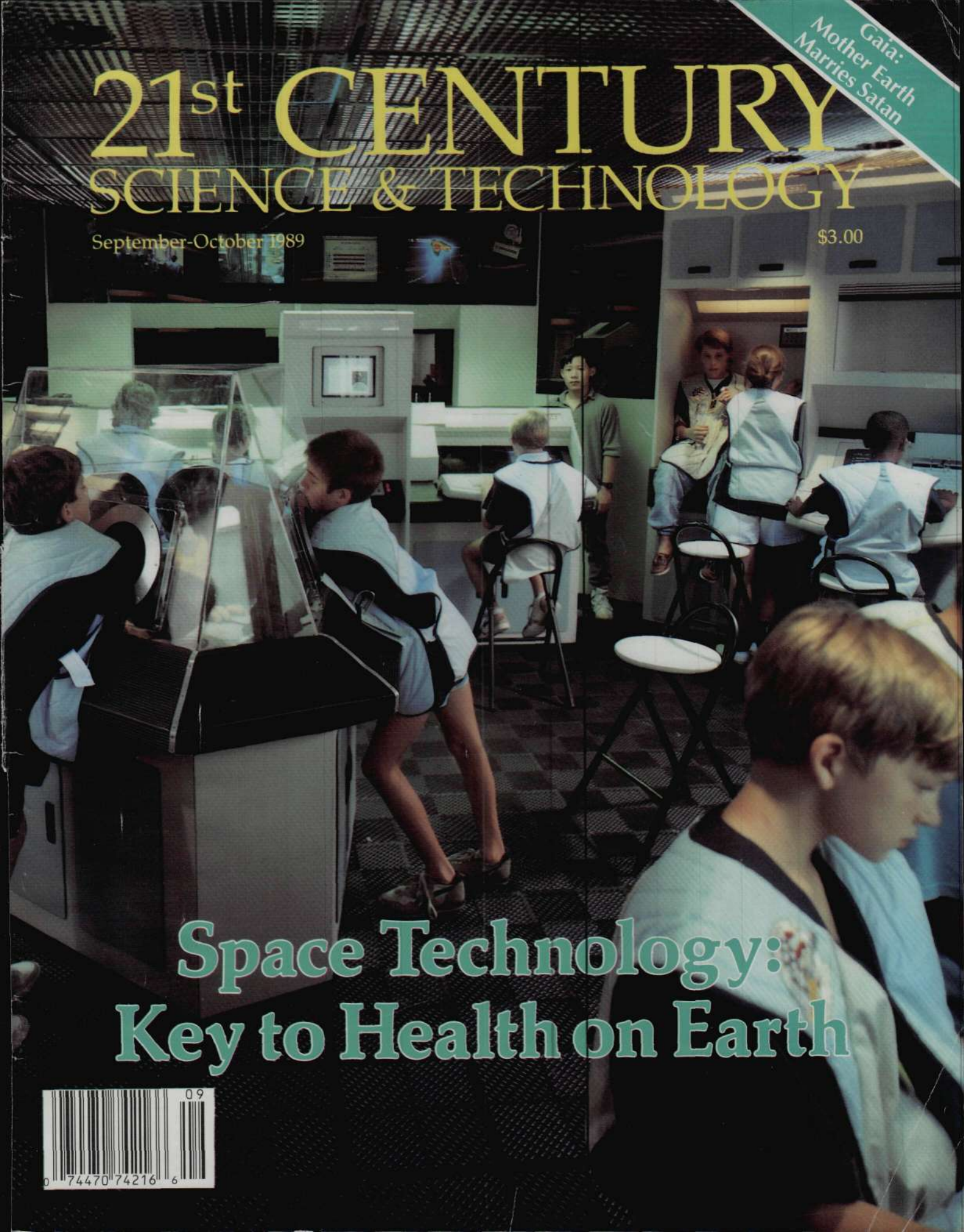


Gaia:  
Mother Earth  
Marries Satan

# 21<sup>st</sup> CENTURY SCIENCE & TECHNOLOGY

September-October 1989

\$3.00



## Space Technology: Key to Health on Earth



# 21<sup>st</sup> CENTURY SCIENCE & TECHNOLOGY

Vol. 2, No. 5

September-October 1989

## Features

### 30 How Space Technology Makes Us Healthier

Marsha Freeman

The Apollo program did more than put the first man on the Moon: Its new technologies gave a shot in the arm to the economy and its medical spinoffs gave a new lease on life to millions of seriously ill people.

### 40 Environmental Pollution and the Causes of Human Cancer

Bruce N. Ames

Despite all the scare stories about carcinogens, Americans are healthier than they have ever been. An expert on cancer causation sets the record straight on six of the most frequent errors about pollution and cancer.

### 50 Gaia: Ecologists Embrace the Earth Goddess

Rogelio A. Maduro

James Lovelock's Gaia thesis, popular in scientific circles for its concept of the Earth as a living system, has become a quasi-religion for New Age environmentalists, including pagan worship of an Earth goddess and a hatred of the human species that "defiles" her.

### 52 Mother Earth Marries Satan

Carol White

The growth of environmentalism over the past 20 years has spawned irrationality in our culture, to the point where Satanic practices are now promoted as "religion."

## News

### SPECIAL REPORT

- 12 The Icelandic Film Greenpeace Doesn't Want You to See

### FUSION REPORT

- 14 Cold Fusion Is Alive and Well  
15 India Joins the Race to Prove Cold Fusion  
17 Cold Fusion in Japan: Excitement and Success

### ENERGY & ENVIRONMENT

- 19 President Bush's New Clean Air Bill: Lots of Money and Hot Air  
22 Mother Nature: The Source of Ozone 'Pollution'  
24 'Clean Air' Will Finish Off U.S. Electric Power  
26 The Ozone Layer That Won't Go Away

### BIOLOGY & MEDICINE

- 28 Conference on Oral AIDS: Kiss of Death for Official Propaganda

### FUTURE SCIENTISTS

- 59 A Laser Experimenter's Diary

## Departments

- |   |                         |    |             |
|---|-------------------------|----|-------------|
| 2 | EDITORIAL               | 7  | VIEWPOINT   |
| 3 | LETTERS                 | 10 | NEWS BRIEFS |
| 4 | RESEARCH COMMUNICATIONS | 60 | BOOKS       |

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**21st Century Science & Technology** (ISSN 0895-6820) is published 6 times a year, every other month, by 21st Century Science Associates, P.O. Box 65473, Washington, D.C. 20035, Tel. (703) 777-7473. Dedicated to providing accurate and comprehensive information on advanced technologies and science policy, **21st Century** is committed to restoring American scientific and technological leadership. **21st Century** covers the frontiers of science, focusing on the self-developing qualities of the physical universe in such areas as plasma physics—the basis for fusion power—as well as biology and microphysics, and including ground-breaking studies of the historical development of science and technology.

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Subscriptions by mail are \$20 for 6 issues or \$38 for 12 issues in the USA and Canada. Airmail subscriptions to other countries are \$40 for 6 issues. Payments must be in U.S. currency.

Address all correspondence to 21st Century, P.O. Box 65473, Washington, D.C. 20035.

POSTMASTER: Send address changes to 21st Century, P.O. Box 65473, Washington, D.C. 20035.

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21st Century Science Associates

Printed in the USA  
ISSN 0895-6820

**On the cover:** Students getting acquainted with space technology at the Challenger Center in Houston. Photo by Gary Young; cover design by Virginia Baier.

# Rebuild U.S. Industry for the Moon-Mars Mission!

On July 20, standing alongside the three Apollo 11 astronauts on the steps of the National Air and Space Museum, President Bush said that these astronauts left not only footprints on the Moon but also "unfinished business." This nation should go back to the Moon to stay, he said, and then begin manned missions to Mars.

Praise for the general sentiment of the President's speech was immediate, as was the just criticism that the initiative lacked specific target dates necessary to organize and drive the program, as well as a specific estimate of the funding to pay for it. President Bush pointed the country in the right direction, but he has no idea how to actually carry out such a Moon-Mars mission.

If the administration were to set these target dates and allocate the funding to the National Aeronautics and Space Administration to accomplish them, both industry and the government would then be in for a shock: The United States probably has less industrial infrastructure now than it did when the Apollo program was first announced in 1961.

Take a specific example—say, a company planning to construct a new plant to build the specialized vehicles that will take a crew from the Earth-orbiting Freedom Space Station to the Moon. In 1989, such a company would probably find that the local utility could not guarantee them a reliable supply of electric power. In the Apollo years, the lunar module, which carried 12 astronauts to the surface of the Moon, was built by the Grumman Corporation in Bethpage, N.Y. Today, because the Long Island Lighting Company has given up fighting the antinuclear mob and is trying to sell its completed but unused Shoreham nuclear plant so that it can be torn down, Grumman's management is forced to conduct practice drills on how to evacuate their handicapped employees in the dark when the power blacks out!

During the 1960s, electricity growth rates averaged about 7 percent per year. This meant a 10-year doubling time for the grid as a whole, to keep up with demand. For the 1980s, the average electricity growth rate will be about one third that of the Apollo period. Even at the depressed rate of economic and energy growth the United States has experienced over the past 10 years, many regions of the country have electric capacity margins below the 17 percent that is considered prudent and have already experienced voltage reductions and local blackouts.

What would happen if U.S. industry had to gear up—to quickly finish Space Station Freedom, build more Space

Shuttle orbiters, develop and deploy a fleet of unmanned cargo-carrying rockets, design and construct fleets of vehicles to carry crews and cargo to the Moon, and rebuild the nation's experimental research capability—to put the United States once again on the frontiers of science and technology?

Currently, the U.S. electric grid has about 650 gigawatts (GW) of generating capacity. Between now and the year 2000, electric utilities in the United States are planning to put less than 100 GW of new generating capacity on line. To return to a period of real economic growth like the 1960s would require at least a 7 percent per year growth in electric power, and that means that today's 650-GW electric grid would have to *double* by the turn of the century.

## The Real Deficit

Do we have the specialty metals, steel-making, and other industrial capacity to build 650 or more new power plants? Do we have the machine tools and machinery factories to supply those builders of power plants? Do we have the nuclear engineers, skilled workers, and technicians to staff the facilities? And that's just electrical energy.

Right now the United States is suffering a multi-trillion-dollar deficit in infrastructure investment. There is hardly a bridge in the country that is not in need of maintenance, repair, or replacement. The deregulation of transportation since the Apollo program has left the nation's trucking and airline industries lacking in the capital investments necessary to make them safe and productive. Water systems for cities, industry, and agriculture have had very few large-scale investments since the great dams of the West were built decades ago. Basic physical plant and equipment have been run into the ground. We have not brought into productive use most of the technologies created by the research and development that allowed man to land on the Moon.

For years the American people have been told that as long as we can produce fast food and computers, the U.S. economy will survive.

The day the Moon-Mars mission is begun will be the day of reckoning. As in 1961, when President Kennedy announced the program to land a man on the Moon, the nation and its resources will have to be fully mobilized to accomplish the task. The investments we make now to become a great nation once again will allow us to reap the harvest of new technologies for decades to come.

# Letters



## Looking for Planet X

### To the Editor:

I enjoyed Grote Reber's ditty on cosmic bangs ["The Big Bang is Bunk," March-April 1989, p. 43]. . . . One calculation overlooked that challenges the big-bangers is that the centrality of mass in such a cosmos would blue-shift all light approaching the more central regions—and we are necessarily not on the edge!! (That's a real think-about, including red-shifted light from the center!). . . .

Let's take another look for Planet X, as follows: Let's take a discovery path, rather than the forcefully direct approach (which yielded Pluto). Beginning with an innocuous reconsideration of the sunspot cycle, let's suppose that the 11-year regularity has an astronomical basis. Jupiter, which is the largest of the planets, has a decent magnetic field as well, and most conspicuously an orbital period very similar, specifically 11.86 years. Several estimates of the solar cycle range from 11.01 to 11.3 years.

Let's conjecture another planet and its concomitant magnetic field interplaying with Jupiter and [the Sun's] own field: where must this simple solution be? Either in closer than Jupiter and orbiting almost twice as fast (that's angularly) to produce the conjunctions at the solar period—that's a placement in the asteroid belt, convenient but not too likely to be hidden; or, the other choice is as far as Pluto's orbit, but in retrograde motion.

Now the pieces begin to fall into place. By proper selection of ephemerides, orbital declination, and eccentricity, we can fit—and it is a good first-hand fit—the variations of the solar cycle to the outer, major planets as they pull the field emanating from Planet X. . . .

Raymond K. Petry  
Kailua, Hawaii

### The Editor Replies

Your suggestions are strong in the Ideas Department but require submission to at least a rough quantitative check.

In your approach to the Planet X question, a comparison of magnitudes argues strongly against it. Magnetic field strength at the center of a sunspot is typically 3,000 or 4,000 gauss. The Sun's rotation twists the interplanetary magnetic field into an Archimedean spiral, but at 1 AU its typical strength is only  $5 \times 10^{-5}$  gauss. The magnetic field strength at the surface of Jupiter is perhaps 4 gauss, and there is no reason to suppose that a planet could have a magnetic field many times that strength.

The singular strength of the magnetic field in the sunspots indicates that magnetically driven processes are controlled from within the Sun, rather than being a Sun-Jupiter-Planet X interaction. If the Archimedean spiral is known to suffer no great distortions, that would also lead to the same conclusion.

## Cold Fusion Cars?

### To the Editor:

When we were attacked by Japan, it took only six months to bring the P-51 into combat. I would like to know if it would be possible to have a crash program to develop an automobile to work on cold fusion. This could not only solve our energy shortage, but also our pollution problem.

Darrel Hansen  
Conroe, Texas

### The Editor Replies

Theoretically, your idea is possible, and there are of course many precedents for crash programs that succeed in developing new technologies.

The University of Utah research team has noted that cold fusion applications would involve smaller-scale power units, not large, centralized power systems. The only specific application they have mentioned would use cold fusion to power a water heater. This issue's report on India's program to commercialize cold fusion (p. 15), however, talks about many applications, including transport.

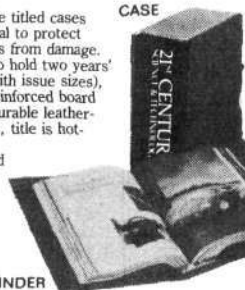
Continued on page 6

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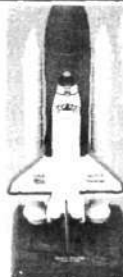
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# Experiment, Demonstration, Observation—or Nattering?

by James Frazer

## EDITOR'S NOTE

*Biophysicist James Frazer comments on how the initial reports on cold fusion by University of Utah scientists Fleischmann and Pons were treated by the scientific community and offers some suggestions for future experimental design. He notes that in addition to the hysteria generated by the popular press, many scientists rushed to report that they could or could not replicate the experiments, without regard to questions of fine-tuned experimental design.*

*Frazer, a scientific advisory board member of 21st Century, is now doing research on the cell mechanics of viruses.*

\*\*\*

In a recent conversation, Lyndon LaRouche and I discussed the matter of useful experiments in the context of the ongoing discordance surrounding "cold fusion." Thinking back on the discussion, and comparing it with some of the conversations I have had with graduate students, postdoctoral fellows, and colleagues, it occurs to me that the term "scientific method" does not mean the same thing to all people. Apparently, there is some lack of unanimity within the scientific community, although many scientists would, of course, deny this.

LaRouche championed an approach to experiment that I wish everyone could have heard unfiltered through my less-than-perfect senses. While we have all dutifully memorized the sequence "problem (materials and methods), results, discussion, conclusion, references," perusal of a selection of respected journals reveals other sections—abstract, background, review of the literature, introduction, summary, and appendix—adequately demonstrating there is something else that does not easily fit into the more

traditional categories. Most truly great experiments have a basis in a philosophical structure and careful mental analysis long before thought is given to a rigorous experimental design.

## 'Fishing'

After the thought and preceding the rigorously defined set of experiments, there often has to be a lot of "fishing"; that is, methods development, some pure trial-and-error, careful analysis of sources of error, an extremely careful analysis of the applicability of results to formation of—or substantiation of—a hypothesis that is really based on the philosophical attitude of the individual doing the investigation. This part of the scientific search for truth is, of course, unfunded, because it does not yield anything except the start of a hypothesis test.

As applied to the "cold fusion" controversy, it is interesting that there are myriad little things that have not made it into the reports I've seen. For example, any good electrochemist includes current-carrying ions in his electrode setup. Sometimes these are lithium salts, sometimes potassium salts, quite often nonpolar compounds to control surface tension—urea, sodium dodecyl sulfate (a detergent), polyethylene glycols, to mention a few of the more common ones.

Since many electrochemists have had their interest pricked by events at a dropping mercury electrode with a reference standard cell (as in Heyrovsky's polarographic techniques) and are well aware of the screwy results that occur when the mercury is contaminated with other metals, or when there is a deviation from the perfectly cylindrical bore of soft lead glass, they pay a lot of attention to the exact character of their electrode material.

Those who have played with bare platinum electrodes quickly find the



*Frazer: "The spirit of true investigation has gotten lost."*

difference between pure platinum and jeweler's platinum when standard cell potentials give incorrect, diffuse values. Similarly, those who have employed silver-silver chloride electrodes quickly learn to place a premium on purity and learn to watch for the blackening that signals the formation of silver oxide, which can be troublesome. The accompanying figure illustrates the importance of these elementary considerations.

The point of the discussion, as the figure indicates, is that the potential applied to such a cell determines the current carrier(s) in the system. A lot of use has come from this kind of arrangement: the oxygen electrodes used in space equipment and every medical laboratory, nickel-cadmium batteries, and so on. Notice that an  $E_0$  is marked on the curves. This "half-wave potential" is characteristic for any ionic species. The current flowing ( $I$ ) is proportional to the concentration of the species, and a very famous equation describing this was devised in the 19th century by Nernst:

$$E = E_0 \pm (57\text{mV}/n) \log C_i,$$

where  $E$  is open circuit potential, mV is millivolts,  $C$  is concentration of the ion whose half-wave potential is  $E_0$ , and  $n$  is the valence of the dissociated ion. This equation, corrected for permeability coefficients, diffusivity, and some other parameters, forms the ba-

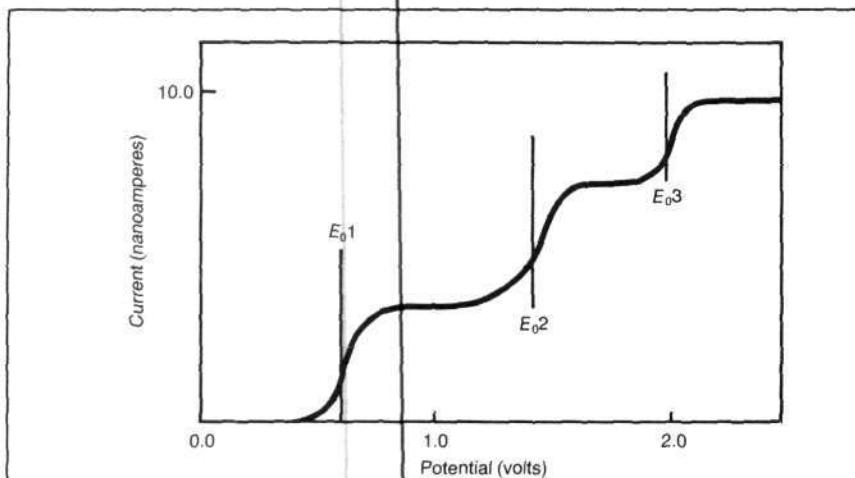
sis for measurement of transmembrane potentials in biological systems and sees quite some use in metal-plating industries, though plating has considerably more art associated with it than might be indicated by this simplistic presentation.

Now consider the mental "set" of an individual well skilled in these arts, who tends to think in the geometries of molecular distances, who is knowledgeable of the crystallography of metals, and knows that the  $^{58}_{28}\text{Ni}$ - $^{106}_{46}\text{Pd}$ - $^{195}_{78}\text{Pt}$  series of elements all share, to some degree, an avidity for  $\text{H}_2$ . In the case of Pd, it can absorb up to 900 times its own volume at standard temperature and pressure. There seems some uncertainty as to whether there might be formation of a compound such as  $\text{Pd}_2\text{H}$ .

The avidity has long been used as a way to purify hydrogen gas, and the finely divided metal is useful as a catalyst in hydrogenation and dehydrogenation reactions. Platinum is sufficiently active to produce large quantities of heat in the presence of methanol, used commercially in hand warmers. The individual would also know of the resonance experiments that show the presence of local fields sufficient to shift proton resonance several hundred cycles—a very large chemical shift.

A person with an appreciation of geometry, catalysis, the properties of the elements, and their interactions with a variety of compounds would then start thinking of ways of using geometrical configurations to shift electron elliptic manifold orbits, and their reciprocal nuclear fields, so that a kind of guided "collision" could occur.

In the context of present-day searches for research support, such a person would keep his thoughts to himself and would not be anxious to release experimental detail until his patent was granted. His attitude in this respect would be reinforced by the administration of his university or commercial laboratory, since they have major ownership of his intellectual products. Thus, I would think we will wait until at least March 1990 to find out what Fleischmann and Pons really had in their mixture and to get a glimmer of the guiding philosophy they used in their research.



