures, he determined that the lab-engineered bugs couldn't survive in the environment.

Dr. James Johnston, chief investigator for the Environmental Protection Agency's Advanced Pollution Control Study, cites this experiment as a criticism that man-made microbes are noncompetitive and cannot exist without aids such as special lights and temperature settings.

But since 25 percent of the 55,000 chemicals in commercial use are suspected carcinogens, Chakrabarty's microbial fighters are still the brightest hope for degrading industry's cancer-causing by-products. Love Canal proved that burying chemicals may be nothing more than a cosmetic exercise. Although there is now a method to incinerate PCBs with up to 99.999 percent efficiency, no community wants such installations built near it.

Once research funds are exhausted and the science is delivered, a commercial incentive will be needed to force industry to clean up its own backyard.

Dr. Kidd suggests that the decomposed wastes might be useful as fertilizer. But Chakrabarty wants the process federally regulated. "There should be a law saying that no chemical can be used until a bug has been created to degrade it." This might be accomplished outside the lab. If minute amounts of new nontoxic chemicals are sprinkled over soil, microbes already present will develop the proper enzymes and immunity on their own. The microbes could then be taken to the lab, strengthened, and cloned into an army.

If Chakrabarty has his way, then the famous slogan "Without chemicals, life itself would be impossible" would read: "Without bugs, chemicals would be illegal." DO

PHOTO CREDITS

Credit in April issue for **pages 120 and 122** should have read: Rodney Catanach. Credit in May issue for **page 32** should have read: © 1981 Michael E. Weinberg/Design Conceptions. **Page 6,** Chelsea Colour; **page 8,** Rhoda Walhans, W.R. Card, Astro Associates; **page 16,** Marcus Halevi; **page 18,** Larry Hamill; **page 20,** Linda Moore/Rainbow; **page 22,** Glen Focht; **page 26,** © 1981 Larry Hamill; **page 30,** United Artists; **pages 32 and 34,** Melgar Photographers; **page 36,** Ladd Company; **page 38,** Granger Collection; **page 40,** Walt Disney Productions; **page 44,** painting by A. Edgerton-Cooper/Granger Collection; **page 48 top,** Fiat; **page 48 bottom,** M. Jeffries; **page 49 top,** Berry Granham/Photo Researchers; **page 49 bottom,** Documerica, G. Hisec; **page 50 left,** Linda Bogdanoff; **page 50 right,** © Leonard Lee Rue III/Photo Researchers; **page 51 bottom,** © 1973 Stephen Dalton/Photo Researchers; **page 52 right,** University of Maryland; **page 53 top,** Jay Lurie/Black Star; **page 53 bottom,** Howard Sochurek; **pages 56–57,** Gamma; **page 57 bottom,** Jim Pozarik; **pages 58–59,** B. Barromes/Gamma; **page 59 top and bottom,** Christopher Springman/Black Star; **page 132,** Pete Turner; **page 134 top right,** Nikolay Zurek; **page 134 bottom left,** Sebastian Bastel; **page 136,** © Marvin E. Newman/Woodfin Camp & Associates; **page 147,** U.K.: Don Dixon; **page 147,** U.S.: Hannah Kay; **page 154,** Pat Hill.

FORUM

CONTINUED FROM PAGE 16

of silting problems and region dams usually have a useful life of only 150 to 200 years, and often less. The water surfaces of the reservoirs behind the dams alter the albedo because of their high reflectivity. I contend that where freshwater discharges have been markedly reduced by the construction of dams the salinity increase raises the ability of those waters to store heat. Storage of heat in a saline body tends, I believe, to support a meteorological high-pressure area, making it more difficult for rain-bearing low-pressure systems to move over the area. With enough heating in an area, clouds associated with a low-pressure frontal system are directed away from the area where rain is needed, or they move at altitudes above which normal cooling occurs, preventing rain from falling.

The cumulative effect of man's manipulation of his environment will be a long-term disaster of global proportions that will erase man as the dominant species, or at least reduce his numbers to something that is in harmony with nature. To paraphrase a verse in the Bible, "the sins of the fathers will be visited

Paul W. Bothwell
El Sobrante, Calif.

The Importance of Being Optical

Before long the market will be glutted with competing video-disc machines, and a process of natural selection will occur. A superior product, the laser scanner will fight for its life in the market jungle.

The superiority of an optical scanning system over those that require physical contact between read-head and disc should be obvious. The frictionless optical machine can read a frame and move on without error or wear. This is crucial in an information system.