**A SIMPLE POLAROGRAPH**

*An important parameter of the Fleischmann-Pons process may be found in polarography: The potential (voltage) applied to an electrolytic cell determines which of the ionic species present in the cell will act as current carriers. Each ionic species has its characteristic half-wave potential ( $E_0$ ). Hence, the resulting current depends upon the potential applied. Is anyone listening?*

Of considerable interest has been the response of the scientific community to the possibility of "cold fusion." Apparently a number of laboratories dunked the nearest available Pd into the nearest available solution, turned on the juice, and measured their favorite phenomenon. Neutrons were produced, no they were not; heat was produced, no it was not. Nearly all the possibilities of  $(a \pm b)^n$  have appeared in reflex press releases in an obvious anxiety to climb on or off the prevailing bandwagon. Cooler heads no doubt wrote some bland patent applications for a principle—about which we may hear later.

All this was from a community that prides itself on objectivity, creativity, serious consideration of the truth, and diligent exercise of intellectual judgment in training and application of a plethora of methodologies. Most sobering of all is the appearance of theoretical apologists for—or against—the possibility of the "Fleischmann-Pons" phenomenon. And Jaroslav Heyrovsky wasn't mentioned at all.

Heyrovsky's polarograms have, of course, their modern-day solid-state equivalencies in the electrons and holes of conventional electronics, and another equivalency at much higher field potentials in the "appearance po-

tentials" of accelerator fame, which has found some use in electron spectroscopy. The latter technique is sufficiently refined to afford quantitative data on dissociation potentials in fairly complex molecules, sufficient for thin film identification purposes.

We know, from experiments on cell fusion in biological systems, that an alternating current at frequencies of a few tens of megahertz, causing charged particle alignment, followed by a direct-current pulse of a few milliamperes, can cause cell fusion and transfer of genes under proper solution conditions. The membranes so affected have charges of about 1 megavolt/cm. Now, think of a deuterium atom in a palladium matrix exposed to local fields several orders of magnitude higher than this, with an extremely high magnetic alignment field, exposed to an impressed resonant frequency in addition to a strong impressed D.C. electric field, and several different types of strongly accelerated ions of 0.5 to 1.5 angstrom separation.

May not cause fusion, but could get most interesting. But this has not been mentioned, either.

It appears that in the anxiety to "replicate," the spirit of true investigation and the tradition of helpful criticism has gotten lost.



## The 'Greenhouse Effect' Is a Hoax!

*EIR's* Special Report, "The 'Greenhouse Effect' Hoax: A World Federalist Plot," analyzes the scientific truth and the political reality behind the latest environmentalist hoax: Kremlin leaders and their Trilateral Commission friends are using "ecological emergency" as the pretext to destroy the sovereignty of nations and establish one-world rule.

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## Letters

*Continued from page 3*

### Tour Three Mile Island!

#### To the Editor:

Last weekend, we found ourselves in Harrisburg, Pennsylvania, very near the Three Mile Island Nuclear Plant. Hoping we could visit this famous site, I called [(717) 367-0518] and, to my surprise, discovered that tours are available three times a day, Tuesday through Sunday.

The tour begins in the visitor center which has among other exhibits a fascinating video of the clean-up process which has been going on since 1979. From the observation deck is a breathtaking view of the facility set on an island in the Susquehanna River.

The tour itself does not include the inside of the plant, though I was told that such tours can be arranged. Instead, a knowledgeable guide drives the group around the facility describing the workings of the various structures.

I must admit that the defensiveness of the guide and his willingness to concede various "points" to the environmentalists is depressing. But the disappointment of power company public relations is certainly compensated for by the close-up view of the plant.

Paul Kreingold  
Leesburg, Va.

P.S. Sold at the Visitor Center are items such as hats and belt buckles with pronuclear slogans and pictures. Among these, for only \$5, is a beautiful purple and yellow tee-shirt with a drawing of a nuclear power station. This should be given to any child who wants a "heavy metal" tee-shirt with the explanation that uranium is the real "heavy metal."

### Who or What to Believe

#### To the Editor:

From a layman's standpoint—mine—after reading the articles in your May-June issue, I am confused as just who to believe, for many of the articles refute what other scientists have written.

Some of the writers are so positive they are right and the other groups are wrong that it confuses me. I usually try to keep an open mind and listen to both sides. . . .

I do know some groups are so set on saying and doing their "thing" and will not listen to other ideas that they have destroyed their credibility. . . .

I also know that there has been much bungling of ideas in various U.S. government departments—a case of too much politics as against sensible and reasonable thinking and doing.

Joe Barber  
Refugio, Tex.

#### The Editor Replies

The constant barrage of environmentalist propaganda on television, radio, and in the printed media repeats lies and misinformation so often that people begin to believe the lies. We intend to take on more of this misinformation (and the Chicken Littles who spread it). Our aim is to present readers with the scientific ammunition—both facts and methodology—to recognize the truth and to counter the lies.

#### OOPS!

The splendid volcano pictured on page 11 in the July-August issue is Mount Saint Helens, not Erebus, in a photo taken by the U.S. Geological Survey. The facts of Erebus's output in the caption are correct, and a color view of the real Mt. Erebus, taken by Bill Rose, appears on the back cover of that issue.

Coming in the Next Issue

**21<sup>st</sup> CENTURY**  
SCIENCE & TECHNOLOGY

**'The Eye Is the Window of the Soul'**

Leonardo on Vision

## VIEWPOINT

### 'Cold Fusion' Development: Let's Do It Right



Ira C. Magaziner

From its early days, this nation has prospered in great measure because we have led the world in taking the scientific knowledge of the day and bringing forth commercial products that we made more efficiently and in greater abundance than anyone else. We have been a practical people. We didn't always pioneer in science, but more often than not we led the way in applying the science to benefit a large number of people. This ability made us the most prosperous nation in the history of this planet.

Over the past 15 years, however, we have been losing this ability. To be sure, we have had more than our share of scientific inventions, but we have lost the knack of converting these into products to create jobs for our people. Too often, we have won the battle of the patents but lost the war of creating the jobs, profits, and wealth to other nations.

- American scientists at Raytheon invented the microwave oven, but today it is Korean and Japanese companies that produce 90 percent of the world's microwave ovens—including well over two thirds of those bought by Americans.

- American scientists at RCA invented the color television, but today European and East Asian companies produce more than 97 percent of the world's color televisions—including 85 percent of those bought by Americans.

- American scientists at Ampex invented the VCR, but today Japanese, Korean, and European companies produce more than 99 percent of the world's VCRs—including virtually all of

*Ira C. Magaziner is president of Telesis, USA, Inc., an international consulting firm specializing in corporate strategy. His viewpoint is adapted from testimony he presented at the April 26, 1989 hearings on "cold fusion" before the House Committee on Science, Space, and Technology.*

those bought by Americans.

- American scientists funded by the Defense Advanced Research Projects Agency (DARPA) invented the computer-numerically-controlled machine tool, but today European and Japanese companies produce more than 75 percent of these machines—including more than 60 percent of those bought by American companies.

- American scientists at AT&T Bell Labs and Texas Instruments invented the base technology that produced the world's first memory chip, but today Japanese companies produce more than 80 percent of the world's memory chips—including more than 50 percent of those bought by American companies.

- American scientists backed by NASA sent the first commercial communications satellites into space, but today, a European company, Ariane-space, has acquired well over half of the commercial space launching business.

- Though American scientists at Control Data Corporation and Cray Corporation first invented and perfected the supercomputer, we now trail Japan's NEC Corporation in supercomputer technology. Though American scientists at Bell Laboratories first invented the solar cell to convert sunlight to electricity, today Japanese and European companies have well over 70 percent of the world market. While scientists in America first invented high temperature superconductors just three years ago, a recent U.S. Office of Technology Assessment study team concluded that the Japanese

were already ahead in commercializing products from this new technology.

There are, of course, exceptions—cases where America leads the world in commercializing products we invented—but the negative list is growing faster than the positive one.

#### The Negative Result

The result of all this is a negative trade balance of \$135 billion, despite a 48 percent devaluation of the dollar over the past four years. This deficit forces us to borrow from our foreign competitors each year and to sell them our land, our buildings, and even our productive companies to finance our current living standards.

Let's be clear. Well over 50 percent of this trade deficit is with nations like Japan, West Germany, France, Sweden, Holland, Switzerland, and Denmark, which pay higher wages—yes, higher wages—and higher benefits to their workers than we do to ours. They don't beat us with cheap labor, they beat us with technology and skilled labor.

There are many reasons for our negative trade balance, but the fact that foreign countries are able to convert science into commercial products more quickly and better than we do is one of the crucial causes. The reasons they can do this are not hard to understand: more investment; better cooperation among government, industry, universities, and research institutes; and superior planning to develop marketable products even before the science is proven.

#### Free Market Vs. Development

In former times, basic research was done in universities, and the process from basic science to mass production took decades. Today, these steps don't move sequentially, they move in parallel. Even before basic science is proven, applied research begins, product developments are undertaken, market research is done, and manufacturing processes are developed



. . . and here is where we in America fall behind.

In America, these early steps are usually taken by companies working on their own, competing with each other and often duplicating each others' work as they compete. In Europe and Japan today, these steps in what is called the precompetitive stage are taken in cooperation. Companies work with each other and with applied research institutes and universities—usually with government funding and support—to accelerate the process of turning science into marketable products.

In America, this partnership approach is frowned upon as meddling with the free market. In Europe and Japan, it is only when the first generation of products is developed that competition is promoted—and then companies compete fiercely.

Increasingly, the early stage competition is among nations and the later stage among companies. We may not philosophically approve of this government backing for industrial development, but it is the reality in today's international marketplace and we cannot let our bias blind us to its effectiveness. Catching up requires many actions: changing our financial structure to encourage industrial companies to take a longer time horizon, for example. But no action is more fundamental than meeting the need for publicly supported commercial research and development to match the efforts now under way in Europe and Japan.

Today in Europe, billions of dollars are being spent each year through general programs such as Eureka, Esprit, Brite, and Race and through specific programs like Airbus and Aerieanne on more than 500 projects bringing together companies and research institutes to pioneer the products of the 1990s. The Europeans are determined. More than \$17 billion dollars of government money went to finance the development of Airbus over 20 years so that it could move from nothing to 25 percent of the world's commercial jet aircraft market, surpassing Lockheed and McDonnell Douglas. The result is that today Europe has 50,000 high-skilled jobs and \$5 billion of positive trade balance, instead of America.

In Japan, billions are being spent through the agency for Industrial Science and Technology located within the Ministry of International Trade and Industry (MITI) on dozens of joint projects bringing together companies, government laboratories, and universities to pioneer products for the 1990s. Areas of emphasis range from biotechnology to new high performance materials to new electronic devices.

And what do we have to match these efforts? A few hundred million dollars funneled through the Defense Department for a handful of projects such as Sematech. Even with these projects, we go through soul-wrenching debates about whether we are violating free-market principles. To take one example: Recently, DARPA has been considering awarding \$30 to \$60 million to fund high definition television development in the United States, and the debate about whether this is correct policy has reached the covers of a half-dozen major periodicals.

From Europe and Japan where hundreds of millions of government dollars routinely have been going into funding this technology every year, our late philosophical debate over so little money seems bizarre.

#### **Fusion Fever**

To make my point clear, I will take an extreme case. Recently we had an announcement about the discovery of cold fusion in a University of Utah laboratory. Acrimonious debate has surrounded this claim with most scientists expressing profound skepticism.

So what should we do? Well, if we do as we did with high temperature superconductivity, we will work for a while to verify and test the science. Then the Defense Department will sponsor some work on how this could be useful to them. A handful of our companies will each put a few people to work in the area and we will hold a few conferences. Some Utah bodies, assisted perhaps by state and federal funds, will support the continuation on a modest level of research in this area and may even develop a national laboratory to pursue the science.

The congressional Office of Technology Assessment will undertake an 18-month study to see how we are doing, and early in 1991 they will report

that the Japanese have blown past us again and are leading in the race to develop industries from this new science.

#### **An Alternative**

There is an alternative. It's an alternative that says that America is prepared to fight to win this time. The alternative is to form a research institute around this new science, but one that will be adequately funded and flexibly run and that will engage both in basic research and in commercial development work.

The institute can be funded with money from the university, the state, corporations, and the federal government. Additional funds can be made available to fund on a matching basis corporate efforts to develop products, manufacturing processes, prototypes, and market demonstration projects.

While federal grants can be made available to fund the basic research portion of the institute, the assistance for applied research and commercialization can be provided in the form of conditionally reimbursable loans that are paid back with a high interest rate if projects succeed and not paid back if they don't, with a sliding scale in between. This will allow the taxpayers of America to receive a potential return on their investment.

This need not be, nor is it desirable for it to be, primarily a federal-government-based project. But to match the competition in Europe and Japan, there must be federal support.

But wait a minute, you say. This science isn't even proven. Reputable fusion physicists throughout the world have expressed profound skepticism about these experiments. We don't even know if this is really fusion or just some quirk. Wouldn't it be prudent to wait until we see whether there is really something of value here? We could all wind up with an extra-large egg on our faces and waste the public's money in the process.

#### **Risk Vs. Return**

Suppose this science is a blind alley. Suppose a week or a month or a year from now scientists find that there really isn't anything much to it. If we move aggressively ahead and invest as I suggest, we will lose a few thousand dollars if it is discredited next week, a few hundred thousand if it is discredited

ed next month, and a few million dollars if it is discredited next year.

A couple of million dollars or even a couple of hundred thousand or even a couple of thousand is serious business—good public servants have gotten in trouble for losing track of lesser sums.

But now let's suppose that this science is real and it does open up a new energy source in the next decade and becomes a multi-billion-dollar or even hundred-billion-dollar industry in the next few decades. If we dawdle and wait until the science is proven, or if we wait for the economists to hold symposia on whether Adam Smith would approve of putting public money into it, or if we move cautiously and invest only in basic research or only in defense applications and wait for the spinoffs, we will be much slower off the blocks than our Japanese and European competitors, because they won't run the race that way.

Competitive success is a leading position in a race. If we fall too far behind at the beginning, we may never catch up. The downside risk of that could well be hundreds of thousands of

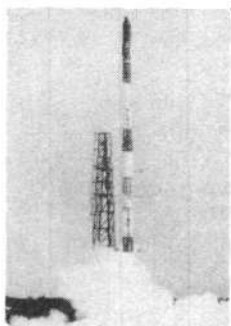
high-paying jobs for our children, billions of dollars of trade balance, and billions in wealth that then will go to someone else.

This is not a very hard business strategy problem. The downside of wasting a few thousand or even a few million dollars is far less risky than the downside of losing this possible future industry to foreign competitors. The right decision is pretty clear.

I have an interest in America's future. I see this as an opportunity for America both to develop this science into future American prosperity and also to develop a model for how America can regain world preeminence in commercializing other new sciences in the coming decade.

If we do not prevent another TV or VCR or computerized machine tool or solar cell or superconductor story, we will be the first of our nation's 10 generations to leave its children a country less prosperous than the one it inherited.

For the sake of my children and all of America's next generation, I urge Congress to have America do it right this time.



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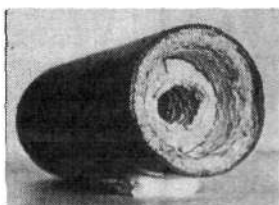
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## NEWS BRIEFS



Stuart Lewis

What defense laser? Princeton's Frank von Hippel (right), claimed that the two Soviet lasers observed at Sary Shagan had a maximum beam power "approximately 1,000 times less powerful" than the U.S. MIRACL laser at White Sands. At left is NRDC physicist Thomas B. Cochran, who led the team on its Soviet visit.

### NRDC SAYS PENTAGON INVENTED THE 'LASER GAP' TO JUSTIFY THE SDI

In a much-reported Washington, D.C., press conference July 12, the Natural Resources Defense Council (NRDC) accused the Department of Defense of "grossly inflating" the threat posed by the Soviet laser installation at Sary Shagan. "What it looks like is a Potemkin Village built by the Pentagon" to justify the U.S. Strategic Defense Initiative, said NRDC senior attorney S. Jacob Scherr. The NRDC was in the Soviet Union to discuss how to verify compliance with a ban on submarine-launched cruise missiles.

The NRDC team toured Sary Shagan at the last minute, with no laser experts present, and their evaluation was based solely on information provided by the Soviets and amateur photos that they brought back for U.S. laser experts to evaluate. One such expert, John Pike of the Federation of American Scientists, went so far as to call for a "public review" of the procedures that led to the Pentagon's assessment of Soviet space defense in the 1985 edition of *Soviet Military Power*.

### SOMEBODY UP THERE WANTS TO SLOW DOWN MAGNETIC FUSION

The Department of Energy (DOE) has changed the focus of the U.S. fusion program to slow down magnetic fusion development and supposedly let the inertial fusion program "catch up." Specifically, this means deferring development of the Compact Ignition Torus (CIT), the next-stage tokamak device that would keep the U.S. magnetic fusion program moving ahead—albeit, slowly. This plan was presented in congressional hearings June 14 by Dr. Robert O. Hunter, Jr., director of the Office of Energy Research, who requested a \$50 million cut in the \$350 million magnetic confinement fusion budget for fiscal year 1990 under the guise of beefing up the inertial fusion budget. Hunter has proposed setting up a civilian laser fusion program using this money and other unspecified funds.

After Hunter's testimony before the House Armed Services Committee, the DOE received letters of protest from fusion researchers around the world. Under pressure from Congress, DOE head Watkins then agreed to appoint an independent panel to review the magnetic fusion program. Panel members have not yet been appointed, and it is not clear if the panel will be able to make its recommendations in time for the start of the fiscal year, Oct. 1.

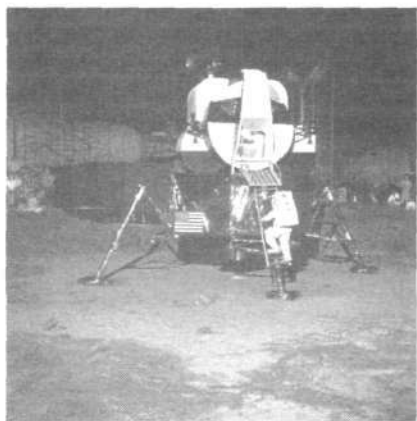
Such manufactured "competition" between the magnetic and inertial approaches was the philosophy associated with former Energy Secretary James Schlesinger. According to this view, the United States doesn't need fusion energy until the 21st century, so why not just conduct physics studies instead of a crash program to develop a commercial reactor?

### EPA IMPOSED RECORD FINES IN 1988 FOR 'ENVIRONMENTAL CRIMES'

Environmental Protection Agency administrator William Reilly expressed his pleasure at the record-setting enforcement numbers for 1988, announced Aug. 16. The EPA enforcement imposed \$36.8 million in civil penalties, convicted 50 defendants of environmental crimes, and sentenced "environmental criminals" to 30 years of jail time in 1988. These record enforcement numbers "show EPA and the federal government generally are getting tougher on enforcement, which is the cornerstone of EPA's environmental programs," Reilly said.

### HUNTSVILLE CELEBRATES APOLLO MOONSHOT'S 20TH ANNIVERSARY

More than 10,000 residents of Huntsville, Ala. celebrated the 20th anniversary of the Saturn V rocket launch that carried the Apollo astronauts to the Moon during mid-July. The celebrations included a dramatic reenactment of the lunar landing at the Alabama Space & Rocket Center, exhibits and lectures about the Moon, appearances by a number of Apollo astronauts, press conferences with the original German rocket team on the future of space flight, and an open house at the Marshall Space Flight Center.



Marsha Freeman

A reenactment of the first lunar landing at the Alabama Space and Rocket Center.

### CHALLENGER CENTER FOR YOUNGSTERS OPENS AT NASA-GODDARD

The Challenger Center, where "children can learn about space, challenge their powers of critical thinking and decision-making, and build the desire to work in space in the 21st century," opened July 17 in one of the many 20th anniversary celebrations of the first footsteps on the Moon. The center, at NASA's Goddard Space Flight Center in Greenbelt, Md., is dedicated to the memory of the *Challenger* astronauts.

### GREEN PARTY LEADER CALLS FOR FASCISM 'TO PROTECT ENVIRONMENT'

Rudolf Bahro, a leader of the West German Green Party, called for what he termed "ecological fascism" in a May 27 interview on ZDF television in West Germany. The theme of the program was the effect environmental regulations might have on the rights of citizens. Several environmentalists asserted that limits would probably have to be placed on human rights to "protect the environment." Although this would not be a "return to Hitler," Bahro said, it would be something "in that direction, a form of fascism."

### HOTLINE ESTABLISHED TO REPORT ENVIRONMENTALIST TERRORISM

The Mountain States Legal Foundation in Denver has established a hotline for reporting acts of environmental terrorism. The number is 1 (303) TESTIFY. William Perry Pendley, president and chief legal officer of the foundation, said: "Men and women who work on and enjoy the public lands of the West are increasingly at risk from the activities of a small band of radical environmental terrorists. From the 'spiking' of trees, to the cutting of ski lift cables, to the issuing of death threats, these environmental racketeers are placing fellow Americans in grave physical danger. . . . We need more facts to establish participants, patterns, and to determine the existence of a conspiracy on the part of those who would kill fathers in the name of Mother Earth. . . . We ask those who have such information to call us."

### HOLLYWOOD ENVIRONMENTALISTS FORM MEDIA PROPAGANDA GROUP

A cast of entertainment bigwigs with a budget of millions has formed a new organization, the Environmental Media Association, to help the "entertainment industry" insert environmental propaganda into TV shows, movies, and lyrics. According to EMA: "Films, television programs, and music have a unique ability to infuse the popular culture with a particular message. Through the incorporation of environmental themes in its projects, the creative community can . . . generate a climate of concern about our environment. . . ." The supporters of EMA include Hollywood producer Norman Lear, financier Marvin Davis, Barbara Streisand, Robert Redford, and the heads of MCA, Disney, Columbia, Fox, NBC Entertainment, and Warner Brothers. "The leaders of all nations must enter into a new global compact for sustainable development. They must forge a blueprint for the planet's future that will include profound changes in attitudes and lifestyles," the EMA document says.

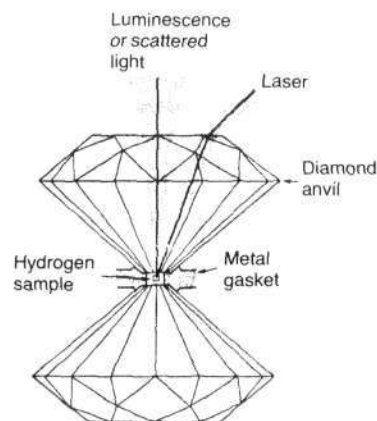
### METALLIC HYDROGEN APPROACHED AT 2.5 MEGABARS

Using brilliant-cut diamonds as anvils (see illustration), two scientists at the Carnegie Institution's Geophysical Laboratory have observed the transition of hydrogen toward its metallic state at a pressure of 2.5 million atmospheres (2.5 megabars). Ho-Kwang Mao, a geophysicist, and Russell Hemley, a physical chemist, reported at the May meeting of the American Geophysical Union that increasing opacity was observed above 1.5 megabars and, with the help of Raman spectroscopy, the weakening of the H—H molecular bond was detected above 1.6 megabars. Both indicate the predicted onset of metallization. The maximum pressure achieved, 2.5 megabars, corresponds to the depth of the Earth's inner core. The pressures are measured in the hydrogen sample by including in it tiny grains of ruby, which fluoresce under pressure.



Stuart Lewis

Astronaut Michael Collins (right) coaches future astronauts in a simulator at the new Challenger Center.



The diamond anvil cell consists of two brilliant-cut diamonds of gem quality, the butt ends of which fit into a tiny, stainless steel gasket. The secret of the device is the intensification achieved by employing a very small area of contact (25-50 micrometers diameter), and the alignment of the two stones is critical.

# The Film Greenpeace Doesn't Want You to See

by Marjorie Mazel Hecht

"The worst crisis Greenpeace has ever faced." This is how members of the multi-million-dollar international environmentalist organization Greenpeace have characterized the film "Survival in the High North," released by Icelandic film-maker Magnus Gudmundsson on March 14, 1989.

The 52-minute film documents the damage done by Greenpeace to the peoples of Iceland, Greenland, the Faeroe Islands, and northern Canada in the name of saving the whales, and shows that Greenpeace staged a brutal seal-killing scene to use in a fund-raising film on saving seals.

Gudmundsson, who has worked as a journalist for 12 years in Scandinavia, was motivated to make the film after he visited Greenland in 1985 and saw first-hand the devastation of its economy and people as a result of Greenpeace's campaign to shut down whaling. He used his own funds to finance the film, which took him four years to make.

Gudmundsson is a modern-day David, fighting Goliath with a slingshot of truth. So far, the threats of the giant to sue him (and individual television stations) to stop the film have remained only threats. The group was unable to get an injunction in Iceland to stop the film from being shown, and it was also shown on television in Holland and the Scandinavian nations. When it couldn't stop the showings, Greenpeace demanded in the name of "fairness" to have time to rebut the film—a decency Greenpeace has never extended to anyone it criticizes.

At Gudmundsson's Washington, D.C., press conference June 6 to show the film, Greenpeace USA leafletted the audience with a release stating: "This screening is the first showing of 'Survival in the High North' in the U.S. and, therefore, legal action could not be pursued until today. . . . Green-



Stuart Lewis

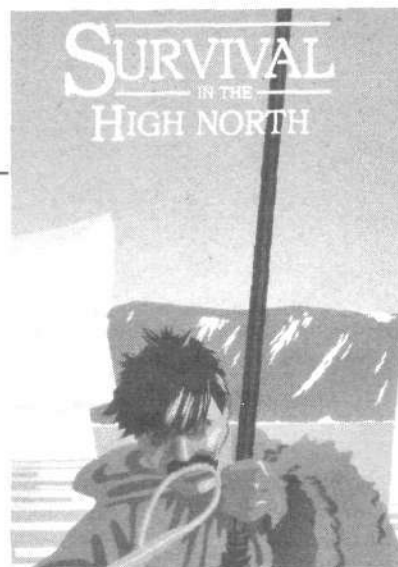
peace intends to pursue legal action against its producers for defamation under U.S. law as well as in other countries where the film has been shown as a legitimate documentary."

Gudmundsson replied to the Greenpeace spokesmen present at the press conference: "Go ahead and sue. I'm ready. This film tells the truth, and therefore Greenpeace does not dare to sue." To date, there has been no lawsuit.

In fact, at that press conference, Greenpeace's "rebuttal" of the film's charges consisted of an attack on *21st Century* magazine, which had sponsored the room for Gudmundsson at the National Press Club. "Contributors to this publication also worked for the LaRouche magazine *Fusion*," the leaflet railed, apparently hoping this would stop anyone from paying attention to Gudmundsson's shocking exposé of Greenpeace's unethical tactics. Greenpeace representatives also phoned some of their friends in the liberal media to solicit articles attacking *21st Century*.

## Whales and Lies

Much of the Gudmundsson film documents—with beautiful photography—the relationship of the peoples of the High North to the sea and the role of whales and seals in the northern economies. The technology of whaling is explained, along with the



Gudmundsson: "Perhaps it is *Homo sapiens* not the whale that is now on the brink of extinction, with Greenpeace and other animal rights groups as the final threat." The film-maker is shown here at a June 6 press conference in Washington, D.C.

facts the U.S. media never report. (For example, Faeroe Islanders depend on whale meat for 50 percent of their protein, and the catch is shared with all the islands' inhabitants.)

Gudmundsson makes it clear that whale hunts and seal hunts are not sport but survival for the northern peoples.

The film effectively counterposes a Chicago slaughterhouse to a whale hunt noting that "in both cases, an animal has been killed so that man can live." Later in the film an Inuit woman, Rhoda Innuksuk, emphasizes this point: We don't understand, she says, how Christians can support Greenpeace, which views man as lower than the animals.

The film also makes the point that a Greenpeace offshoot, the Sea Shepherd group, doesn't hesitate to sabotage whaling boats, physically endangering the lives of whalers in the name of saving the whales.

As the film shows, the whale and seal hunts are carried out as efficiently and humanely as possible; the whales are dead in 5 seconds. The current abundance of various types of whales is documented, contrary to Greenpeace's heart-rending propaganda about their dwindling numbers. Iceland, in fact, was the first nation in the world to protect whales by law, and the only time the seas around Iceland



© 1989 Adrian Boot

Greenpeace International in Red Square in June, celebrating the release of its Melodiya Records release, "Breakthrough," the first Western rock record in the Soviet Union.



A scene from the 1978 staged seal hunt that Greenpeace used to raise funds . . . and to destroy the sealing industry in Canada and Greenland.

were "overfished," the British were doing it, and Iceland nearly went to war to protect its marine resources.

Given their relationship to the nation's natural resources, the Icelanders interviewed are particularly incensed that Greenpeace is accusing them of depleting their resources, and that Greenpeace has organized a boycott of Icelandic fish products, which make up 75 percent of the tiny nation's economy.

#### Profitable Deceit

As more than one Greenpeace bigwig says on camera, seals are a big money-maker; whales are next.

The most controversial sequence in the film is footage taken—with the written permission of Greenpeace—from Greenpeace's 1983 fund-raising film "Bitter Harvest." The episode is a brutal scene where an alleged harp seal hunter, face blackened, drags a baby seal away from its protesting mother. As Gudmundsson shows, the scene was staged; the same event was filmed several times from different angles.

After this phony Canadian seal hunt episode was aired on television in March 1978, Canada's sealing economy was destroyed. Now, as a result, the overpopulation of seals is a problem for the ecosystem in the North. Last year, the same faked footage was shown again in Norway. Although Greenpeace protests that the footage

is from a real seal hunt, the one witness they quote, Dr. Harry C. Rowsell, actually says the opposite of what Greenpeace claims he said.

Gudmundsson now has two written statements from witnesses present at that 1978 filming who say that the event was staged.

#### Desperate

The reaction of Greenpeace to the documentary, Gudmundsson says, is "the reaction of a group of desperate people who have been exposed for what they are: a power- and money-motivated organization that does not hesitate to use grossly biased and even deceitful methods to increase their influence at the expense of countless innocent victims. Throughout the years they have manipulated public opinion by mass propaganda, disinformation, intimidation, and economic boycotts aimed at destroying the means of livelihood of thousands."

Greenpeace, he notes, began agitating to stop the film even before they had seen it or had any knowledge about it. The only thing they knew was that it was critical of their organization. "Greenpeace has managed so well to manipulate the media throughout the years that they had not considered the possibility that anyone dared to challenge their credibility," Gudmundsson said.

As a result of Greenpeace's heavy-handed attempts to suppress his film,

Gudmundsson has already begun to work on a second film that will document more of the story of their economic terrorism—and Greenpeace's attempts to stop him from telling the story. Gudmundsson has also volunteered to debate Greenpeace spokesmen anywhere; he is so effective in debate with them, in fact, that Greenpeace recently canceled scheduled debates in Spain and Japan.

Hopefully, the second film will also discuss some of Greenpeace's other deceitful exploits—its role in forcing unilateral disarmament in the United States by attacking defense production; or its recent attack on a Navy submarine, preventing it from launching a new missile; or its multi-million-ruble relationship with the Soviet Union, where consumers who buy the rock record Greenpeace produced in Moscow also become Greenpeace members.

Gudmundsson has given Americans a powerful weapon to use against the economic and cultural terrorism of Greenpeace. The challenge now is for U.S. television—as well as schools and community groups—to get the first film, "Survival in the High North," before as wide an audience as possible. Gudmundsson is also arranging a U.S. distributor for a videotape of the documentary. For information, write Maged Film, Laugavegur 26, 101 Reykjavik, Iceland.

# Cold Fusion Is Alive and Well

by Marjorie Mazel Hecht

*At last: The next issue will have some first-hand information on U.S. cold fusion gathered from our visits to laboratories and discussions with cold fusion researchers.*

As we go to press, there are continuing reports from around the world of researchers achieving success with a diversity of "cold fusion" experiments, producing excess heat as well as neutrons and tritium in amounts above the expected background levels. This includes at least 10 research teams in Japan and several in India, as reported in this section. It also includes U.S. laboratories that are withholding the news of their success because they don't want to risk attack.

What exactly is the cold fusion reaction? That is the question that research teams around the world are now asking. In Japan, the Institute of Fusion Science has just put together a team of 80 scientists from 15 institutions to probe the nature of the cold fusion process and the mechanics of producing more of it. In India, a "crash program" approach has been launched, involving a large number of the country's best scientists.

But in the United States, where the University of Utah team of Martin Fleischmann and Stanley Pons first announced their startling discovery in March, the unscientific attitude prevails that if bigger-name scientists can't get the Fleischmann-Pons results, Fleischmann and Pons must be wrong. In addition, the panel appointed by the Department of Energy gave an official go-slow signal, recommending against any significant expenditures at this point, because the "experiments reported to date do not present convincing evidence that useful sources of energy will result."



News of the demise of cold fusion is decidedly premature. Inset—Three leaders in cold fusion at a May 8 press conference sponsored by the Electrochemical Society in Los Angeles: (from left) M. Fleischmann, S. Pons, and S. Jones.

It's almost as though—outside of Utah—cold fusion has gone underground, buried by the pessimism of a hostile press. As one observer from the business community notes (see page 7), unless this nation acts with uncharacteristic boldness to begin developing this new technology now, in its research infancy, the United States may end up importing—once more—the finished product from Japan.

The Utah state government has put \$4.5 million into a new National Cold Fusion Institute at the state university, and General Electric has invested an undisclosed amount of money along with some manpower for the Utah effort. Other companies have signed contracts with the University of Utah to share knowledge of the details of the nine patent applications the university has filed.

Also in Utah, a privately funded Fusion Information Center plans a monthly newsletter to supply news on cold fusion to those who cannot find it in their local press—or the scientific press.

Finally, it was a Utah reporter for the Salt Lake City *Deseret News* who unearthed the story of a research team at Los Alamos National Laboratory that replicated the Fleischmann-Pons experiment and measured large

amounts of tritium—4,000 counts per milliliter.

Although the Los Alamos laboratory has not put this news out officially (they are waiting for verification from further experiments) the national media did not pick up on this news. Most noticeably silent were those scientists and reporters who had dogged Fleischmann and Pons at press conferences with questions of why no national laboratories could reproduce their results.

### A Scientific Perspective

Helpful accounts of cold fusion for the layman appear in the monthly newsletter *Access to Energy*, published by Dr. Petr Beckmann. We quote one passage from his July report: "...I am amazed at the number of people, including some scientists, who think that failure to reproduce the F&P [Fleischmann and Pons experiment] is a refutation of the effect. It is no such thing—when my car won't start, does that prove that gasoline engines are a hoax?

"The many teams who did *not* get excess heat proved no more than that their setups were the wrong way to do it, for they lacked a certain something that F&P had and they didn't; but what that certain something is has not yet

*Continued on page 63*

# India Joins the Race to Prove Cold Fusion

by Ramtanu Maitra



*In search of cheap electricity: Two members of the Tata Institute of Fundamental Research in Bombay working with the detection equipment used in their cold fusion research.*

A new excitement has swept India's prestigious Bhabha Atomic Research Center (BARC), the premier nuclear research center of the country: cold fusion. Less than three weeks after the University of Utah team of Fleischmann and Pons startled the world by announcing discovery of an electrochemical process claimed to demonstrate fusion of hydrogen nuclei at room temperature, Indian scientists rushed to validate the experiment and pave the way for commercial development.

The Indian experiments began in two laboratories in mid-April. The Department of Energy put one team onto the job in the Indira Gandhi Center for Atomic Research in Kalpakkam under Dr. C.K. Mathews, who heads the center's radiochemistry program. A second team was set up at BARC under Dr. R. Chidambaram, head of the physics group there. Both at BARC and the Gandhi Center, four separate groups carried out the Fleischmann-Pons experiment with slight or no variation.

Simultaneously, a third team began to work on the experiment at the internationally renowned Tata Institute of Fundamental Research in Bombay—a leading institute for theoretical and pure science—under Dr. K.S.V. Santhanam, head of the chemical physics department.

The first set of results appeared within weeks. The Tata team, which reportedly wrecked two temperature measuring thyristors, observed a temperature rise of 1 degree Celsius per minute. Santhanam confirmed the detection of neutrons and gamma rays, emitted during the experiment at a level above that of normal background radiation.

## Cautious Optimism

Mixing optimism with caution, Santhanam told the local press, "We are not calling it fusion though this appears to be a possibility." Discarding the possibility of an "unknown chemical reaction" to generate such a rapid buildup of heat, Santhanam noted that "no chemical reaction can sustain this phenomenon" and it is inconceivable that any chemical reaction can release such quantities of heat.

Soon enough, similar reports began to issue from BARC and the Gandhi Center. At BARC, where the Chidambaram team is backed by the noted neutron physicist and director of BARC, Dr. P.K. Iyengar, and an extremely well-equipped laboratory, the observations made were similar. Chidambaram reported that the team has "surely seen neutrons here and some cold fusion is surely going on."

Chidambaram, however, admits that "the process seems to depend on

so many poorly understood parameters—it is not a straightforward experiment." Therefore, he said, "it is not surprising that other laboratories are having difficulty replicating the result."

Iyengar, keen to utilize the experiment's potential to generate electricity for the power-starved country, said, "We are convinced that there is something significant in all this."

At the same time, Iyengar was cautious. He pointed out that a lot of science work remains to be done in order to be convinced one way or the other. It is imperative, he said, that one find out the function of the palladium lattice—whether it made internucleonic distances shorter or caused cold fusion through an effective electron mass that screened the electrostatic forces between the two deuterium nuclei.

Iyengar was equally cautious about predicting whether the process can eventually be translated into a successful commercial technology. Admitting that he is greatly excited by the experiments, he emphasized that to make this process a commercial reality, a number of questions must be closely investigated. To begin with, he said, we must be able to answer the following questions:

## Questions for Experimentation

Does local heating due to cold fusion aid or diffuse further fusion reactions?

Are there any alternative mechanisms to pump much more deuterium into the palladium lattice?

Are the two alternative pathways for fusion—high energy-induced and high density-induced—leading to helium-3 and tritium equally probable or do they have different probabilities?

Or, is there a new mechanism for the fusion of deuterons that results in helium-4, helping in the transformation of energy to the lattice?

The Gandhi Center team published the findings of its experiments in the *Indian Journal of Technology*. The 12-page report basically confirmed that surplus heat was generated and that



the level of emission of neutrons observed was too low to account for the entire heat generated. "The neutron signals were fairly weak and they were not detected in all the experiments we conducted," Mathews said.

#### The Experimental Setup

For the experiment, the Gandhi Center team used an electrolysis cell made up of a platinum mesh anode in the form of a cylinder with a palladium cathode in the center. The cathode was cast by melting palladium powder. A cylindrical titanium mesh cathode was used in some experiments.

The electrodes were immersed in 200 milliliters of heavy water held in an electrolysis vessel. A constant current was passed between the two electrodes. The cathode temperature and the temperature of the heavy water were observed.

Mathews, who considers himself involved in probing a scientific principle, is, like Iyengar, puzzled over the experimental findings. He is quick to note, however, that "if we can have cold fusion, it will be a dream come true."

Meanwhile, Mathews's colleague, Dr. S.R. Balasubramaniam, is looking into the possibility of devising a system for extracting the generated heat for producing usable energy. This in-

volves scaled-up experiments to facilitate work on engineering designs for the heat extraction process. Balasubramaniam is the chemical engineer in charge of the Kalpakkam nuclear fuel reprocessing development program.

The laboratories are now involved in preparing a second set of experiments that may provide a few more clues to the mysterious effect that has puzzled scientists the world over. Meanwhile, in mid-May, a team of six scientists at the Variable Energy Cyclotron Center in Calcutta announced that they had observed a rise of temperature from 25 degrees to 53 degrees Celsius during a 10-minute neutron burst. The Cyclotron Center director, Dr. Bikash Sinha, pointed out that the rise in temperature of the palladium electrode occurred almost simultaneously with the detection of the neutron burst.

"The coincidence is intriguing," Sinha told the press. "We took measures to shield the experiment from background neutron level by confining it in paraffin. There are strong indications that the neutron bursts result from the reaction taking place in the beaker. The surge in neutron level is three times the initial level at the start of the experiment. This is simply puzzling!" he said.



BARC's Iyengar: "We are convinced there is something significant in all this."

#### BARC Begins Commercialization

Although a number of other groups in various scientific institutions and universities are preparing to carry out variations of the Fleischmann-Pons experiment, it is the efforts of BARC that are drawing national attention. BARC, with a background of 40 years of nuclear research and development of an indigenous nuclear reactor, boasts superbly equipped laboratories and generous government grants. More important, the BARC team, comprising more than 40 top-level scientists, is perhaps the first anywhere in the world to have started work on making cold fusion cells a commercial reality, even as they are not sure of the physics behind it.

One of the first items on the agenda at BARC is to develop an electrode that does not corrode or burn. The palladium and titanium electrodes, it has been noted, burn and corrode easily, rendering the cell useless. The problem can be easily solved, Dr. Iyengar said: "We can design an electrode that has cold water running through its center to carry off the heat it generates. An electrode shaped like a tube will not only be more uniform in its physical properties in that the center of the metal portion will be subject to similar conditions as the outside, but it can also carry cold water that takes

*Continued on page 18*



Information Service of India

The North site of the impressive Bhabha Atomic Research Center, where scientists are now working to commercialize cold fusion. In the background are radiological and food irradiation and processing laboratories. In foreground is the central administration building; at left are engineering halls and the long building is the modular laboratories.

# Cold Fusion in Japan: Excitement and Success

by Kiyoshi Yazawa

There was a burst of excitement over the prospects of cold fusion research after a July 31 symposium in Tokyo at which 10 research teams announced their success in a variety of cold fusion experiments. Although there has not been much press coverage, Japanese researchers have reported finding tritium and excess neutrons and heat in their experiments.

The consensus at the symposium sponsored by the Electrochemical Society was that the cold fusion process is not so much akin to muon-catalyzed fusion as previously thought, but actually similar to the deuterium-deuterium reaction in thermonuclear fusion.

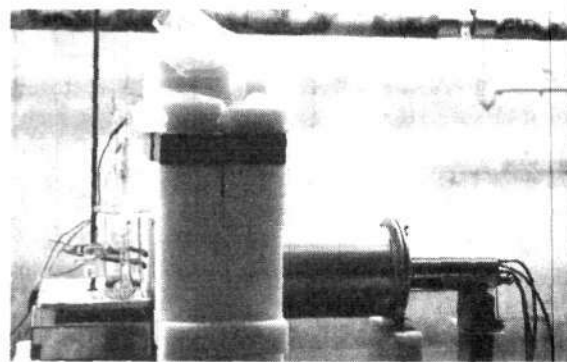
Among the teams reporting success were the University of Tohoku, the University of Hokkaido, Aoyama-Gakuin University, and a joint group from

Tokyo University of Agriculture and Technology and the Japan Atomic Energy Research Institute.

Previously, this last group had said that they found "no clear evidence" of tritium; at the July 31 symposium, however, they announced that they had found both tritium and a vast amount of heat.