With an optical video disc, time becomes a variable, a fact that is not trivial or incidental. The image can be run forward or backward at any speed desired. The image scan rate is not altered by any change in the rate at which frames are projected, including stopping altogether. There is no discernible degradation of a still picture, which is not the case with standard film in a motion-picture projector.

The video disc is also an art medium that is bound to become smashingly popular. Visual patterns generated by the computer will play interactively with computer-generated sound patterns.

A composer with a digital musical instrument may shape the waveform of each note in his composition. He can make tonal and graphic elements symmetrical so that his composition will play as well forward as backward.

Composing music with interactive challenges to the listener is not really a new idea. Before this century, all music engaged us by requiring us to perform our own. There were no recordings; consequently, more music was played and sung than was just listened to.

Why not have compositions designed to be played with? The viewer/listener can play the work his own way. Let him play upon a theme the way Brahms played variations on a theme by Haydn. Music we love urges us to play it again and again. Good music is fresh each time we hear it.

Both for its information handling and for its artistic capacity, some kind of reversible optical-scan video disc is the best buy in the market. Investigate before you invest.

John Whitney
Pacific Palisades, Calif.

Space-Interest Groups

Since we were listed in *Omni*'s Space-Interest Groups chart in the February issue, the response has been overwhelming, and we thank you for mentioning us in your publication. However, since the information that was listed was incorrect, it has caused much confusion. Our correct listing is:

Strategic Arms Control Organization
275C World Trade Center
San Francisco, CA 94111
Information contact: Department of Public Relations
Activities: Focuses on international power imbalances posed by development of space weapons systems

Kenneth Largman
President
Strategic Arms Control Organization
San Francisco, Calif.

Games People Play

As a fencer, I think the explanation for the relationship between the counterclockwise movements of our bodies and right-handedness [Games, February 1981] is quite obvious.

When persons are engaged in a fencing match, a right-handed fencer will have his heart farther away from his opponent than a left-handed fencer will. The right side of the body offers additional protection from an advancing blade when a counterclockwise rotation of the body brings the right shoulder into the path of the attack. In the case of a left-handed fencer, the equivalent maneuver will expose the left chest more.

Macabre as it sounds, this may be why the majority of humans are right-handed.

Patrick Tam
Vancouver, B.C.
Canada

Scot Morris replies: *Your theory of right-handedness is not new. It suffers from these flaws: (1) The heart is really not on the left side of the chest cavity, but nearly in the middle. (2) There is evidence to indicate we were a right-handed species in Neanderthal times (100,000 years ago), possibly much further back than that. This predated the Steel Age and sword-and-shield warfare. (3) It doesn't explain why women are also right-handed, even though they have not generally been warriors.* OO

OTRAG

CONTINUED FROM PAGE 73

also helped hobble OTRAG's rocket plans, particularly its Third World spy satellite.

But the full scope of Soviet skulduggery did not become evident until early in 1978, when Radio Moscow announced that the peaceful inhabitants in the vicinity of the test range were being attacked on orders from OTRAG that their villages were being burned, and that their livestock was being destroyed. "Employing the most ruthless methods," Radio Moscow broadcast, "the Zaire army has already evicted from the territory of the testing range almost two hundred twenty thousand of the three hundred thousand inhabitants of this region who have fled to Angola." This claim was a total fabrication.

On April 5, 1978, Angola formally complained to the United Nations about a new series of Zairian attacks. Angola referred to "the dangerous nature of the recurrent hostile acts by Zaire and [to] the present concentration of Zairian troops stationed along the border."

That same month the *Daily Times*, Nigeria's leading newspaper, published a lengthy anti-OTRAG report. The article ended with a sweeping indictment. "It is quite evident that the creation of the nuclear rocket potential, together with the revenge-seeking aspirations of the West German militarist circles, create[s] a real threat to the cause of peace throughout the world."

Suddenly the Zairian government was confronted with a rebellion in the province of Shaba, formerly Katanga. The insurgents had been armed and trained by East German "advisers" while they were "guests" in Angola. They were led by none other than "General" M'Bumba. Because of the propaganda blitz about Zairian and OTRAG atrocities, most African countries were only too willing to consider the conflict a purely internal affair brought on by President Mobutu's tolerance of a European military base in his country.

Ultimately the Katangan forces fell apart and turned to looting and murdering instead of liberating their homeland. What had been planned as another "spontaneous national liberation uprising" degenerated into the vicious Kinshasa massacre in which hundreds of Europeans and thousands of Africans died.

Aided by Belgian paratroopers, the French Foreign Legion, and American transport planes, Mobutu's regime survived. But OTRAG was in even deeper diplomatic trouble because of the controversy that now swirled around its presence in Zaire. The company conducted two more rocket test firings in May and June 1978, one reaching an altitude of 20 miles. Multistage tests were scheduled for later that year, and an actual satellite launching was supposedly only a year or two away. But time was running out for the rocketeers.