## Doubts Dispelled

The symposium presentations transformed the cold fusion situation in Japan, which was previously dominated by stories of doubts and failed experiments. The atmosphere was such that when two researchers at the University of Hokkaido announced June 2 that they had succeeded in creating cold fusion, they did so with hesitation. Tadahiko Mizuno and Tadashi Akimoto, both assistant professors in the department of engineering, com-



© Tadahiko Mizuno

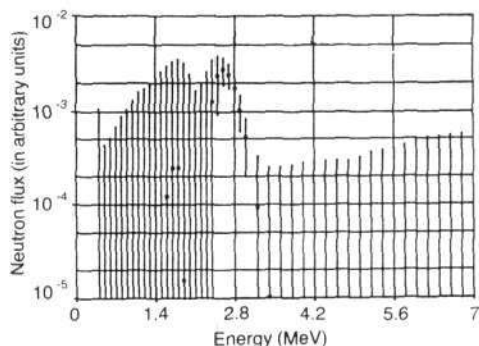
The cold fusion apparatus used by Mizuno and Akimoto at the University of Hokkaido. The neutron detector is surrounded by borated polyethylene bricks to reduce the level of background neutrons.

mented that they did not intend to conclude that cold fusion took place in their experiment.

The reason for their hesitant attitude was that several weeks after the worldwide press coverage of Fleischmann and Pons's announcement, a Hokkaido atomic engineering professor had announced to the press, after his own tests, that cold fusion does not exist! The two researchers may have felt that their announcement brought shame on a professor who is their senior.

Now, cold fusion research will be vastly expanding. The Cold Fusion Gathering, represented by Hideo Ikegami of the Institute of Fusion Science, announced Aug. 1 that the Institute has decided to begin joint research on cold fusion by dividing into three topical groups, involving 80 scientists from 25 institutes, colleges, and universities. The three groups are: (1) a detection group to detect neutrons in detail; (2) a chemistry group to find the most appropriate conditions in deuterium electrolysis; and (3) a physics group to conduct theoretical research on the reaction mechanism.

In addition to university research, many private companies are thought to be involved in cold fusion research



## HOKKAIDO NEUTRON ENERGY SPECTRUM OBTAINED FROM PALLADIUM CATHODE IN HEAVY WATER

The Hokkaido team obtained a peak flux of neutrons at 2.5 MeV as shown here, with a neutron signal 10 times above background level. After electrolysis ceased, the neutron energy spectrum had no such peak. The background neutron flux, measured for 7 days before electrolysis began, has been subtracted here. The solid line at each energy level indicates the estimated error range, and the solid point shows the mean values of the counts.

Neutrons of energy 2.5 MeV are produced when deuterium nuclei fuse:  $D + D \rightarrow {}^3\text{H} + n$ . Fleischmann and Pons reported detection of 2.5 MeV neutrons at three times above background count but did not publish a spectrum. Jones and coworkers at Brigham Young University show a distinct peak at 2.5 MeV in their neutron energy spectrum with neutron fluxes varying in different runs from 1.1 to 3.5 times background.

including cold fusion applications, although there are no reports of this in the press.

#### A Variety of Experiments

**Neutron production.** Hokkaido researchers Mizuno and Akimoto constructed their experiment in a physics department laboratory 5 meters (16 feet) underground, surrounded by a thick concrete wall and separated from the outside by three sets of doors. They began their electrolysis experiment in late March, using palladium and platinum immersed in a solution of heavy water and lithium-hydroxide.

The underground experiment lasted about 18 days. Neutrons were measured at 10 times above background on average, and 20 times above background (1,140 neutrons per hour) at peak. Mizuno said the experiment was a preliminary one to confirm the basic principle of cold fusion, and that now

they have to accumulate more data.

At the University of Osaka, Akito Takahashi and colleagues at the Department of Engineering announced July 30 that they had detected neutrons thought to be produced by their cold fusion experiment. The number of neutrons detected was more than those observed in nature and two to four times more than the data reported by Steven Jones of Brigham Young University in Utah.

Their electrolysis experiment, using a palladium electrode dipped in heavy water and lithium sulfate (1 mol/liter), lasted for about a week each time and was repeated five times. The researchers tried to detect neutrons at two different energy levels—fast neutrons and thermal neutrons. The results were as follows:

The energy of fast neutrons was 2.4 MeV, the same level as those of neutrons produced in deuterium-deuteri-

um fusion reactions. The observed data of the fast neutrons and the thermal neutrons were consistent, and both levels were greater than the normal background level.

Takahashi said they switched the electric current between 0.8 amps and 0.4 amps every 2.25 minutes. As a result, deuterium that is going out of the electrode in the current-drop phase tends to meet deuterium that is coming in. The deuterium atoms thus come close to each other, increasing the possibility of fusion reactions.

**Tritium production.** Noboru Oyama, electrical chemistry professor at Tokyo University of Agriculture and Technology, was the first among Japanese researchers to announce that his cold fusion tests showed a possibility of detecting tritium. One week after his announcement, however, the Japan Atomic Energy Research Institute

*Continued on page 27*

## India Joins Race

*Continued from page 16*

the heat out. We can also keep the currents passing through the cell low so that temperature inside the electrode does not rise too high."

At the same time, the plan is to scale up the experiment to make the venture commercially viable.

If this turns out to be a success, there is no reason that the electrolytic cell cannot be used as a heat source just as a nuclear fission reactor or a coal-fired plant. It is expected that the commercial-size reactors will consist of a pressure vessel, filled with heavy water and containing a battery of electrodes. The pressure vessel will be used to generate steam, which will in turn run a conventional steam turbine.

The Tata Institute's Dr. Santhanam agrees that in principle there is "no reason why the experiment can't be scaled up to commercial size."

#### Cheap Source of Electricity

There is no doubt that the planners of India's long-term power development program are eagerly awaiting the outcome of the next batch of experiments on cold fusion. One estimate shows that if commercial-scale cold fu-

sion reactors are only as efficient as experimental cells in producing heat energy, then a reactor the size of a small house containing 150 tons of heavy water and about 90 to 120 tons of titanium would produce 1,000 megawatts of electrical power.

At \$250 per ton of titanium and \$300 per ton of heavy water, the reactor would cost under \$30 million, and the power station as a whole under \$300 million—one third to one quarter of the current cost of a thermal power station of similar size in India.

This assumption does not take into account the much higher energy density that will be obtained, compared to that already observed in simple electrolytic cells, and hence, the capital costs will be correspondingly lower. Operating costs would also be much lower than in either nuclear fission or coal-fired power stations, because of the energy density of the fuel source. The fusion of even tiny quantities of fuel releases a huge amount of energy. Therefore, in a 1,000-megawatt fusion power station, the total amount of heavy water consumed through fusion is insignificant.

More important, commercial reactors, albeit small in size, can be set up in the rural areas of India where electricity is in perpetual shortage. These

reactors will meet only the local demand, thus eliminating the line loss, which runs as high as 22 percent in India. This will mean capital cost savings of as much as 40 percent, which would make the electricity generated in local plants cheaper than kerosene or propane gas as a source of heating energy in the home, and cheaper than diesel for train transportation.

#### Far-reaching Economic Impact

These possibilities will have a far-reaching impact on the nation's economy. Beside producing electricity at a cheaper cost, such a development will enable the industry and transport sector to switch from oil consumption, saving about \$1 billion of foreign exchange annually.

Cheaper electricity will also mean an immediate jump in the standard of living in India. And abundant electricity will rapidly improve India's manufacturing industries and enhance productivity. One calculation shows that India's energy efficiency—measured as a ratio of the number of energy units it takes to produce one unit of economic output—is 1.7 compared to the U.S. ratio of 0.68. A rapid shift over to electricity will lower this ratio dramatically.

*Ramtanu Maitra, a nuclear engineer, is the editor-in-chief of Fusion Asia magazine.*

# President Bush's New Clean Air Bill: Lots of Money and Hot Air

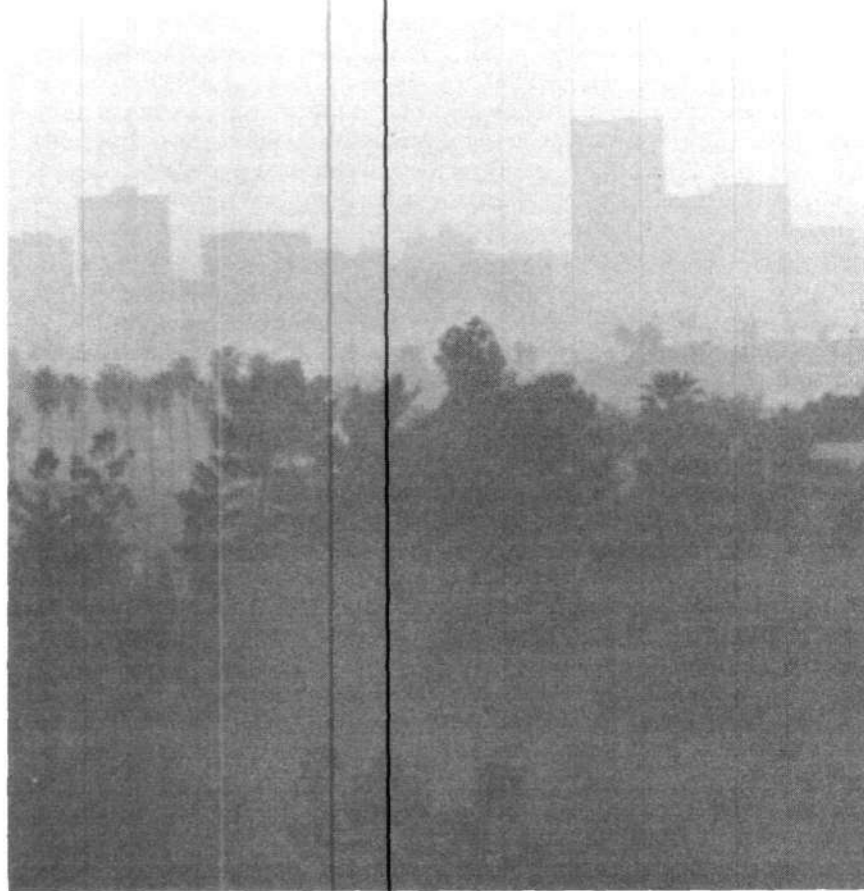
by Hugh W. Ellsaesser

Regardless of what else may be said about President Bush's proposed Clean Air Bill, it can be stated with certainty that it will not bring Los Angeles into conformity with the present National Ambient Air Quality Standard for ozone and it will not eliminate any now-recognized health effects.

This NAAQS standard—120 ppb (parts per billion) on not more than one day per year in any three-year average—is impossible to meet in Los Angeles. It would be exceeded there even if man and his works were removed from the planet. Achieving the standard is not necessary to protect public health and would not be worth the cost even if it could be done—since at most it would contribute to aesthetics and reduction of nuisance.

It should also be borne in mind that, in so far as the smog blanket is removed from Los Angeles, the local climate will more closely resemble that of Palm Springs; many residents would not consider that an improvement. To the same extent, such removal will allow additional ultraviolet radiation to penetrate to the surface with the attendant threat of increased skin cancer—the specter always attached to discussions of the effect of freons on stratospheric ozone.

If the above sounds presumptuous, ask yourself: Since the inhabitants of Los Angeles have been exposed to air exceeding the present NAAQS for ozone on 100 to 200 days per year for at least 40 years, where are the invalids and cadavers that are supposed to be eliminated by meeting the standard? Despite considerable effort, researchers have been unable to find distinctive health statistics for the population of Los Angeles that could be attributed to their exposure to frequent elevated levels of ozone. Given this circumstance, what makes it worth \$10 to \$15 billion a year to the taxpayers and con-



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*Los Angeles would exceed the current air quality standards even if man and his works were removed from the planet!*

sumers of this country to try to eliminate Los Angeles smog, that is, ozone alone? (Russell 1988). Estimates of the cost of air pollution control are now running at \$35 billion a year (Lochhead 1989).

The attribution of health effects to sulfur dioxide and particles is based entirely on statistical correlations between the airborne concentrations of these pollutants and health statistics. The amazing thing is that the *lower* the average airborne concentrations of these pollutants, the *higher* the statistical correlations found and the *greater*

the fraction of the reported morbidity and mortality they appear to explain (Schimmel et al. 1974; Lipfert 1980).

This should tell you that the correlations have nothing to do with cause and effect. If sulfur dioxide and particles were emitted at constant rates, all local changes in concentrations would be caused by meteorological variations. And meteorological variations also have effects on illness and mortality: If they did not you would not see the large differences between summer and winter. It is merely that the meteorological conditions that give rise to

higher concentrations of sulfur dioxide and particles are also the ones resulting in higher levels of illness and death.

The so-called "Air Pollution Episodes" are the classical example of misinterpretation of meteorologically mediated morbidity and mortality as the results of elevated levels of air pollution (Ellsaesser 1975).

If our present draconian clean air program—which claims to have eliminated 96 percent of auto exhaust pollutants and to have reduced other emissions of hydrocarbons, sulfur dioxide, and particles by some 80 percent—has not reduced airborne concentrations to the NAAQS levels, even with a further tightening of the Clean Air Act in 1977 and two successive postponements of the mandated attainment date, why should we expect a miraculous improvement from elimination of the remaining 5 to 20 percent of our emissions?

What happens if after another 10 to 20 years of tightening the screws the standards still have not been attained? Must we wait until then to bring reason into the program? Removal of pollutants from emissions is now costing \$1 to \$6 per pound (Lochhead 1989). This cost will skyrocket as the remaining amount of pollution to be removed continues to decrease.

#### The Emperor's New Clothes

What we have here is another case of *The Emperor's New Clothes*: The "health effects" of air pollution are the illusory "New Clothes" that the environmentalists and their supporters have come up with to sell their program to a gullible public.

Until the mid-1960s, they had tried to sell clean air on the basis of aesthetics and the nuisance caused by air pollution, but it was not selling on a large enough scale to please them—even though (or perhaps, because) most of the observations at the time indicated that airborne concentrations of air pollutants were going down. So the environmentalists decided to switch the sales pitch to health effects, despite the fact that there was no evidence to support the claim that air pollution had been affecting health adversely.

Proceeding under the Clean Air Act of 1967, state Technical Advisory Committees were instructed to recom-

mend air quality standards "based on health effects." The task was approached methodically. In California, the Air Resources Board received the following definition from its Technical Advisory Committee on May 21, 1969:

"Air quality standards based on health effects are desirable levels of air quality which, on the basis of present knowledge, are expected to prevent health hazards or health impairment due to air pollution. Health hazards include not only production, aggravation or possible production of disease but also interference with function.

"Health impairment includes sensory irritation and impairment of well-being by such phenomena as odor [emphasis added]."

#### No Objectivity

Note the following:

(1) Nothing is said about levels necessary to eliminate health effects, rather the definition cites levels expected to prevent health effects, that is, the level of zero would satisfy the definition.

(2) "Health hazards [health effects by definition]" include the mere "possible production" of disease and "interference with function"—the latter has been defined to include any detectable physiological response such as odor, eye irritation, enzyme level, or increased respiratory resistance. Changing the size of the iris of the eye, goose pimples, and suntan are all physiological responses, while suntan lotions, antiperspirants, and "the pill" all interfere with normal physiological functions. But such things are intolerable "health effects" if they can be

blamed on air pollution. After more than 40 years of effort, Los Angeles has not been able to objectivize "eye irritation."

Even after this shading of the rules in order to make a claim of air quality standards "based on health effects," the California Air Resources Board on Nov. 19, 1969, adopted air quality standards for sulfur dioxide, particles, and visibility even more stringent than those recommended by their Technical Advisory Committee. Board chairman A.H. Haagen-Smit (1969) explained:

"These standards represent long-range air quality goals rather than air quality levels where only minimum effects are expected to occur. This long-range air quality goal approach recognizes the public demand for air of satisfactory quality for enjoyment of life, and that future research will likely show adverse effects at lower contaminant concentrations than present data indicate. In view of the action on these standards, it will be necessary for the board to re-examine the standards it has adopted previously to determine whether they are consistent with this approach [emphasis added]."

The Clean Air amendments of 1970 were designed in part to preempt a diversity of state air quality standards as a consequence of the 1967 act. This required both precipitous action and stringent requirements. The precedents of California determined much of our national policy, and the standards announced by Environmental Protection Agency administrator William D. Ruckelshaus on April 30, 1971—just within the 120-day period

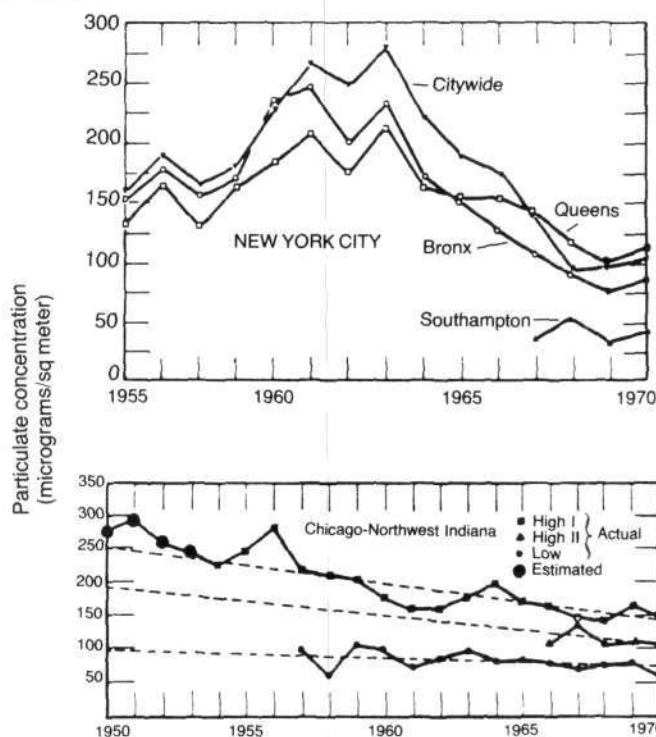
## The Administration's Clean Air Proposals

The White House released a fact sheet June 12, listing the objectives of President Bush's clean air recommendations and the steps required of industry. These include:

- Bringing all cities currently not meeting the health standards for ozone and carbon monoxide into compliance by the year 2000.
- Cutting sulfur dioxide emissions in half by the year 2000. The

plan calls for a 10-million ton reduction in SO<sub>2</sub>, 5 million of that by 1995, and a 2-million ton reduction in nitrogen oxide emissions.

- Requiring factories and plants emitting toxic compounds into the air to employ the best technology currently available in order to achieve a near-term cut, estimated at 75 to 90 percent, in pollutants suspected of causing cancer.



#### TRENDS IN AIRBORNE PARTICULATE MATTER (1955-1970)

The air was actually getting cleaner during the 1960s, just before the formation of the Environmental Protection Agency in 1970, when environmentalists—and politicians—were claiming that air pollution was increasing out of control. These charts were prepared by the EPA in 1974.

mandated by the Clean Air Amendments of 1970—equaled or were more stringent than those that had been adopted by any state other than California.

These precipitously adopted standards, so unrealistic that they required a new set of definitions to make them palatable to the Technical Advisory Committees, are the pivotal rules driving the present clean air program, which has already cost \$500 billion and is now costing the nation \$35 billion a year.

#### No Public Discussion

Despite this cost, these standards have been exposed to essentially no public examination or discussion. Given an open and objective explanation of the basis on which these standards were adopted and an honest appraisal of what it would cost to meet them and what we achieve by doing so, it is inconceivable that the public would support them.

It is equally inconceivable that they

could have survived this long without question if we had had a free and unbiased press—devoted to the ferreting out and exposure of the truth—as our news media claims to be.

The sacrosanctity of our NAAQSs is a subject on which we have been so thoroughly brainwashed that many people are incapable of rational thought on the subject. Let me try to bring the point home by analogy.

Suppose the environmentalists and their supporters, aided by the news media, launched an all-out condemnation of our society for the 5,000-odd drownings that occur in this country each year. After a few years of continuous harangue on the subject they get Congress to create a Drowning Prevention Agency with appropriate powers.

The newly formed agency launches a survey into past drownings and tabulates the minimum water depths in which any person or animal was observed to be a presumed victim of

drowning. The list includes cases of people slipping and knocking themselves unconscious face down in a bathtub, Mafia victims whose heads were held in a wash basin and mice and rats which, for whatever reason, happened to fall into a puddle with just enough life left to draw water into their lungs.

Once the list is begun, each new case claiming a shallower drowning depth is accorded automatic publication in our most prestigious scientific publications.

By omitting the "analysis and critical review" supposed to accompany the drafting of criteria documents (just as was done in the preparation of our present National Air Quality Criteria Documents), all of these details would simply be ignored. A mere tabulation of the minimum water depths in which cadavers were found would appear as the Drowning Criteria Document. Thereafter, the minimum drowning depth found, reduced by an "adequate margin of safety" (which may be orders of magnitude because there are no strictures or warnings against going overboard and no peer reviews), would be announced in the Federal Register as the Drowning Prevention Standard and no man-made water reservoir would be allowed to exceed this depth, whether it be sink, bathtub, swimming pool, canal, or dammed lake.

Any beneficial purposes that these water reservoirs might serve if a greater water depth were allowed would be irrelevant. So would be the fact that millions of people have swum in waters of all depths and survived. These, obviously, were not "the most sensitive members of our society." By legislative decree, the Drowning Prevention Agency is allowed one and only one criterion—whether the Drowning Prevention Standard can assure that no person will drown in any man-made reservoir.

#### What Is Bush Up To?

Since these facts can hardly be unknown to the President's advisers, why has Bush proposed his new Clean Air Bill? I have been able to come up with only three explanations that make any sense:

(1) Bush has lived through many political battles and well understands

## Mother Nature: The Source of Ozone 'Pollution'

The proposed clean air guidelines announced this year by President Bush will not reduce the amount of "ozone pollution," according to many scientists who say that ozone is produced chiefly by natural processes, not autos or industry.

Three such scientists from Michigan State University at East Lansing made the point in a novel way by showing that the patterns and levels of ozone in the atmosphere today are the same as they were 100 years ago, before cars or electric power plants existed.

The scientists, Dale E. Linvill, W.J. Hooker, and Brian Olson, unearthed monthly average ozone values recorded by Dr. R.C. Kedzie from a Michigan statewide network of 20 recording stations, for the period 1871 to 1903. Kedzie also left behind daily ozone measurements taken at Michigan State University (then known as Michigan Agricultural College) from 1871 through 1882.

Since Kedzie published an exact account of how his tests were performed with Schoenbein's test paper, Linvill and his coworkers were able to replicate his tests and calibrate his Schoenbein numbers with the ultraviolet absorbance given by today's Dasibi ozone monitor. (The numbers are named for C.F. Schoenbein, who first identified ozone in 1845.)

After studying Kedzie's data for 1876-1880, the three scientists found that "day-to-day ozone levels exhib-

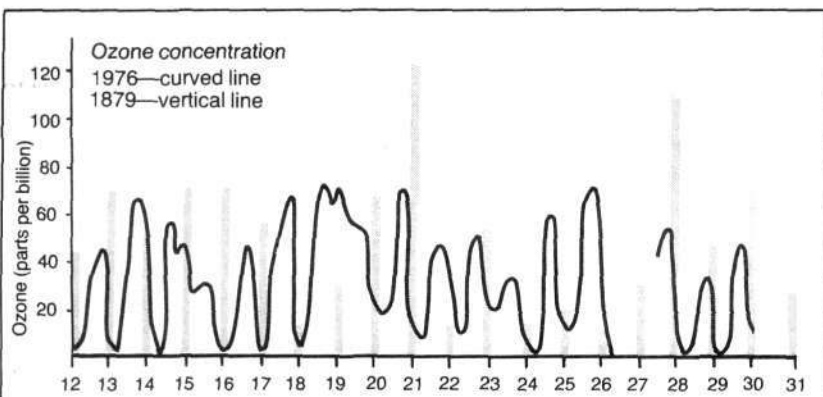
ited patterns very similar to patterns seen in today's data. Ozone concentration was lowest during the coldest part of the year and highest during warm months. Ozone concentration also increased with time as an air mass moved slowly across the area."

Where did this ozone come from? The three scientists reviewed studies of nitrogen emission from plant life, concluding: "a strong argument can be advanced for plant-soil emissions as the major contributor of photochemical ozone precursors. Levels of O<sub>3</sub> [ozone] in Michigan start to rise in the springtime as

the green wave advances northward. Maximum ozone levels and episodes of high ozone levels occur during the months of July and August, the prime vegetative growth months for northern latitude crops. Ozone levels and episodes generally decrease in late August and during September, the time of grain filling or the reproductive stage of crop growth."

Since the pattern is the same in the 1870s and the 1970s, there is a strong presumption that the same causes are at work, and that industrial and automotive emissions are not a major factor in ozone levels. The study appears in *Monthly Weather Review*, Nov. 1980, pp. 1883-1891.

—Rogelio Maduro



### OZONE LEVELS IN MICHIGAN 100 YEARS AGO—AND TODAY

Ozone patterns and levels are much the same today as they were 100 years ago. The bars are daily ozone concentration in parts per billion (ppb) for each day of July 1879; the curve is the same measure for July 1976. The year 1879 was typical of the 1876-1880 period.

On July 21, 1879, the ozone level exceeded the current Environmental Protection Agency limit of 120 ppb, without any of today's industry to blame it on!

that politics is the art of the possible. He could well have been convinced that despite the merits, fighting for the overall welfare of the public on air pollution and acid rain would merely drain resources and political support from the myriad other issues on which he must wage political warfare and which he considers to be more important.

This would be a cop-out, but this is the kind of charge that is hard to make

stick against a practicing politician. After all, Ronald Reagan clearly proclaimed his Latin American policy before both elections and could claim mandates to enact it. Yet, not only did he lose politically on Central America but he almost lost everything.

(2) If the media can be believed, then, "the American public wants clean air and is willing to pay for it." Who is President Bush to stand in the way of letting them have what they ap-

pear to want—even if it is an illusion. I support this position myself, but with the caveat that the decision should be made by an informed public.

In my opinion the public is less than uninformed; it has been consistently misinformed on the price of the clean air programs, on who will pay that price and, most of all, on what the present and Bush's Clean Air Acts will buy in terms of detectable improvements in airborne levels of air pollut-

ants and in measures of public health. Not the least of the ironies of the clean air movement is the fact that an economic and social impact statement has never been prepared for the law that now requires minutely detailed environmental impact statements on every succeeding program of consequence.

(3) In view of the dismal progress in bringing reason and efficiency to the \$50 to \$150 billion a year program launched by the National Environmental Protection Act and the Clean Air Amendments of 1970, even by such popular executives as Ronald Reagan, President Bush may well have been advised to adopt the wisdom of former President Ulysses S. Grant given March 4, 1869: "I know no method to secure the repeal of bad or obnoxious laws so effective as their stringent execution."

As a Bush supporter, I would like to believe that this was the decisive argument prompting his new Clean Air bill. However, if such were the case, public announcement of his intention would surely encourage and speed up the public expressions of opposition required to accomplish the goal.

The prospect of massive public revolt has served as a damper of unknown magnitude on more vigorous execution of the present Clean Air Act and its amendments. But so far, the only concessions to reality have been successive postponements of the date for attainment of the levels mandated by the current NAAQSs and a lifting of the NAAQS for ozone from 80 to 120 ppb.

Although this discussion has focused almost exclusively on the NAAQS for ozone, similar objections can be raised against all aspects of the present and proposed Clean Air Acts. The most effective action we could take against any possible human contribution to acid rain would be to stop removing the particles (which tend to be basic, or acid-neutralizing) from exhaust plumes before they are released to the atmosphere.

Just imagine the screams from the environmentalists if President Bush were to make such a proposal! The derision and the decibels would exceed that hurled at Ronald Reagan for daring to suggest that trees pollute—which they do, of course. At least they

emit substances that contribute to ozone and particle formation and that are called pollutants when emitted by man. According to Abelson (1989) plants are now emitting 2 to 4 times as much hydrocarbons as man and they release them strongly preferentially on hot summer days favorable for ozone formation.

Anyone who is concerned about toxic chemicals should tabulate the number of injuries or deaths per year caused by these substances and compare these with the 50,000 deaths per year from automobiles, 8,000 from fires, 5,000 from drownings, 3,000 in mine and drilling accidents, and 1,000 from electrocutions, and then decide where we could best spend our money to do the most good. Anyone who thinks the problem is carcinogenesis should read *Toxic Terror* (Whelan 1985), *The Apocalypitics—Cancer and the Big Lie* (Efron 1984), and recent articles by Bruce Ames (p. 40, this issue).

In any endeavor it is a good idea to take advantage of the efficiency of the marketplace. However, this is not likely to make much difference in attempts to achieve goals that it is not possible to achieve.

*Dr. Ellsaesser, an atmospheric scientist, retired from the U.S. Air Force Air Weather Service after 21 years as a weather officer and from the Lawrence Livermore National Laboratory after 24 years in climate research. He is continuing his studies at LLNL as a Participating Guest Scientist. In recent years he has investigated many of the largely unsubstantiated claims that man is fouling his nest.*

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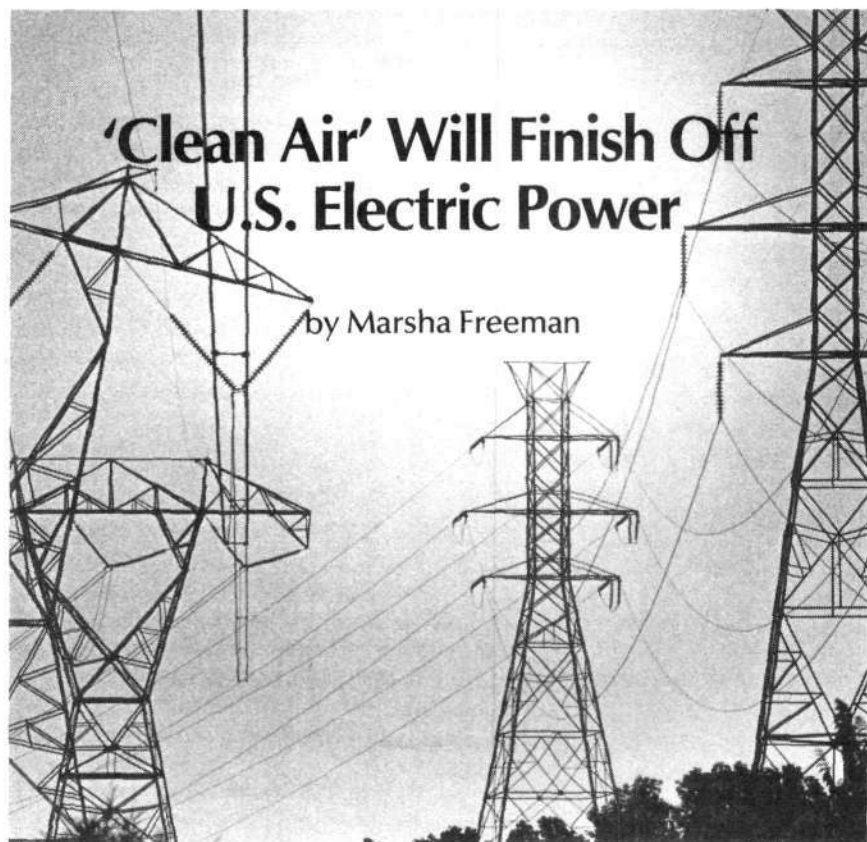
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# 'Clean Air' Will Finish Off U.S. Electric Power

by Marsha Freeman

Philip Ulanowsky

The summer of 1988 was the beginning of the end of reliable electric power in the United States. The supply situation has now become so tight that no matter how mild the summers or warm the winters, there is not enough electrical capacity to meet demand in large sections of the nation.

During the 1960s, the utility industry was adding approximately 20,000 megawatts per year to the national power grid, which supported an average growth rate of 7 percent per year of electricity demand in that period.

Today we are adding capacity at only about one fourth the level of the 1960s. This year, only 6,500 MW of new capacity are planned, and through 1995, less than 5,000 MW per year will be added. Meanwhile, electricity demand growth rates, which had been depressed to less than 3 percent per year through the earlier 1980s, have now climbed up to 4 to 10 percent, depending upon the region of the country.

Already in 1988, four of the nine U.S. power grid regions had capacity margins below the 17 percent minimum considered necessary to deliver reliable electric power. Before summer

1989 even started, utilities in New England and the mid-Atlantic states announced to customers that they should expect voltage reductions ("brownouts") and even blackouts.

Despite this shaky situation, President Bush has proposed amendments to the Clean Air Act that will shut down existing fossil fuel electric power plants, replace them with nothing, and make it even more difficult for utilities to build new power plants.

The ostensible purpose is to cut down on sulfur dioxide emissions, which, it is claimed, cause acid rain. However, although drastic reductions in power plant emissions of sulfur dioxide are proposed, the administration did not even wait for the completion of the 11-agency National Acid Precipitation Assessment Program study in 1990, which will assess the actual scientific evidence on the causes of acid rain.

As with the so-called Greenhouse Effect, economic and political policies are being made with no real evidence that they are necessary. Has the administration forgotten that when the first round of amendments to the

Clean Air Act were put into effect in 1977, the Smoky Mountains were found to be out of compliance?

The President's proposals for bettering the environment will actually have the opposite effect: Shutting down power plants will destroy the standard of living and degrade all the improvements man has made in our planet since the stone age.

The day after the President released his proposed changes in the law, the Environmental Protection Agency announced a list of 107 coal-burning generating plants that it expects will be out of compliance with the new, more stringent regulations. Even the EPA admits that the list is conservative.

The region that will suffer most dramatically if the new amendments are enacted is the industrial heartland of America. This East Central Area Reliability region, which includes Ohio, Indiana, Pennsylvania, Kentucky, and Michigan, now produces 85 percent of its electric power by burning coal.

Out of the 107 plants on the EPA out-of-compliance hit list, 40 are in this region and more than 20 are in the state of Ohio alone. During summer 1988, the peak demand of the East Central region grew 10.3 percent over the previous peak and was 10.5 percent higher than had been forecast.

Thomas Hand, executive director of the East Central Area Reliability region estimates that 10,000 MW of coal capacity in the region will be lost if the acid rain legislation becomes law. For one, more than 137 coal plants in the region, or 24 percent of the region's total capacity, are more than 30 years old. Very few utility executives could justify spending millions of dollars to bring a plant with such a limited lifespan into regulatory compliance. It is also possible that even if the utility wanted to add scrubbers for the sulfur dioxide emissions, for older plants, it may not be possible to meet the proposed nitrogen oxide standards.

In addition to simply shutting down many of these older plants, Hand pointed out that the capacity of the younger plants will be reduced by 5 to 6 percent by adding scrubbers, because electricity produced by the plant is needed to power the scrubbers!

All told, Hand estimates that 10,000 MW, or 10 percent of the region's total

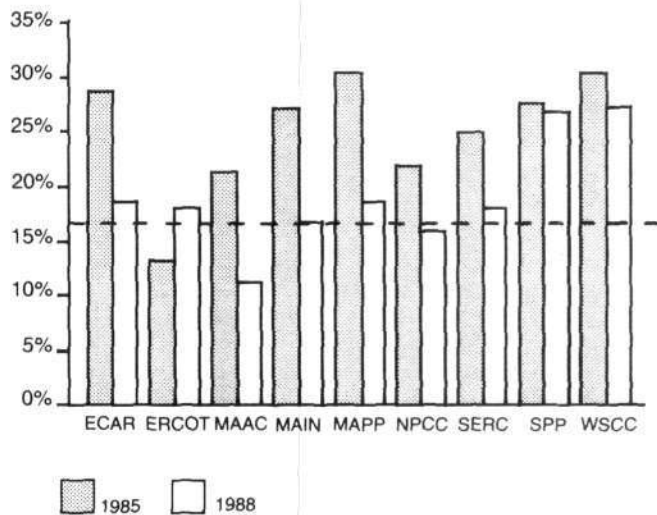


Figure 1

**ELECTRICAL CAPACITY MARGINS BY REGION: 1985 VS. 1988**

Electric power reliability has been falling in all but one region of the country for the past three years. In four of the nine areas, reliability is now below the 17 percent minimum: MAAC (Mid-Atlantic Area Council), MAIN (Mid-America Interconnected Network), NPCC (Northeast Power Coordinating Council), and SERC (Southeastern Electric Reliability Council).

Source: Arthur Andersen & Co./Cambridge Energy Research Associates

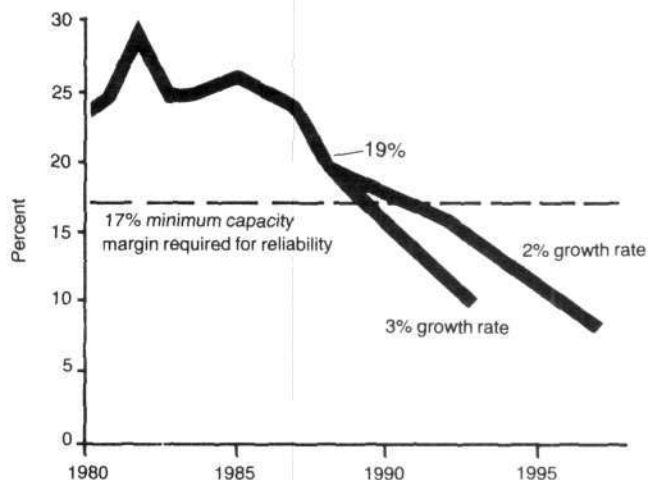


Figure 2

**DECLINE IN NATIONAL ELECTRIC POWER CAPACITY MARGIN**

The overall electric power capacity margin for the nation has been going down since 1981, and projections are that there will be a precipitous decline below the safety margin by the early 1990s. If the projected national demand growth rate is 3 percent instead of 2 percent, the safety point will be passed earlier. This pessimistic picture does not even include any forced shutdowns of currently operating coal-burning plants.

Source: U.S. Council for Energy Awareness

capacity could easily be lost through the environmental regulations. The entire region is planning to add only 3,000 MW of new capacity in the next 10 years. Where will another 10,000 MW of replacement capacity come from? Hand stated categorically that 10,000 MW of additional, currently unplanned capacity *could not* be added in the next 10 years.

**In the Dark**

A study released in early July by the U.S. Council for Energy Awareness documents that *even without any acid rain legislation*, the three industrial states they studied will have a severe electricity deficit within the next few years.

The study, "Economic Growth and the Requirements for Electric Power During the 1990s in Illinois, Indiana, and Ohio," forecasts that by the year 2000, these three states will lose more than 1 million jobs because of a 15,000-MW shortfall of electric power.

Not only the industrial heartland will suffer, but the reliability of the entire U.S. power system. For years, the East Central region has been an electricity exporter. Because the utilities in the Midwest use cheap coal and nuclear power, they have wheeled or transferred power to the less economical oil-burning utility systems, which have been short of capacity. These systems, including the Pennsylvania/New Jersey/Maryland inter-tie, and also Virginia Power, will now have to fend for themselves.

As Peter Nulty advises in the June 5 issue of *Fortune*, "Get ready for power brownouts." In power-starved New York, where antinuclear Governor Mario Cuomo has waged a propaganda war to tear down the ready but unused Shoreham nuclear plant on Long Island, Grumman Corporation executives told Nulty that this was the first year the utility asked them to shed load (turn off equipment) in the winter.

How is industry reacting to this frontal assault on the nation's energy lifeblood, electricity? "We're planning drills to get our handicapped workers down from the fourth floor in the dark," a Grumman executive told Nulty.

Soon, we may all be sitting in the dark.

# The Ozone Layer That Won't Go Away

by Rogelio A. Maduro

For 30 years, the environmentalists have argued that one form of technological progress after another would destroy the stratospheric ozone layer that protects the Earth from excess ultraviolet radiation.

Today's often-repeated assertion that chlorofluorocarbons (CFCs) destroy stratospheric ozone is only the latest in this series of "Chicken Little" stories (see "The Myth Behind the Ozone Hole Scare," *21st Century*, July-August 1989, p. 11). Previous installments include the following alleged causes of ozone depletion:

(1) Detonation of nuclear devices whose debris clouds could produce or carry nitrogen oxide into the stratosphere or mesosphere. The environmentalists whipped up mass hysteria, predicting the destruction of the ozone layer by the nuclear bomb tests in the 1950s and 1960s. It never happened.

In 1973, years after the last major U.S. atmospheric nuclear weapons test, scientist P. Goldsmith wrote in *Nature*: "Analysis of the ozone records reveals no detectable changes in the total atmospheric ozone during and after the periods of nuclear weapons testing. Although two models of nitrogen oxide injection [the Supersonic Transport and nuclear bombs] may not be identical from the meteorological viewpoint, the conclusion that massive injections of nitrogen oxides into the stratosphere do not upset the ozone layer seems inescapable."

(2) The operation in the stratosphere and mesosphere of aircraft and rockets exhausting water vapor ( $H_2O$ ), nitrogen oxide ( $NO_x$ ), or chlorine (Cl).

This was the argument used by the environmentalists—led by Senator William Proxmire (D-Wisc.)—to ban the testing of the Supersonic Transport in 1971. The SST would have been three times the size of the Concorde as well as much faster and cheaper. This ploy succeeded, even though the actual scientific data from meteorological observations contradicted the

main claim that increased water vapor would destroy the ozone layer.

(3) Operation of the Space Shuttle or similar programs with frequent ballistic return of orbiting vehicles to the atmosphere, producing  $NO_x$  by compressional heating. This was a popular hobby horse for the news media in the 1970s, with some scientists even claiming that the Space Shuttle would make holes in the atmosphere and release the ozone into outer space.

(4) Stimulation of nitrous oxide production by addition of fixed nitrogen to the biosphere whether through nitrogen fertilizers, animal wastes, combustion-produced  $NO_x$ , expanded growth of legumes, infection of nonleguminous plants with nitrogen-fixing bacteria, or by green mulching. This particularly silly theory was proposed by Paul J. Crutzen of the Max Planck Institute in 1974, and was used by environmentalists in an unsuccessful attempt to ban fertilizers in agriculture.

(5) Atmospheric release of stable bromine-containing compounds such as  $CH_3Br$ , now used as a soil fumigant, which can penetrate the stratosphere before decomposing. Environmentalists were unsuccessful in banning pesticides on the basis of this theory.

(6) An increase of acid rain. This theory claimed that acid rain would destroy the ozone layer indirectly through its effect on soil bacteria. Acid rain would stimulate the growth of denitrifying bacteria, which would in turn release nitrous oxide into the atmosphere.

## Why These Stories?

Climatologist Hugh W. Ellsaesser, who has fought against the environmentalist pseudoscience since the 1960s, made the following observations in *Atmospheric Environment* magazine in 1982:

"I can only conclude that . . . during the SST controversy . . . the scientists involved took it upon themselves to act as a priesthood by suppressing information by which the laity could be expected for itself to arrive at conclu-

sions different from those espoused by the priests.