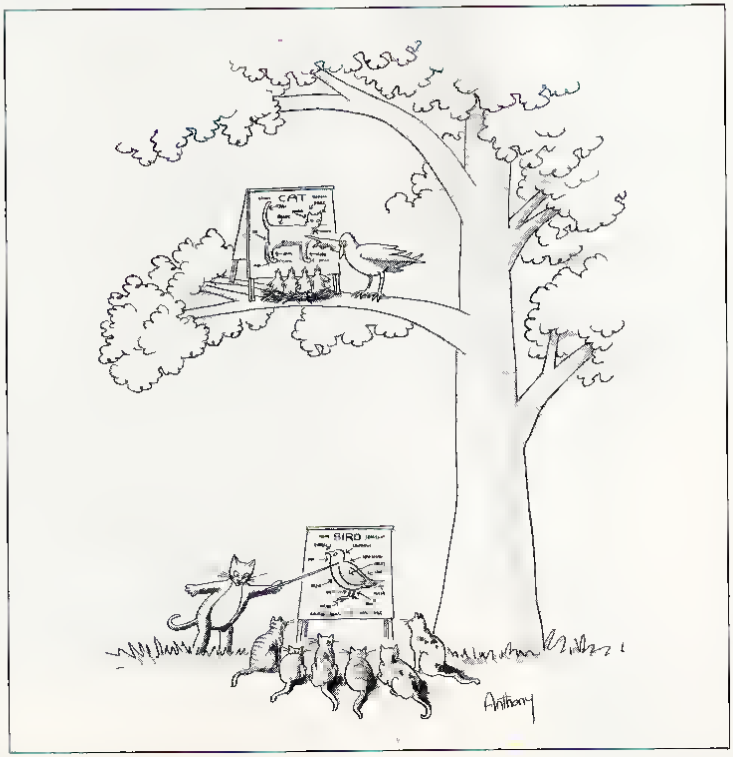
Using political surrogates, the Russians continued to press for the removal of OTRAG. Angola obediently stepped up its denunciations. In a statement issued June 1, 1978, Angolan Prime Minister Lopo do Nascimento complained, "The West German testing range is the barrel of a pistol aimed at the heart of Angola. OTRAG is part of the unified plan drawn up in NATO to step up military-political penetration into Africa and to suppress the national liberation movement of the peoples of the continent, and Washington directs the fulfillment of this task." Remarkably similar statements were uttered by the governments of Tanzania and Zambia. To blame OTRAG on Washington was ironic, since the U.S. government wished as much as anyone that the project should fail.

When West German Chancellor Helmut Schmidt toured Africa in June 1978, he heard outraged complaints about OTRAG at nearly every stop. The Nigerians were particularly insistent that Schmidt stop OTRAG, and the German leader had to admit that OTRAG had become an embarrassment. Returning to Bonn, he told newsmen, "These activities are jeopardizing our foreign policy." Later in 1978, it is said, Soviet President Leonid Brezhnev personally put pressure on Schmidt, who in turn finally threatened to stop West German aid to Zaire if Mobutu did not annul his contract with OTRAG. Mobutu realized that OTRAG was not going to pay off as handsomely as promised and that the project was a lightning rod for hostility from neighboring countries. In early 1979 he ordered Kayser to suspend all further rocket experiments.

The USSR continued to use the Zaire incident. Its rabidly anti-Western station Radio Peace and Progress broadcast a news analysis on April 14, 1979. It claimed that OTRAG missiles now carried chemical warheads and that South Africa had been allowed to build an air base and an atomic-bomb testing range in Zaire. "The creation of the OTRAG missile-testing base is part and parcel of the general plan of imperialist powers aimed at destabilizing the progressive nations of the continent," Radio Peace and Progress maintained.

Kayser meanwhile tried various legal moves, including an unsuccessful appeal to the World Court in the Hague, to force Mobutu to honor the 1976 contract. But by the end of 1979 Kayser was hunting desperately for a new equatorial host country. The Zaire chapter had closed; the Libyan chapter was about to begin.

OTRAG's new alliance may prove rewarding. But it may simply reenact the Russians' successful campaign of slander and subterfuge. A story is now circulating that Libya has signed a contract with OTRAG to buy missiles. According to a familiar-sounding accusation—this time emanating from Morocco—the missiles will carry nuclear warheads developed in a separate Libyan research project. It is a report Wukasch quickly dismisses. ∞



GRAVITY WATCH

STARS

By David K. Lynch

At Stanford University physicists are hard at work trying to detect gravity waves as they pass through a huge aluminum bar. Elsewhere researchers are monitoring large sapphire disks and performing other delicate experiments in an attempt to understand this weakest, least known of the fundamental forces. But even as the scientists wait for results, gravity itself may be slowly fading away.

This idea came to light after Nobel Prize winning physicist P.A.M. Dirac had noticed a numerical coincidence between certain atomic and gravitational calculations. Dirac deduced that gravity might be getting weaker as time passed. Other theories, including the most recent, have predicted gravity does change—they're called G theories, or G dot. Some have postulated that the amount of mass in every object would change with time.

The theoretical rate at which G, the gravitational constant, declines is extremely slow, less than 1 part in 100 billion per year. For the average human being this means "losing" weight at well under a millionth of an ounce each year. But since the universe is 10 billion to 15 billion years old, gravity might well have waned significantly since the Big Bang.

If gravity is losing its grip on the universe, the solar system is a good place to search for evidence. The sun does not collapse under its own gravitation, because the pressure from highly compressed internal gas resists. If G shrinks, it must let the sun expand, throttling back the nuclear furnace. The sun would grow cooler and dimmer.

Meteorites, those rare chunks of pristine solar material, should have recorded any changes in their environment, including solar cooling. Volatile decay products from radioactive nuclei would have outgassed at different rates at different temperatures. The thermal history could be partially unraveled by comparing the relative abundances of decay products trapped in the meteorites.

The earth would also expand. The predicted rate is between 0.02 and 0.1 inch per year. Like a spinning ice skater extending her arms, Earth would decompress and its rotation would slow, causing the day to become longer.

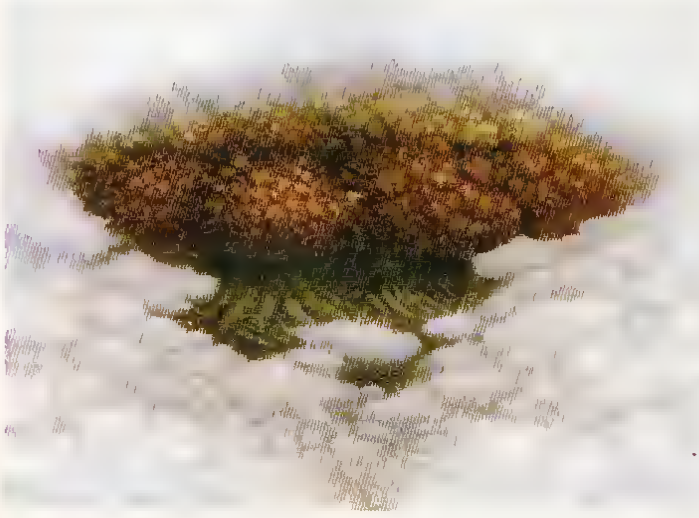
All gravitationally bound systems would slowly come apart. The length of the year would increase as our planet spirals away from the sun. The moon, too, would retreat from the earth, and star clusters would "evaporate" as each star's kinetic energy exceeded the ever-decreasing gravitational energy. Stars everywhere would fade, and so would their galaxies.

Despite the abundant opportunities to measure G dot, digging it out of the noise and other distractions has proved difficult. Earth is expanding, but this expansion may be due to other factors. The day is getting longer, but tidal friction seems to explain it nicely. By looking at distant galaxies whose light is just now reaching us, we can look back in time and see whether they truly are dimmer than nearby galaxies. Unfortunately, preliminary results are ambiguous. It is difficult to classify distant galaxies and know how bright they would ordinarily be. And even without changing gravity, galaxies may become fainter as stars undergo evolution.

Recently Dr. Thomas Van Flandern, at the U.S. Naval Observatory, in Washington, D.C., found the first evidence of a changing G. As the moon orbits the earth, it passes in front of background stars. By timing these occultations with two different clocks—one an atomic device not affected by gravity, the other a gravitationally regulated clock based on the earth's motion around the sun—he has shown that the moon is almost exactly as far away as we would expect if gravity is fading according to Dirac's theory.

The uncertainties in Dr. Van Flandern's data are great, and until independent evidence for a changing G is found, it is possible that some unknown factor is responsible for the excess lunar recession he has detected.

If G really is changing, Einstein's theory of general relativity would have to be scrapped or seriously modified, because it leaves no room for G to vary with time. Indeed, our entire understanding of the origin and evolution of the universe would have to be revised. ∞



TECHNOLOGY

CONTINUED FROM PAGE 30

Two years ago Kodak introduced an even sturdier film stock, known as LFSP. Kept at 18°F, this film would lose one fifth of its density in the cyan range in a mere 100,000 years. "LFSP represents a thousand percent improvement in stability," Kaska says. But do you know what? We have yet to sell a single foot of it to the commercial film industry. LFSP adds five percent to the cost of the film and processing, however, and Hollywood is apparently unwilling to pay for it."