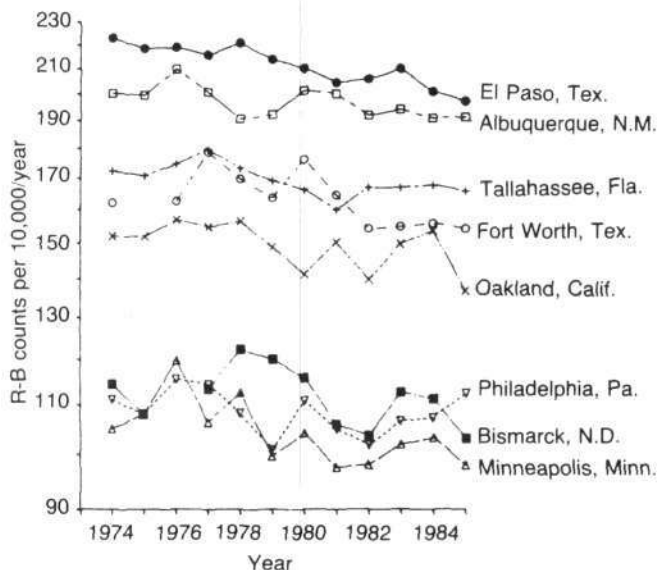
"For example, data indicating concurrent upward trends in ozone and stratospheric water vapor were not widely circulated as long as water vapor was considered theoretically to be a threat to the ozone layer. Also, all during *The Ozone War*, it was quite clear that the principals did not want the public 'to be misled' by being able to estimate thinning of the ozone layer with equatorward displacement, presumably because some might begin to wonder what all the fuss was about. Why the discrepancy between theoretical and observational estimates of stratospheric  $NO_x$  production rates was ignored remains unclear."

## The Sky Is Falling

In August 1988, it was announced to the international press that, lo and behold, the ozone layer had indeed become thinner. Robert Watson and the Ozone Trends Panel reported that between 1978 and 1985, the ozone layer between 29° and 39° N. latitude had decreased by 3.7 percent, and by 2.7 percent in the latitude range from 39° to 53° N., using data from satellite-based instruments.

The announcement drew banner headline stories projecting a massive increase in skin cancer from higher doses of ultraviolet radiation. Watson, F. Sherwood Rowland, and the anti-CFC crowd argued that a 1 percent decrease in stratospheric ozone would cause about a 2 percent increase in the amount of biologically effective ultraviolet radiation (UV-B, with a wavelength of 2,900 to 3,300 Å). This is the wavelength of solar ultraviolet radiation that can produce sunburn in humans and skin cancer in laboratory animals.

The conclusion, therefore, was that the alleged depletion of the ozone layer by CFCs should have increased the amount of UV-B reaching the Earth by at least 7.4 percent, with a concomitant rise in skin cancer, and devastating effects on plant and animal life.



**SOLAR ULTRAVIOLET TRENDS, 1974-1985:  
ULTRAVIOLET LEVELS ARE NOT GOING UP**

*If the ozone layer is thinning, why is the amount of biologically effective ultraviolet light (UV-B) that reaches the surface of the United States declining? The greatest total decreases occurred at the field monitoring stations in El Paso, Tex., and Minneapolis, Minn.*

Source: J. Scotto, et al., *Science*, Feb. 12, 1988.

The claims made by Watson and the Ozone Trends Panel, however, also do not stand up to scientific scrutiny. In a study published in *Science* Feb. 12, 1988, Joseph Scotto and others from the Biostatistics Branch of the National Cancer Institute presented hard, scientific evidence showing that the amount of UV-B radiation reaching ground level across the United States not only had not increased, but actually had decreased 0.7 percent on the average between 1974 and 1985. This study, systematically blacked out of the daily press, was based on readings from a network of eight ground-level monitoring stations that has been tracking measurements of UV-B radiation since 1974.

The Scotto study states:

"Average annual R-B counts [the standard measure of UV-B] for two consecutive six-year periods (1974 to 1979 and 1980 to 1985) show a negative shift at each station, with decreases ranging from 2 to 7 percent. [The figure] (semi-logarithmic plot) shows that there are no positive trends in annual R-B counts for 1974 to 1985. . . .

For all the stations the R-B counts dropped an average of 0.7 percent per year since 1974. . . .

"These results are consistent with earlier reports that used R-B data for a shorter time period from 1974 to 1979 and Dobson meter total column ozone data for the period from 1970 to 1982. Although recent measurements of stratospheric ozone from satellite in-

## Cold Fusion in Japan

*Continued from page 18*

carried out a joint experiment with Oyama but found almost no neutrons and no clear evidence of tritium. Now the latest results have turned this around.

*Muon-catalyzed fusion.* From the beginning, many physicists at laboratories in Tsukuba Science City gave support to the work of Steven Jones of Brigham Young University, who is using a principle similar to that of muon-catalyzed fusion.

The method of using a muon—a negatively charged particle 200 times heavier than the electron—as a "glue"

struments indicate that total column ozone is being depleted during the 1980s, anticipated resultant increases in solar UV-B were not evident. . . ."

In sum, the supposed thinning of the ozone layer should have led to an increase of UV-B in the range of 5.4 to 7.4 percent for the period 1978-1985. Instead, decreases of 2 to 7 percent were found at monitoring stations at the same latitudes for the period 1974-1985. The same kind of instrument, the Dobson spectrophotometer, is the basis for both the ground level measurement of UV-B intensity and the satellite-based measurement of ozone layer thickness.

The Nimbus 7 satellite relaying the data is indeed indicating ozone loss. The key element in its ozone detector, however, the optical diffuser plate, is known to be deteriorating in the space environment, causing it to lose sensitivity. S. Fred Singer, the designer of the ozone detector, says the instrument has exceeded its designed lifetime.

There is a raging debate about the reliability of the accumulated ozone level data from the satellite, with some scientists presenting papers documenting that the entire "ozone depletion" can be ascribed to the deterioration of the diffuser plate.

What is certain is that the amount of biologically active ultraviolet radiation at the surface of the United States is decreasing significantly. The question, then, is whether the entire ozone depletion argument is a deliberate hoax.

to combine positively charged deuterium nuclei is being studied by Masayasu Kaminura of the University of Kyushu, Kanetada Nagamine of the University of Tohoku, and others.

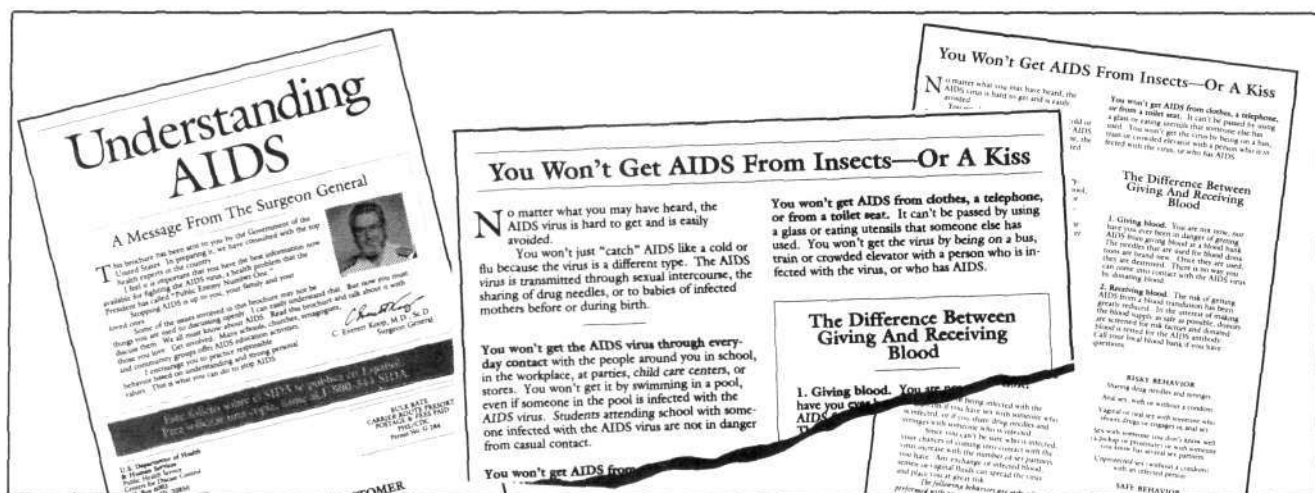
Nagamine's team has confirmed that muon fusion has taken place in their experiment, although it produced very little energy compared to the amount of energy put in.

A special seminar on cold fusion, with international participation, is scheduled for Kyoto Sept. 22.

Kiyoshi Yazawa, based in Tokyo, writes on advanced technologies for many Japanese science and news publications.

# Conference on Oral AIDS: Kiss of Death for Official Propaganda

by John Grauerholz, M.D.



The official line on kissing and AIDS, as spelled out in the message sent to U.S. households and written by the Surgeon General and the Centers for Disease Control.

The variety of evidence that the AIDS virus (HIV) can be transmitted by mouth, presented at the First International Symposium on Oral AIDS June 1-3, will make it difficult for the AIDS mafia to continue its official line that oral transmission of AIDS is not possible.

The conference was organized by Canadian dental researcher Drasko D. Pekovic and took place in Montreal, despite direct and indirect attempts at obstruction by the World Health Organization and other components of the international AIDS mafia. Scientists from around the world gathered to exchange information on the diagnosis and treatment of AIDS-associated oral diseases, as well as to investigate the possibilities of oral transmission of AIDS and the risk factors and safety conditions for dental health care professionals and patients.

The AIDS mafia tactics were heavy handed. Three groups from the United States who wanted to attend the conference and present their results were forbidden to do so, and the leader of a major group working on oral

AIDS in California forged the signatures of other members of the group on a letter withdrawing from participation in the conference.

In spite of this, 50 speakers from around the world participated in the conference, compared to a mere six presentations on the subject of oral AIDS at the officially sanctioned Fifth International Conference on AIDS held June 4-9, just after the oral AIDS symposium.

The first session of the oral AIDS conference discussed recent advances in understanding AIDS and other HIV-1 induced diseases, followed by a presentation on the HIV receptor, CD4, and its role in infection and treatment. CD4 is the newest item being pushed as a potential "magic bullet" for treating HIV infection. Ironically, conference organizer Pekovic presented evidence at the main AIDS conference that casts doubt on the primary role of CD4 in HIV infection.

Nine presentations covered the entire spectrum of HIV-associated oral disease, making the point that oral in-

fections are the first clinical manifestations of AIDS. In fact, while HIV, supposedly a sexually transmitted organism, produces no ulcerations or sores of the genitals, it produces a great many such lesions of the lips, tongue, gums, and oral cavity.

Anyone seeing the dozens of slides of AIDS-associated inflamed, ulcerated, and rotting mouths, gums, and even jaws would have a hard time believing that contact with such mouths posed no threat of transmission of HIV.

### The Coup de Grace

The final presentation of this session demonstrated that there was a difference between the bacterial population of the mouth of homosexual AIDS patients and that of the intravenous-drug-using AIDS patients. This difference may relate to the higher incidence of HIV-associated gum disease in homosexual AIDS patients.

A session on microbiology and immunology gave the coup de grace to the idea that oral transmission, especially by saliva, is impossible. Dr. D. Adjukovic presented an overview of

oral transmission of HIV confirming that there indeed was active, infectious virus in some of the inflamed, ulcerated mouths seen in the previous session.

The next presentation, "Lymphocyte Activation by Oral Bacteria As a Factor in Transmission of AIDS by Saliva," was given by Dr. Q.L. Liu of Shanghai and Drs. Pekovic, Ajdukovic, and colleagues. They demonstrated the presence of HIV-infected lymphocytes in the gingiva and saliva of HIV-seropositive individuals and showed that these HIV-infected lymphocytes had been immunologically activated by bacteria in the mouth. These bacteria facilitated infection of the lymphocytes by HIV and stimulated the production of high titers of virus by the infected lymphocytes. The researchers concluded: "This activation capacity of oral bacteria may play a significant role in the infection of PBL [peripheral blood lymphocytes] by HIV."

Pekovic then presented more evidence of involvement of HIV in human oral diseases. Using sophisticated immunologic techniques and electron microscopy, Pekovic and his colleagues studied 96 patients at different stages of HIV infection. They demonstrated the presence of HIV in blood lymphocytes, gingival epithelial cells (that is, the surface of the gums), lymphocytes in the gums and saliva, as well as in areas of gingivitis and periodontitis. In fact, the number of infected lymphocytes in saliva was higher than in blood!

#### Saliva Transmission

The "kiss of death" for the prevailing line that oral transmission of AIDS is impossible came in the presentation by a research group from the Infectious Diseases Clinic of the Medical Faculty of the University of Naples, Italy. In studying the level of hemoglobin, a red blood cell pigment, before and after activities such as eating, kissing, and tooth-brushing, the Naples group found a significant increase after brushing teeth and kissing—but not after eating.

The researchers concluded: "It is generally accepted that the presence of blood in the saliva is indirect evidence that microlesions are present in the oral cavity. During kissing, two mucosae, both of which may contain

microlesions, come into close contact. The intense rubbing which occurs during kissing can favor both the formation of microlesions and the passage of blood from one partner to the other. If the blood of one partner contains HIV, the virus can pass into the blood stream of the other partner. Our study has shown that microlesions are normally present in the oral mucosa and that saliva contains blood. Therefore, we feel that passionate kissing cannot be considered protective sex for the transmission of human immunodeficiency virus infection."

Next, Dr. Robert Illa of Oroville, Calif., presented the case of a 70-year-old woman who received blood from an HIV-positive donor after coronary bypass surgery in 1979, developed AIDS, and died in 1984. Her husband, a 72-year-old man, then became HIV positive, suffered from numerous lung infections and neoplasms, and died in 1985 of respiratory failure.

The husband was sexually impotent and he denied having sexual intercourse with his wife (or with any other woman) since the time of her surgery.

He also denied any other risk factor for HIV infection although the couple was affectionate and kissed each other on the mouth often. The U.S. Centers for Disease Control officer who interviewed the husband and his children did not suspect any other reason for HIV infection. This case, Illa concluded, may represent the spread of HIV via saliva.

When asked whether he had published anything on this 1985 case, Illa said that he had been subjected to threats by state and federal health officials and that the laboratory that did the AIDS test on the patient had been closed by the State of California! Before it closed, the laboratory had sent Illa a report claiming that the positive test on the husband was an error and that a second sample was actually the positive one. The second sample, however, was Illa's own blood, and he has never tested positive before or since.

The next stage in this battle to tell the truth about AIDS will be to get the conference proceedings published and circulated.

## THE STRECKER MEMORANDUM

With no cure and no effective treatment in sight, by the year 2000 A.D. everyone in the U.S. will be infected with A.I.D.S. This is the chilling conclusion of 5 years of exhaustive research by Dr. Robert B. Strecker, M.D., Ph.D.

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- A.I.D.S. is NOT a venereal disease . . .
- A.I.D.S. can be carried by mosquitoes . . .
- Condoms will NOT prevent A.I.D.S. . . .
- There can never be a vaccine.

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The most dreaded fear that all oncologists (cancer doctors), virologists and immunologists live with is that some day CANCER in one form or another will become a contagious disease, transferable from one person to another. A.I.D.S. has now made that fear a reality, and if you think you're safe because you're not gay or promiscuous or because you're not sexually active then you had better watch Dr. Strecker's video very carefully and then watch it again and again until you fully understand what Dr. Strecker is telling you as he takes you step by step and shows you how this dreadful disease was actually:

- PREDICTED . . .
- REQUESTED . . .

- CREATED . . .
- DEPLOYED . . .

And now threatens the very existence of mankind because:

- IT WORKS!



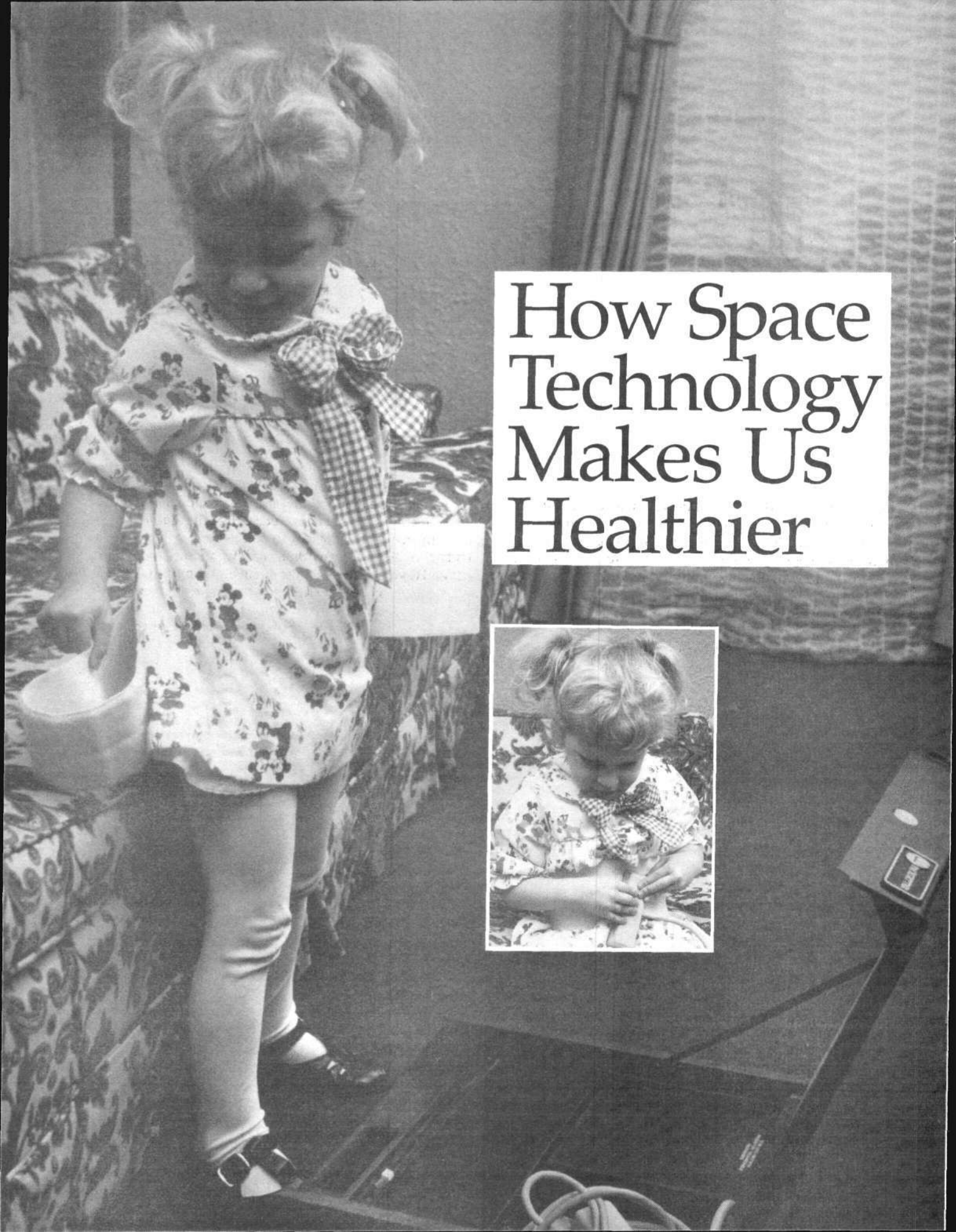
Dr. Robert B. Strecker is a practicing Internist and Gastroenterologist. In addition, he holds a Ph.D. in Pharmacology and is a trained Pathologist.

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# How Space Technology Makes Us Healthier



*The Apollo program did more than put the first man on the Moon: Its new technologies gave a shot in the arm to the economy and its medical spinoffs gave a new lease on life to millions of seriously ill people.*

by Marsha Freeman

**A**s we celebrate the 20th anniversary of the Apollo landing on the Moon and decide the direction of America's space program in the next 20 years, the budget lesson learned in the space program's first 30 years should be a clear guide: The question is *can we afford not to go back to the Moon and on to Mars?*

In short, the space program gave us real economic growth. The greatest peacetime mobilization of science, technology, and industrial manpower in history created an economic boom in the 1960s and early 1970s by increasing productivity and creating new industries. Every government dollar spent by the National Aeronautics and Space Administration (NASA) generated \$14 for the rest of the economy. Perhaps not as well known is the fact that the medical applications of space technology have saved billions of dollars by saving—and improving—lives:

- Hundreds of thousands of people, from newborn babies to the elderly, are alive because they wear heart pacemakers.
- Thousands of people have implanted heart defibrillators, which save them from sudden cardiac arrest and death.
- Every intensive and cardiac care unit has an array of "remote sensing" systems to monitor the vital signs of patients.

There are no limits to the development of further medical devices to save lives, as long as the necessary research and commercialization programs are funded and as long as the space program moves on to new frontiers—industrializing the Moon and colonizing Mars. In the very near future, we will be reaping more of the benefits of the first 30 years of the space program, as implantable insulin pumps for diabetics significantly cut the cost of diabetic medical care, and as the same implantable technology is then applied to the treatment of other problems, like chronic pain and diseases of the central nervous system. Also, a new artificial heart is now under development using the computer technology created to design aircraft.

Of course, there is a higher purpose for exploring and inhabiting the rest of the solar system than simply to get the economic pay-back. Just as the mobilization to win

*A young patient with a rechargeable cardiac pacemaker, which eliminates the recurring need for surgery to charge the battery. Inset shows her recharging the device.*

World War II produced materials, radar, antibiotics, and other spinoffs that were developed into valuable commercial products, these benefits were certainly not the reason for fighting the Axis powers. However, it is the case that the future growth of mankind on this planet will depend upon increasing the rate that new technology is introduced into the economy, which requires increasing the productivity and standard of living of the the world's growing population. It is also true that national and international mobilizations to accomplish "great projects," like the Apollo project, are the most efficient way to do this.