Robert Rosen, director of the film archives at the University of California at Los Angeles, does not believe LFSP is the answer. "From an archivist's point of view we have a lot to be pessimistic about," he insists. "We've heard about slow-fading film, but nothing about no-fading film. Frankly, most film is not in cold storage. Most of the prints that archives hold are not originals. We get the castoffs, the inferior products, and that's what people see."

Rosen suggests that two actions be taken immediately. "First, the inferior stock should be discontinued entirely. It's polluting the cultural atmosphere the way cars are polluting the air we breathe. Second, we need to build cold-storage facilities."

There are surprisingly few cold-storage facilities in the United States. The Library of Congress only recently received its first cold-storage vault. Though there are some 500 underground film-storage facilities in the country—the largest in a salt mine near Hutchinson, Kansas—they put only a crimp in the deterioration process. Most vaults, like UCLA's, are little more than rooms with thick walls and no temperature or humidity controls.

Improving the film stock means nothing, "if there's no cold storage," says Del Costello. "That's like putting a Band-Aid on a terminal disease." He and Scorsese are further upset that some people in the film industry are suggesting that only "important" or commercially successful films be shot on better stock or put into cold storage. "We have to save everything," he believes. "You can't pass judgment on what to keep and what to throw away. So what if Margaret Mead can't afford LFSP! We should preserve her films anyway."

Patrick T. Kurtz, Kodak's technical service director, says there is little hope for any marked improvement in film color stability in the near future. "We know of no way to improve the stability. The changes to be made are more significant than anything we can do in chemical postprocessing."

In essence, Kurtz says, as long as you photograph on film, your colors will fade. But Kodak does recommend the use of color separations for motion pictures. And though Kodak is wise enough not to say so publicly, the industry's failure to use the color-separation technique puts the ball back into Hollywood's court.

In today's extraordinary film budgets, the $15,000 to $30,000 needed to make a set of color separations seems inconsequential when measured against the economic consequences if the picture is lost forever. Yet there is only one studio that makes color separations of its films as a matter of policy—Disney Studios.

A Disney spokesman asserts, "Our films are on a rerelease rotation every seven years. Our films are made to last forever. Each new generation of children sees *Fantasia* just as people saw it when it first came out. We feel it's worth the extra trouble and expense to uphold the quality Disney has always stood for." In fact, Disney makes two sets of separations and stores them in different locations for added safety and security. A successful film may be reproduced from these high-quality separations 2,000 times in the course of its life.