Today, the lives of many thousands of people have been saved and their ability to live productively is being extended because of innovative technologies that were developed by applying developments from space research. In addition, space research medical technology spinoffs have created more than \$2 billion in sales of medical equipment, and this has led to millions of dollars of savings in diagnosing and treating disease, compared to previously available technology.<sup>1</sup>

#### **Making People Healthier Brings Costs Down**

Although there are many complaints about the rising costs of health care, it is a demonstrable fact that the only way to bring these costs down is to *make people healthier!* For example, every year in the United States more than \$20 billion is spent to treat diabetes. That direct medical cost could potentially be cut *in half* by making available a miniaturized implanted insulin pump to more carefully control the disease. If one's interest is saving money, this is clearly the way to do it. And if one's interest is to increase the health, productivity, and lifespan of millions of our citizens, new technology is also the pathway.

There is clearly much that still needs to be done today to bring the medical developments already realized from the first 30 years of the space age to all the people who require them. As the scientists who developed the medical technologies described here have stressed, if insurance companies refuse to pay for these new treatments, only the very rich will be able to reap the fruit of the past 25 years of space medical research. And nearly a majority of the nation's poor have no health insurance at all.

We have to defeat the fallacious argument that new medical technology is "too expensive" to be wasted on people who are seriously ill, too old, or too poor. Already the



**Table 1**  
TYPICAL ANNUAL COST OF DIABETIC PATIENT

Charge	Cost
Insulin	\$300
Disposable syringes	241
Physician visits	335
Laboratory	343
Urine ketone tests	9
Home glucose monitoring	847
Glucometer	75
Emergency treatment kits	20
Miscellaneous	151
<b>Total</b>	<b>\$ 2,321</b>

**Table 2**  
ANNUAL COST FOR DIABETIC PATIENT  
ON IMPLANTABLE PUMP THERAPY

Charge	Cost
Insulin refill solution	\$128 to 514
Clinical refill charge	180 to 720
Nurse clinician	280
Physician visits (other)	200
Laboratory	343
Home glucose monitoring	847
Glucometer	75
Emergency treatment kits	20
Miscellaneous	110
<b>Total</b>	<b>\$2,183 to \$3,109</b>

*More than \$20 billion is spent yearly in the United States to treat diabetes. It is estimated that the miniaturized implanted insulin pump would cut medical costs in half, reducing the complications and illnesses associated with diabetes.*

results of this argument can be seen: For the first time in more than 100 years, the life expectancy of the U.S. black population has *fallen* for the past two years.<sup>2</sup>

Often breakthroughs come from the application of technology that has been developed for a different purpose. The revolutionary new techniques discussed here to treat and cure disease have come from government-funded research in the space program, not the National Institutes of Health. Similarly, the Apollo mobilization did more to improve education in the 1960s and produce scientists and engineers than has ever been accomplished by the billions of dollars spent since by the U.S. Department of Education, as is clear from Figure 1.

Space technology creates these opportunities for dramatic new improvements in our lives because it must function in the harshest environment that man—or his machines—has ever explored and worked in. Man and machines must have the technology to be able to work where it is so cold that there is a nearly total absence of heat and where there is no atmosphere for protection or no familiar gravity. Nor are there technicians or doctors nearby to fix things that break. In the 1960s, to build rockets, orbit satellites, gather and process scientific data, send robots throughout the solar system, and land men on the Moon, wholly new technical capabilities had to be developed, many of them from scratch.

In the decades ahead, as man once again takes up the challenge to travel through space, this time to settle in and create other worlds, the next generation of tools in our medical arsenal will become available to keep people on Earth healthier and longer-lived.

Years before the first crews are in their spacecraft ready to embark on the journey to Mars, new microgravity medical instruments and treatment technologies will have to have been tested and available. The techniques that will be required to settle the space frontier can put those of us still on Earth at the medical frontier, long before that first crew leaves. It is past time for this society to recommit itself to making the entire U.S. population—and the rest of the

world—as “healthy as an astronaut.” Certainly as we move to become the space-faring society of the 21st century, we cannot afford the loss of human productivity and waste of capabilities that result from premature death and poor health.

#### **Implantable Devices: A Revolution in Size**

When the space program began, the computer and electronic equipment needed simply to navigate a spaceship and communicate long-distance with Earth was so large and heavy that no launch vehicle could have gotten it off the ground. When it came time to launch people into space, which meant adding life support systems, redundancy for safety, and other equipment, a crash effort was begun to make every piece of equipment smaller and lighter. The resulting microminiaturization has been applied to many familiar commercial products, like hand-held calculators. One of the most important fields of application, however, has been implantable medical systems. The advantage of implantable devices is that they achieve the precise regulation of medication and care without requiring constant medical supervision of the chronically ill patient.

All spacecraft transmit data from space to the control center on Earth. An implanted medical system also uses telemetry to transmit data on the status of the patient and itself, such as verifying commands sent to it and monitoring the rate of medication infusion, the state of the battery voltage, and other parameters.

A medical device can be implanted only if its power supply is small, reliable, self-contained, and long-lived. Spacecraft require the same kind of technology. In the past, both spacecraft and implantable medical systems used rechargeable nickel-cadmium cells to power their systems. Recently, however, the power required for the medical devices has become so small that a single AA-size lithium primary cell can operate some devices for 10 years without recharging.

The most important to come from the rigorous requirements for systems in space was the increased relia-

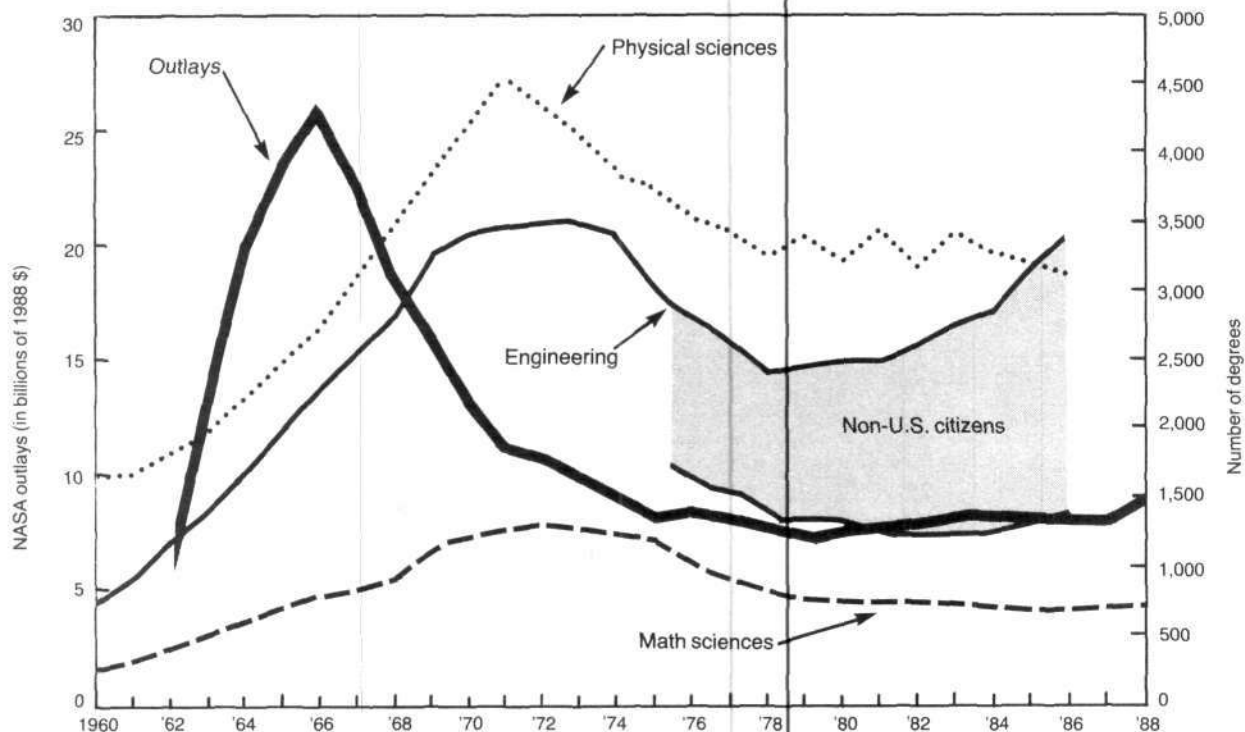


Figure 1

**NASA BUDGET OUTLAYS AND SCIENCE AND ENGINEERING DOCTORATES (1960-1988)**

The peak year in NASA funding (1965) produced the peak number of doctorate degrees in science and engineering five years later. There has been a parallel and steady decline in both NASA funding and science doctorates.

Source: NASA

bility of medical technology. Space "property" is much too costly to allow a high probability of failure during or soon after launch. The satellite must work autonomously. Not until the Space Shuttle was there the possibility of in-orbit repair. Over the 30-year history of the U.S. space program, the useful life of satellites has increased from weeks to up to 10 years. The same trend has taken place in implantable medical devices, following the space technology advances.

The very first U.S. spacecraft, launched in 1958, sent radiofrequency signals back to Earth. Later, in order to allow satellites to respond to changes in their environment, engineers incorporated control systems into the satellite that allowed them also to respond to commands from Earth. Such spacecraft could change their orbit, turn various systems on and off, and change the frequency of their radio transmissions.

Heart pacemakers, the first implantable medical devices, also emit a signal to control pulse rate. According to Robert E. Fischell, chief of technology transfer at Johns Hopkins University and the developer of an implantable insulin medication system, the control systems in modern pacemakers "change the stimulation pulse rate, pulse voltage, or pulse width; enable or disable an electric signal from the atrium; and adjust the sensitivity for an electrical signal from the ventricle." All this is done with a command system operating through a radio signal originating in a doctor's

console (see photo on page 34).

The first pacemaker of the late 1950s failed less than 12 hours after it was implanted in a human patient, but by 1970, components were able to last about 2 years. Now rechargeable pacemakers are still functioning after 10 years of service.

The prerequisite for the development of the new field of implantable medical devices was the miniaturization of electronic components. The first pacemaker, available about 30 years ago, was 3 inches in diameter, 1 inch thick, and weighed about 250 grams. Today pacemakers are small enough to be implanted even in newborn babies. "Modern multiprogrammable pacemakers contain the equivalent of 100,000 transistors, yet have one-tenth the volume and one-fifth the weight of the first pacemaker," Fischell told a recent congressional committee hearing.

**Space Technology for the Heart**

Every year, nearly 500,000 people suffer a sudden cardiac arrest in the United States—the equivalent of one cardiac arrest per minute. Because only 20 to 30 percent of those stricken survive, cardiac arrest is currently the nation's number-1 killer. The number of survivors of cardiac arrest has been increasing because of the more widespread availability of paramedical services, but of the more than 100,000 Americans who survive cardiac arrest episodes every year,



Johns Hopkins University

With this PIMS Remote Communication Unit, a doctor can remotely (by telephone) rewrite the patient's prescription dispensed by the implantable device.

up to 40 percent will have a recurrent and fatal arrest within two years, caused by heartbeat arrhythmias.

NASA support to medical researchers has helped create a new medical treatment that can prevent the initial occurrence of cardiac arrest for those at high risk, such as the 100,000 people each year who have recurrent fast heartbeat caused by abnormal impulses in the heart. It can also help save the lives of those who have survived a sudden cardiac arrest episode.

During the past eight years, an automatic implantable cardioverter defibrillator (AICD) has been developed that can monitor patients at high risk for sudden cardiac death and intervene to save their lives. Thousands of people today are alive thanks to this device.

The normal heart keeps its rhythm through a signal from a small area in the upper right chamber, or right atrium, called the SA node, Figure 2(a); it is the heart's "natural pacemaker." When this pacemaker goes awry, it produces a condition called *ventricular tachycardia*, shown in Figure 2(b). The SA node loses control over the signal and a new area in one of the lower chambers of the heart takes over the signal function. The heart does not contract normally, the heartbeat rate increases, and the person may feel that his heart is skipping a beat. As the heart beats faster, it pumps less blood with each contraction because there is

not enough time for the heart to fill with blood between beats. This can produce fainting spells, blackouts, dizziness, and, eventually, unconsciousness and cardiac arrest. Ventricular tachycardia has been treated with medication for many years, with varying success, and sometimes an electrical shock is used to slow the heart down.

An even more serious situation arises when instead of one abnormal impulse controlling heartbeat, many different impulses try to send signals, Figure 2(c). The heart beats very fast—sometimes more than 300 beats per minute—which is called *ventricular fibrillation*. A person suffering from this problem becomes unconscious very quickly, and if a doctor is available electrical energy will be used to try to "shock" the heart back into a normal rhythm. With a very fast heart beat, brain tissue cannot survive.

#### Correcting Arrhythmias—Automatically

The automatic implantable cardioverter defibrillator is about the size and shape of a deck of cards, weighing about ½ pound. It monitors the heart's rhythm and can also correct arrhythmias to help prevent sudden cardiac death. This remarkable device was conceived of and developed by Dr. Michel Mirowsky, who immigrated to the United States from Israel in 1967 to develop the technology.

As Dr. M.S. Heilman told the story at congressional hearings in May 1989, a prototype implantable defibrillator was successfully tested in dogs in 1969. Then, during the 1970s, Heilman's company, Medrad, and later its successor, Intec, took Mirowsky's invention and developed it into a first-stage commercial product. Before the first human implant was done at the Johns Hopkins University Hospital, NASA sponsored an independent and comprehensive design review, conducted at the Hopkins Applied Physics Laboratory.

The AICD is a hermetically sealed, battery-powered device that is implanted in a patient's abdominal wall with electrical leads extending to the heart. It continuously monitors the electrical activity of the heart, similar to the monitor in a hospital coronary unit. If a potentially life-threatening cardiac arrhythmia is detected by the device, it delivers a corrective electrical shock to the heart to restore a normal rhythm. The currently available fourth-generation device lasts between four and five years and has the capacity to deliver up to 300 shocks, if needed.

The device has now been implanted in more than 7,000 patients, including children. This has reduced the first-year incidence of sudden death from arrhythmias in these patients from an expected incidence of greater than 25 percent to an actual incidence of less than 2 percent. The space-age implantable cardiac defibrillator has already saved the lives of thousands. As it gains more widespread use, a significant percentage of the half-million people who now suffer sudden cardiac arrest each year can be kept on the path of good health.

#### Improving the Artificial Heart

Other space technology applications for the heart are still in the developmental stage, including important computer

modeling research at the NASA Ames Research Center. At Ames, scientists with an expertise in computational fluid dynamics are working with medical specialists from Penn State University's Hershey Medical Center to improve the artificial heart.

"Many of the present problems with artificial hearts are directly attributable to the fluid dynamics of the blood flow," Dr. Stuart Rogers at Ames has pointed out. Embedded regions of turbulent flow, for example, can damage red blood cells, while blood trapped in corners of the heart can lead to clots that can cause strokes.

By developing new theoretical tools in computational fluid dynamics specifically to solve the problem of modeling complex fluid flow in a body that has changing boundaries (as the heart beats), the Ames scientists hope to eventually have a "computer-aided design" of an improved heart. To carry out the necessary computations, the Ames group uses the Numerical Aerodynamic Simulator, which was initially designed and built to create three-dimensional models of the air flow around proposed aircraft (Figure 3).

An improved artificial heart will have a ready consumer base. These scientists estimate that if everyone who needs an artificial heart could have one, the annual requirement could range from 17,000 to 35,000 units.

#### Conquering Crippling Diabetes

Diabetes is one of the most debilitating human diseases, requiring the hospitalization of about 2 million people per year in the United States alone. About 12 million people suffer with various forms of diabetes here, and the figure is more than 100 million worldwide. Of these, more than 1 million in the United States are dependent upon daily doses of insulin. Each year between 135,000 and 208,000 new insulin-requiring patients are diagnosed in this coun-

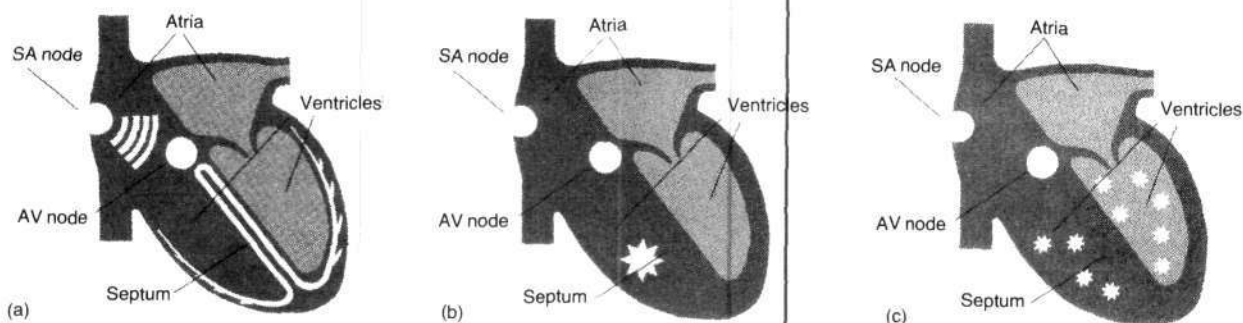
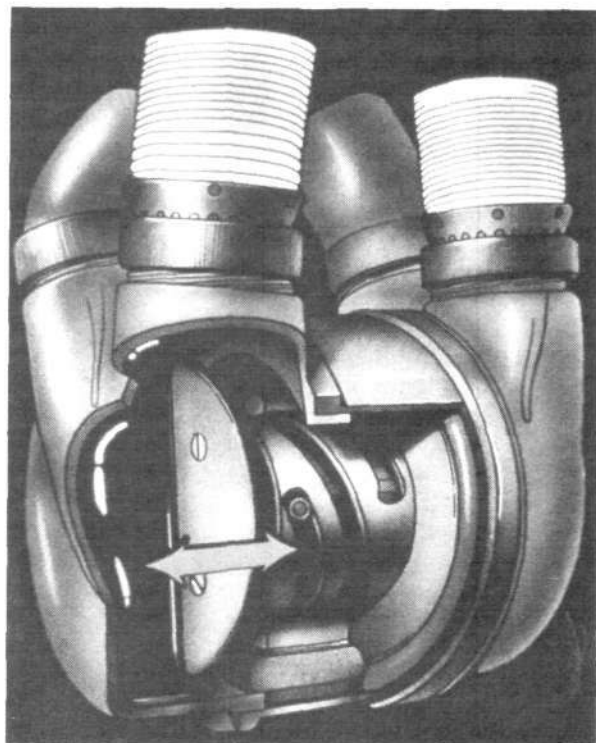


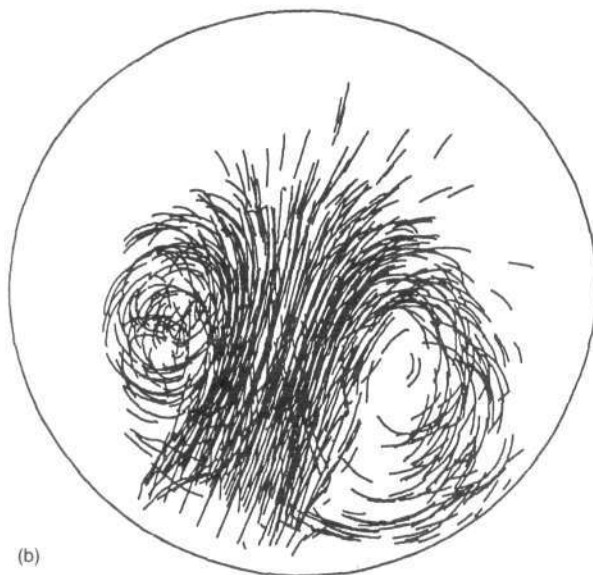
Figure 2  
THE NORMAL HEART'S 'PACEMAKER'

The "pacemaker" in a normal heart (a) is a signal sent from a small area in the upper right chamber called the SA node. This signal regulates the heartbeat; a normal heart beats between 60 and 80 times per minute. Ventricular tachycardia (b) is the abnormal heartbeat produced by loss of signal function at the SA node and transfer of the signal to the lower chamber or ventricle (asterisk at lower left). This faster beat can cause fainting spells, blackouts, temporary blind spots, dizziness, and eventually unconsciousness and heart arrest.

Ventricular fibrillation (c) occurs when there are numerous abnormal signals produced in the heart's ventricles, causing more than 300 beats per minute and leading to unconsciousness and even sudden death. Electrical shocks are used to try to get the heart back to a more normal rhythm.



(a)



(b)

Figure 3

#### THE ARTIFICIAL HEART AND A COMPUTER MODEL OF ITS INSTABILITIES

*The Penn State artificial heart (a) is an electromechanical device with a cylindrical chamber and two openings on the side for valves. The computational results from studying the flow inside the artificial heart produced this clear depiction (b) of two vortices that form as the piston of the artificial device is in its bottom position. Such instabilities can lead to medical problems for the patient and have limited the usefulness of the artificial heart.*

Source: NASA Ames Research Center

try alone. This figure is likely to increase as the population ages; 38 percent of all people with diabetes are over the age of 65, and 20 percent are over the age of 80.

The cost of treating diabetes in the United States in 1988 was estimated to be more than \$18 billion, according to a University of Minnesota study last year.<sup>3</sup> Approximately 50 percent of all diabetic hospitalizations are for the care of patients with chronic complications from diabetes, which in 1983 included 31,000 amputations, 5,800 cases of blindness, 4,000 cases of renal failure, 85,000 heart attacks, and 23,000 strokes. In addition to these direct medical costs, it is estimated that diabetics lose two to three times as many work days than does the average worker. An additional \$10.8 billion in indirect costs were estimated to be incurred in 1987 as a result of lost productivity, lost earnings, premature retirement, and premature deaths from diabetes.