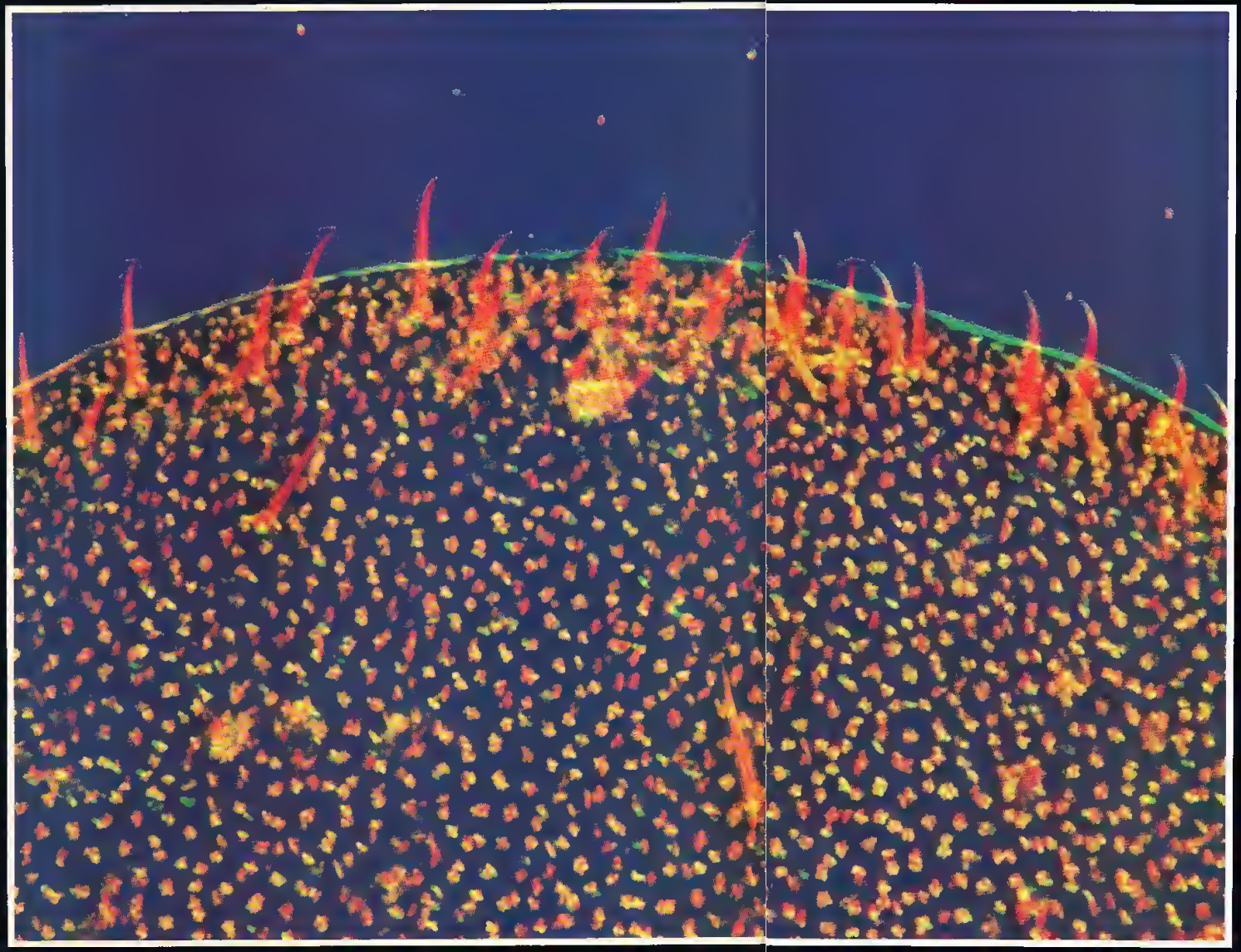
Rosen warns that Hollywood should not expect his profession somehow to rectify the problem of fading color. "I've more bad news for them," he warns. "Because of the proposed government budget cuts in the arts we are going to have a terrible problem with funding. As it is, all our funds are put into transferring old nitrate films onto safety stock. That can't wait. Color preservation is simply not done. I can count all the color preservations done by major archives on one hand. And I don't accept the argument that because the studio has a good color negative, we're in good shape. We need a lot of prints so that there is a chance of survival, not just one hidden somewhere."

Are any solutions forthcoming? Because of patent conflicts and astronomical start-up costs, the return of Technicolor has been virtually ruled out. No scientific breakthrough is predicted either. Many industry figures are content to stage a holding action. Bard, for example, believes that we should lower our expectations, that to dream of a permanent color film is fanciful. "Let's not ask for perfection. Leonardo da Vinci's *The Last Supper* has been repainted fifteen times. You don't see the original." He hopes that color restoration techniques will be used more frequently.

One quick, temporary solution Scorsese proposes is that directors include a clause in their contracts specifying the kind of film stock with which they will shoot their picture. Francis Ford Coppola, Terence Malick, and Jonathan Demme have all asked for such clauses, which have been constructed by Scorsese's attorneys.

"We started this thing on emotion," Del Costello says. "The problem is notorious enough now that everyone is bugging everybody else about it. Now we have a momentum of our own, and maybe something positive can be done."

In the end, compromise may be the only alternative. Like the book business with its hardcovers and paperbacks, moviemakers may resort to putting some of a film's 600 to 800 prints on the best stock while committing the rest of the prints to less durable material. ∞



PHENOMENA

An insect's wingtip, under accentuated lighting, illustrates the aerodynamics of true flight. Free of any dependence on gravity or air currents, insects generate lift and forward thrust by flapping lateral appendages in an oval rotation. This is achieved by pulsation of the thorax, not by flexing a set of muscles. Kent P. Wood shot this photomicrograph through a Zeiss Ultraphot II photomicroscope. Using Ektachrome tungsten film (ASA 160), and a half-second exposure, Wood recorded the wingtip's brilliant structure. The vibrant colors are produced by Rheinberg illumination, a modified version of dark-field lighting. Magnified by a factor of 40, this image portrays aesthetic science in a minute motif.

Roland Baladi's amazing sun sculptures and a cartoon competition

GAMES

By Scot Morris

Dylan fades in and out (top). Cheops's 15 second stripe (left); bricks and tabs cast different shadows in morning, noon, and afternoon (above, from left)

Last month we saw what happens when computers reduce an image to shades of gray and artists reconstruct the image with a grid of squares or even dominoes. This month we are delighted to present, for the first time in the United States, some remarkable work using the same process and nothing but shadows.

The principle is as ancient as the pyramids. Although most visitors don't notice it, the sides of the Great Pyramid of Cheops are not planes but have a slight indentation—a dihedral angle of about 1/3°. It is hardly visible to the naked eye except on one day a year, the spring equinox, when a sharp vertical shadow divides the pyramid's south face at sunrise and sunset (see photo above, left). You have to be sharp to see it. The shadow lasts only about 15 seconds. Scholars say the design was intentional—the shadow heralds the first day of spring and the imminent flooding of the Nile.

Roland Baladi, a thirty-eight-year-old sculptor living in Paris, has invented and patented an amazing new art form based on this ancient knowledge of the sun's cycles. Born in Egypt, appropriately enough, in the town of Heliopolis ("city of the sun"), Baladi was fascinated by the idea of using sunlight as an artistic medium. He designed a set of bricks having indentations that produced shadows of various sizes depending on the specific angle of the sun's rays. When the sun shone from a different angle, the bricks retained about the same degree of grayness.

His first work was the image of Bob Dylan, from the *Blonde on Blonde* album cover (top, this page). Using a Thompson CSF video camera, Baladi reduced the photograph to a grid of 8 000 spots. The density of each spot was in turn subdivided, with a Mitra 15 computer, into eight gradations of gray. He then constructed the image, using eight gradations of his notched bricks. It stands 1.6 meters (about 5 feet) tall. At 8 A.M., May 24, Dylan's image appeared and lasted just over two minutes—the photographs were taken at approximately 30-second intervals. Baladi tells me that the negative image shown in the last frame was completely unexpected.

The sculptor next designed a technique for producing shadows in an even more startling way: square bricks, set diagonally, with shadow-casting metal tabs mounted on their upper edges. A close-up of one section is shown above, at three different times of day—when the sun shines from the upper right (morning), from above (noon), and from the upper left (afternoon). Note that in morning light one set of tabs (on the upper right of each brick) leaves shadows, while the other set (on the upper left) is perfectly lined up with the sun's rays and leaves almost no shadow at all. In the afternoon the lighting and shadowing are reversed.

The technique suggests some possibilities that spark the imagination. In his 1.6 meter-tall prototype, Baladi showed French writer-politician Andre Malraux as a young man and in old age. The original

Lion cub in the morning (top) and at about 1 PM

photos of Malraux were taken 40 years apart by the same photographer. The sun causes a daily fade-out/fade-in of the two images: young man to old man. At left on this page is a mock-up of how the work might appear in morning and afternoon sun on the UNESCO Building, in Paris.

Baladi has built one full-scale work using marine-wood tabs. It is nearly three stories tall (nine by seven meters) on the side of a smokestack in Les Halles, Paris, just a few blocks from the Louvre. It shows a lion cub visible between noon and about 2 PM on sunny days. The lion, an ancient sun symbol, is most prominent during the month of August (Leo).

The work is to be torn down later this year. A hotel will be built on the site. Baladi is not distressed. The lion should come down, he says, because the wooden tabs are beginning to deteriorate. He wants to erect an even grander image using permanent materials—marble or plastic.

His artwork is an innovative combination of the old and the new. It pairs thousand-year-old studies of the sun's course with modern techniques such as the computerized decomposition of a photograph according to given light gradations.

Roland Baladi wants to build his shadow graphics for a commission, anywhere in the world—whether to transmute from morning to afternoon, whether to appear once a day, once a year, or even, he says, every few centuries. He may be reached through the Games department.

OMNI COMPETITION #20: CARTOONS

Isaac Newton, in bed with Mrs. N. He's obviously unfulfilled and is instructing her: 'Remember what I said. For every action make an equal but opposite reaction!'

A newspaper on the doorstep of the Easter Seal campaign headquarters. The banner headline: 'Doctors Find Cause of Tuberculosis: Stamp Mucilage.'

The *Titanic* is sinking into the Atlantic, flotsam all around. Floating in the foreground is a mattress, with three people aboard. A uniformed man is speaking to a kneeling couple. By the authority vested in me as captain of this vessel . . ."

One brontosaurus to another: "Did you ever have one of those days when you didn't feel fit?'

Martian standing in front of a gasoline pump turns to speak to another Martian: "He won't answer, sir. I keep saying, 'Take us to your leader,' and he just stands there with his reproductive tube in his ear."

Above: some left-brained cartoons. Send us, in prose, the great cartoon idea that would surely appear in *Omni* if you could only draw. Postcards only, please, with one entry per card. The grand-prize winner will receive $100; runners-up (2–10) will receive $25. Entries become the property of *Omni* and will not be returned. Send your brilliant ideas, postmarked by July 15, 1981, to: *Omni* Competition #20, 909 Third Avenue, New York, NY 10022. ◻◻

LAST WORD

By Richard Ballad

"Our printouts confirm that the Red Sea is wet all the way to the bottom," said Anwar Kabat "Moses will never make it"

Dr Robert Jastrow, NASA It is entirely possible that man has evolved as far as he can and that a new form of life based on silicon will replace the carbon-based human life form as the dominant species

Stunned reporter Do you mean a computer society could supplant mankind as the highest form of life on Earth?

Dr Jastrow Yes

This snippet of conversation between me and Dr Robert Jastrow two years ago has been sticking in my throat like a hair ball It's been further irritated by epic battles with certain computers belonging to the telephone company with various credit card machines, and with the videotape-editing devices at NBC News which can do in ten seconds what it once took humans half an hour to sweat out

But for all the cute and clever things these silicon-based computers can do I find it appalling that we are beginning to lean on these weird creatures for decisions that should necessarily involve the human will and imagination It's insanity to let these dumb machines decide who is a good loan risk, who will make the best employee and whom we should date or marry I don't care what Dr Jastrow says

Consider the world of gambling The big casinos use computerized odds They know they are going to make 14 percent or 19 percent, or whatever on the black jack tables and slot machines and maybe 90 percent on roulette There's no romance in that Compare the dullness of a casino manager's life with the gizzard twisting feeling you get when you put your quarter or better still a slug into a slot machine and hit the jackpot because something inside told you this was the right moment and the right machine

Computers much like loan sharks and medical doctors and such trash, deal with projections based on probabilities But it's the *possibilities* that make us want to get out of bed in the morning and try it one more time

Imagine what history might have been if our ancestors had paid homage to a bunch of silicon chips and depended on computers to tell them what to do Here's the way some great historical moments might have flattened into nothingness as reported in the press of the time

The Israelite Daily Shofar 1313 B C

Egyptian authorities were snickering last night over the Israelites plan to escape through the Red Sea "Our printouts confirm that the Red Sea is wet all the way to the bottom" giggled Anwar Kabat a spokesman for the Pharaoh's government "Moses will never make it"

Shortly before midnight Moses made a brief announcement to the press "I am canceling the Exodus," he said "Apparently the Lord made some serious mistakes in His computations Everyone be back at work on the pyramids at six"

The Paris Inquisitor 1431

Authorities were relieved this week when a peasant girl named Joan renounced heretical remarks she had made earlier Joan appeared before the Dauphin and said she had heard voices telling her to lead the French army to victory over the English The girl refused to change her story even when threatened by fire and dismemberment But she quickly recanted when the cathedral computer proved that her "voices" were in all probability the result of becoming disoriented by a Swiss bell-ringing contest held in her village Joan was still burned at the stake, of course, but "without prejudice

The Madrid Bullthrower 1493

Captain Christopher Columbus returned to Spain, redfaced, after giving up on his attempt to sail west to the Indies. "I must have been off my gourd" he said The computer became so hysterical when we got approximately fourteen leagues from the edge that I managed to come to my senses and turn back"

The San Antonio Spur 1836

Davy Crockett smarting under allegations that he is 'the coward of the Alamo' defended his actions in recommending that the Texans surrender to General Santa Anna. 'It wasn't easy being in charge of a computer that keeps telling you the Mexicans would win, the Alamo would be razed we would all be forgotten, and something called a Tastee Freeze Taco stand would be built here," Crockett said Meanwhile General Sam Houston on hearing the news, disbanded his army and advised his troops to stop saying "greaser" and start learning Spanish

The Munich Flugelhorn 1890

Eleven year-old Albert Einstein was transferred from an academic course to a cooks' school at the insistence of Professor Friedrich Platzhammer He's a nice boy" Platzhammer said "but a mathematical dummkopf He barely passes our computerized, multiple-choice tests and he has the worst memory I've ever come across He spends his days dreaming and doodling meaningless formulas Look at this one E equals mc squared We fed it into the computer and it blew a fuse I just hope they can teach him to make strudel"

The London Tattler, 1893

George Bernard Shaw burned his unpublished works in the middle of Fleet Street today shouting that he would join the Church of England and go to America as a missionary "I've no future in literature or drama Shaw cried I've written five novels and three plays and they have all been banned or panned or both The computer confirms that my stuff is all talk and no action I'll never make it"

Richard Ballad, a veteran newsman and TV writer is a producer/writer with NBC