Currently available insulin therapy does not prevent long-term complications in the great majority of the insulin-dependent diabetics, because it is difficult to maintain blood glucose levels in the normal range. This level changes with food consumption, exercise, and sleep. According to the University of Minnesota study, being able to supply insulin so that the blood levels of patients "close-

ly approximate the normal state, will help to curtail and possibly alleviate long-term diabetic complications."

The microminiaturization developed through advances in satellite technology at the Johns Hopkins University Applied Physics Laboratory made possible Robert Fischell's invention—the Programmable Implantable Medication System (PIMS) for controlled release of insulin. So far, 18 PIMS devices have been implanted in insulin-dependent diabetic patients at Johns Hopkins and the University of California at Irvine.

#### Fool-Proof Insulin Delivery

Using PIMS to treat diabetes is a remarkable improvement over the traditional patient-administered therapy. Irregular dosage applications lead to wide swings in blood sugar (or plasma glucose) levels, even for those who are diligent about their insulin therapy. The PIMS system makes dosage completely regular.

PIMS consists primarily of the patient's programmable infusion pump, which is implanted and delivers prescribed and precisely measured insulin doses without any attention from the patient. The patient also has a hand-held unit, with which he can initiate changes in dosage—within the

constraints set by his doctor—when he eats or exercises.

Using a medical programming system, the doctor can control the insulin dosage amount delivered through the pump. The system has a computer terminal that can be connected to a telephone so that the doctor can communicate his instructions directly to the implanted device via phone, and the patient does not have to go to the doctor's office.

The use of PIMS has already yielded important advantages over traditional treatment. Within a couple of days after the pump is implanted, the daily mean value of the plasma glucose level, measured in milligrams per deciliter, has been shown to stay within the normal 50 to 150 range (Figure 4). Diabetics on regular insulin therapy have swings, at different times of day and in relation to when they eat, that can push their blood sugar level up to 400. Most likely because of the better control over blood sugar levels, there are reports of the reversal of diabetic retinopathy; it is also expected that various secondary complications will be prevented.

There are additional potential advantages of implantable systems, including the possible decrease in side effects and the buildup of tolerance, because the medication rate is precise. The accidental or deliberate overdose of medication is prevented, and it is hoped that lower doses may be possible if it is thus delivered more effectively. In addition, medications that would normally require hospitalization could be safely given on an outpatient basis.

The implantable pump available today cannot function as an "artificial" pancreas, although future versions should be able to continually measure the blood glucose level of the patient and respond by automatically adjusting the amount of insulin that is delivered to the patient. It might also provide an alarm system, Fischell said, that could alert the patient when there is a problem in the device or with the body's reaction to the medication. Also open for development is the use of a PIMS system for the delivery of other medications for chronic illnesses.

The actual cure for diabetes, however, may also come from the space program. The implantation in diabetics of healthy, insulin-producing cells from the Isles of Langerhans area in the pancreas can be carried out today, but because of the lack of purity in the biological material, costly immune suppression techniques must be used. Space-based materials processing of biological material, using a technology called *continuous flow electrophoresis*, promises orders of magnitude improvements in purity and an eventual cure for this crippling disease.

#### Good Health Is Cost-Effective

The major stumbling block to making the PIMS device and system available to more of the insulin-dependent diabetics in the United States, Fischell reported, is the fact that medical insurance companies will not pay for it. Currently, the initial cost of PIMS is about \$8,000, or \$2,000 more than a heart pacemaker.

A University of Minnesota study assessing the potential economic impact of implantable insulin devices on health care systems created a 10-year economic model to test the hypothesis that implantable devices in high-risk diabetic



Johns Hopkins University/ Applied Physics Laboratory  
PIMS developer Robert Fischell holds the implantable insulin pump device.

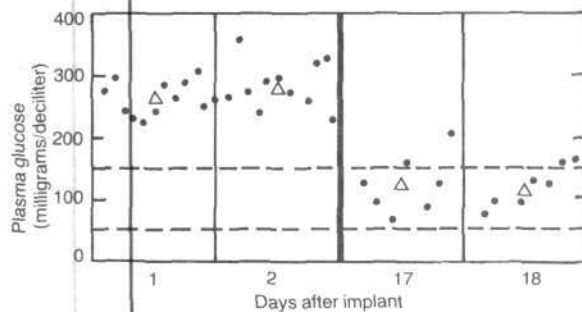


Figure 4

**RESULTS OF THE IMPLANTED MEDICATION SYSTEM**  
Data from the first human subject to be given the PIMS (Programmable Implantable Medication System) show clearly that after about two weeks, the blood glucose level has stabilized into the normal range, between 50 and 150 milligrams per deciliter. Over the long term, it is expected that this stability will reduce the secondary medical complications that diabetics now suffer.

Source: Robert Fischell

patients would result in significant savings.<sup>3</sup> The study assumed that "currently available forms of diabetic therapy do not prevent long-term diabetic complications in the greater majority of patients." In addition, the study stated that "supplying insulin blood levels that closely approximate the normal state will help to curtail and possibly alleviate long-term diabetic complications, thereby reducing the amount spent on hospitalization and outpatient care."

According to the report, 30 percent of the currently diagnosed insulin-dependent population are poorly con-

trolled, at high risk for complications, and in need of pump therapy. As well, 30 percent of newly diagnosed insulin-dependent patients are also at high risk for complications. In addition, 10 percent of the non-insulin-dependent diabetic population develop insulin-requiring disease each year and are also at high risk. The study model projects that with pump implantations done on the basis of need, there would be a 20 percent reduction in the costs of hospitalization and outpatient visits, with an immediate impact on the health care system during the first year of the implantation program.

Today, the cost of treatment for an individual on insulin therapy, based on two or three injections per day, is between \$1,700 and \$2,800. By comparison, the study found that the cost to implant pumps and maintain pump patients is comparable, averaging between \$2,100 and \$3,000 per year (see tables). In addition, there is an initial outlay for the device that they estimated could be as high as \$15,000. This cost would be greatly reduced, of course, as more devices were produced.

The number of implantable pumps required to meet the U.S. demand for the *currently diagnosed* insulin-requiring high-risk patients—30 percent of the insulin-requiring patients—would be 209,250, according to the Minnesota study. Initially, the number of pumps required to meet the yearly demand would be 15,500 to 24,800.

The total cost to treat diabetes with today's technology over the next decade is estimated to be \$303 billion. Using implantable pump therapy, the study states, "given the 20 percent reduction in the amount spent for hospitalization and outpatient visits, there will be \$27.8-\$35.4 billion cost savings at the end of 10 years. The total number of pumps implanted during those 10 years would, in our model, be 371,990-469,053."

Taking overall health care costs into account, the model predicts that the use of implantable insulin pumps will produce a savings to the health care system of \$600 million to more than \$2 billion per year. These savings do not include the other advantages, the study says, as "we are unable to place a price on the added convenience, possibly self-esteem, work capacity, and social bonds that may develop as the result of a more normal life with an implantable pump."

In sum, it seems clear that if our society wants to "save money" on health care, we should use the most advanced technology available and keep people healthier.

### From Space to Earth

At congressional hearings in Washington in May, PIMS developer Robert Fischell was asked why support from NASA, and not the health establishment, had helped bring his device to commercial development. Fischell said that when he went to the National Institutes of Health for support, they told him that the development of new hardware was "not their department." Only NASA would fund the project, he reported.

The space agency invested \$3 million in the PIMS system from its technology transfer program, and industry invested three times that amount. Donald Friedman, chief of the Office of Commercial Programs at the NASA Goddard

Space Flight Center, is one of the people who has made this technology transfer a reality. Goddard became involved with the Johns Hopkins Advanced Physics Laboratory 25 years ago through the development of scientific satellites, and since 1972 the center has been funding medical and other secondary applications of space technology. Friedman's office funds small projects that take a number of years to complete.

Goddard began funding implantable technology in 1979, and the first implant was accomplished in 1986. It could take up to 10 years for a company to see any return on investment from new biomedical device, Friedman said, but a prerequisite for obtaining NASA funding is for a commercial partner to be found. A company may not put money directly into a project during the research and development phase, but it does put in resources—people, facilities, and equipment.

The Goddard Center is now spending about \$1 million per year to support the development of the implantable pump system, in addition to the cardiac defibrillator and a human tissue stimulator. Two other technology transfer projects involve applications of robotic technology from the space program.

Could Goddard spend more? According to Friedman, "There's no problem or shortage of ideas; there's a shortage of money and resources."

Learning the lesson from NASA, the Strategic Defense Initiative Office established a technology transfer program, which has been supporting the use of the free electron laser for medical applications, among other programs. Also, the new legislation changing the National Bureau of Standards to the National Institute of Standards and Technology mandates a more aggressive effort in technology transfer from research to the manufacturing industries.

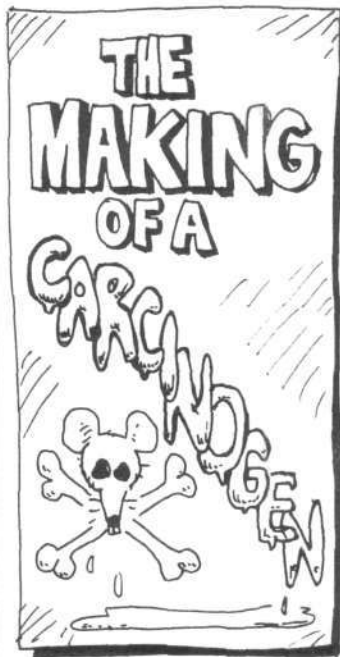
There have been loud complaints from the U.S. Congress recently that research initiated here is not brought into commercial production in this country, but is developed for the marketplace by other countries and then exported back to the United States. The solution is simple: Instead of complaining that other nations' policies are "unfair," why not change U.S. economic and financial policies so that government-funded research is applied to a broad range of problems and private companies are encouraged to invest in commercial development.

In the case of advanced medical technology, it is clear that the relatively small effort made through the space program to transfer technology has already improved the health and well-being of a significant number of this nation's people. The challenges of the next frontiers in space will further advance the medical frontiers on Earth.

*Marsha Freeman is an associate editor of 21st Century and frequently writes about the space program.*

### Notes

1. "An Exploration of Benefits from NASA "Spinoff" (Littleton, Colo.: Chapman Research Group, 1989).
2. "The State of Black America" (New York, N.Y.: National National Urban League, Jan. 1989).
3. Departments of Surgery and Biomedical Engineering, University of Minnesota. "The Economic Impact of Implantable Insulin Devices on Health Care Systems," 1988.



HERMAN! DID YOU HEAR? THELMA WITTLESBACK DIED OF CANCER!

I TOLD YOU ALL THOSE CHEMICALS AT THE LEMONADE FACTORY WERE NO GOOD, MOM!

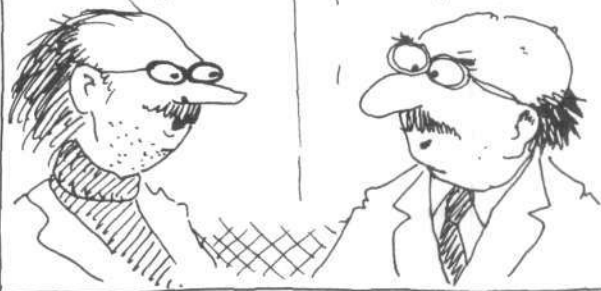


LATER...

SO ALL THESE PEOPLE WHO WORK IN THAT LEMONADE PLANT ARE DYING OF CANCER!

THERE MAY BE A CONNECTION! AND MAYBE A GRANT, TOO!

RATCO RESEARCH INC



LATER...

C'MON YOU LITTLE BUGGER-A LITTLE MORE LEMONADE WON'T KILL YOU!



CONT. ON PG. 45



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# Environmental Pollution And the Causes of Human Cancer

by Bruce N. Ames

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*Despite all the scare stories about carcinogens, Americans are healthier than they have ever been. An expert on cancer causation sets the record straight on six of the most frequent errors about pollution and cancer.*

## EDITOR'S NOTE

*New warnings of pollution, poison, cancer, and birth defects from chemicals are in the headlines daily, as the campaign against pesticides and industrial chemicals expands its list of accused items. Rarely do these reports include any mention of the necessary scientific criteria to place these allegations in proper perspective.*

*We asked one of the nation's foremost authorities on cancer causation to provide some technical ABCs on carcinogens and risk as a guide to readers in search of the truth. Compared to the scare stories that bombard the public, the truth may be shocking: For example, the amount of man-made pesticides ingested by Americans in their daily diet is 10,000 times less, by weight, than the natural pesticides ingested!*

*Dr. Ames is chairman of the Department of Biochemistry, University of California, Berkeley, and was formerly on the board of directors of the National Cancer Institute (National Cancer Advisory Board). A member of the National Academy of Sciences, he was the recipient of the most prestigious award for cancer research, the General Motors Cancer Research Foundation Prize (1983), and of the highest award in environmental achievement, the Tyler Prize (1985). He does no consulting for the chemical, drug, or food industry or for law firms. A more detailed version of this article, including a fuller list of references, can be found in the book, *Important Advances in Oncology 1989*, edited by V.T. DeVita, Jr., S. Hellman, and S.A. Rosenberg (Philadelphia: J.B. Lippincott).*

## Error 1: Cancer Rates Are Soaring

Overall, U.S. cancer death rates are staying at the same levels or are decreasing, the major exception being smoking-related cancer. A 1988 update from the National Cancer Institute indicates that "the age adjusted mortality rate for all cancers combined except lung cancer has been declining since 1950 for all individual age groups except 85 and above." There is a 13 percent decrease overall, with 44,000 fewer deaths than expected; and a 0.1 percent increase in the over-85 group.

The types of cancer deaths that have been decreasing during this period are primarily those of the stomach (by 75 percent, 37,000 fewer deaths than expected), cervix (73 percent, 11,000 fewer deaths), uterus (60 percent, 9,000 fewer deaths), and rectum (65 percent, 13,000 fewer deaths).

The types of cancer deaths that are increasing are primarily lung cancer (by 247 percent, 91,000 more deaths than expected), which is caused by smoking (as is 30 percent of U.S. cancer) and non-Hodgkin's lymphoma (by 100 percent, 8,000 more deaths). The overall cancer mortality trends can be seen in the latest data from the American Cancer Society (Figure 1).

Clearly, changes in survival rates and incidence rates are also relevant in interpreting the changes in death rates from cancer. For some types of cancer, the incidence rates have been increasing. In a definitive study on cancer trends, researchers Doll and Peto pointed out that although incidence rates are of interest, they should not be taken in isolation because of the substantial extent to which trends in these rates are biased by improvements in the level of record-keeping and diagnosis, as appears to be the case with breast cancer. Even if particular types of cancer are shown to increase or decrease, establishing a causal relation among the many changing aspects of our lives remains difficult. *Overall, there is no convincing evidence that there is a general increase in cancer related to the conditions of the modern industrial world* (Doll and Peto 1981; Higginson 1988; Peto 1985).

Life expectancy has been steadily increasing in the United States and other industrial countries; infant mortality is decreasing; and, although the statistics are not good, there is no evidence that birth defects are increasing. Thus, the conclusion is that Americans are healthier than they have ever been.

## Error 2: Only a Small Number of Chemicals Cause Cancer or Birth Defects, and We Can Eliminate Them

More than 50 percent of the chemicals tested to date in rats and mice have been found to be carcinogens at the high doses administered, the maximum tolerated dose. The exhaustive database of animal cancer tests developed by me and my colleagues listed 392 chemicals tested in

both rats and mice at the maximum tolerated dose (Gold et al. 1984; Gold et al. 1987). Of these, 58 percent of the synthetic chemicals and 45 percent of the natural chemicals were carcinogens in at least one species. We concluded that the proportion of chemicals found to be carcinogens is strikingly high, a conclusion reached by others on the basis of smaller compilations.

Even when one considers that some chemicals are selected for testing based on a high index of suspicion, the large proportion of positive findings is disturbing. From considerations of carcinogenesis mechanisms, it is plausible that a large proportion of all chemicals we test in the future, both natural and man-made, will prove to be carcinogens—see Error 4 below (Ames, Magaw, and Gold 1987).

Large proportions of positives are also reported for teratogenesis tests. Fully one third of the 2,800 chemicals tested in laboratory animals have been shown to induce birth defects at the maximum tolerated dose. Thus, it seems likely that a sizable percentage of both natural and man-made chemicals will be reproductive toxins when tested at these doses. The world is full of carcinogens and reproductive toxins, and it always has been. The important issue is the human exposure dose, and, fortunately, this is almost always miniscule.

The major preventable risk factors for cancer causation, such as tobacco, dietary imbalances, hormones, and viruses, have been discussed by us and by others (for example, Ames, Magaw, and Gold 1987a,b).

## Error 3: Man-made Chemical Pollutants Are Present in Significant Amounts

Carcinogens differ enormously in potency in rodent tests, and comparisons of possible hazards from various carcinogens ingested by humans must take this into account. We have attempted to address the issue of priority setting among possible carcinogenic hazards (Ames, Magaw, and Gold 1987). Our analysis makes use of an exhaustive database of carcinogenic potency (currently 3,500 experiments on 975 chemicals) that analyzes animal cancer tests and calculates the dose of the carcinogen sufficient to cause cancer in half of the animals, which is abbreviated as  $TD_{50}$ . The  $TD_{50}$  is close to the high dose (maximum tolerated dose) actually given, and thus involves a minimal extrapolation.

To calculate our index of possible hazard, we express each human exposure (daily lifetime dose, in milligrams per kilogram of body weight) as a percentage of the rodent  $TD_{50}$  dose (mg/kg) for each carcinogen. We call this percentage HERP (human exposure dose/rodent potency dose). Because rodent data are all calculated on the basis of lifetime exposure at the indicated daily dose rate, the human exposure data are similarly expressed, although the human exposure is likely to be less than daily for a lifetime. The HERP values are not risk assessments, because it is impossible to extrapolate to low doses (see Error 4), but provide a way to compare possible hazards of exposures so as to put them in perspective and set priorities (see table on page 44).

This analysis suggests that the amounts of pollution hu-

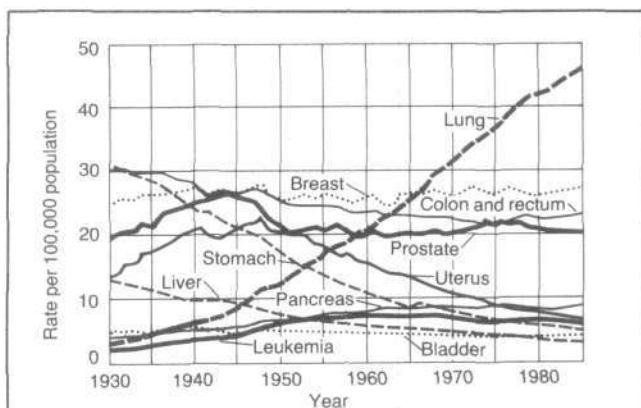


Figure 1

**U.S. CANCER DEATH RATES BY SITE (1930-1985)**

Cancer death rates are staying at the same rate or decreasing, except for smoking-related cancer. All figures are age-adjusted, and the rate for the population is standardized for age based on the 1970 U.S. population. Rates are for both sexes combined except breast, uterus, and prostate cancer.

Sources: National Center for Health Statistics and U.S. Bureau of the Census.

mans ingest from pesticide residues or water pollution appear to be trivial relative to the background of natural or traditional carcinogens, for example, from cooking food.

**Nature's Pesticides**

Americans ingest in their diet at least 10,000 times more natural pesticides by weight than man-made pesticide residues. These natural "toxic chemicals" have an enormous variety of chemical structures, appear to be present in all plants, and serve as protection against fungi, insects, and animal predators. Although only a few dozen are found in each plant species, they commonly make up 5 to 10 percent of the plant's dry weight. There has been relatively little interest in the toxicology or carcinogenicity of these compounds until quite recently, although they are by far the main source of "toxic chemicals" ingested by humans.

Although most chemicals tested for carcinogenicity in rodent bioassays are synthetic compounds, the proportion of positive tests is about as high for natural pesticides as for synthetic chemicals. Because more than 99.99 percent of the pesticides we ingest are "nature's pesticides," our diet is likely to be very high in natural carcinogens. Their concentration is usually in parts per thousand or more, rather than parts per billion, as is usual for synthetic pesticide residues or water pollution.

The known natural carcinogens in mushrooms, parsley, apples, coffee, cabbage, radish, basil, parsnips, fennel, pepper, celery, figs, mustard, and citrus oil are no doubt just the beginning of the list because so few of nature's pesticides have been tested. For example, a recent analysis of lima beans showed an array of 23 natural alkaloids (those tested have biocidal activity) that ranged in concentration in stressed plants from 0.2 to 33 parts per thousand fresh weight. Not one of them appears to have been tested for carcinogenicity or for teratogenicity.

**Man-made Pesticide Residues**

The intake of man-made pesticide residues from food in the United States, including residues of industrial chemicals such as polychlorinated biphenyls (PCBs), has been estimated by the U.S. Food and Drug Administration (FDA). They assayed food for residues of the 70 compounds thought to be of greatest importance (Gartrell et al. 1986). The human intake averages about 150 micrograms per day. Most of this intake (105 micrograms) is composed of three chemicals (ethylhexyl diphenyl phosphate, malathion, and chlorpropham) shown to be *noncarcinogenic* in tests in rodents. Thus, the intake of carcinogens from residues (45 micrograms/day if all the other residues are carcinogenic, which is unlikely) is extremely small relative to the background of natural substances.

The latest figures from the FDA about actual exposures do not include every known man-made pesticide, but represent a reasonable attempt to do so. In a recent National Research Council/National Academy of Sciences report, *Regulating Pesticides in Food*, it is suggested that some of the pesticides not covered by the FDA sampling, particularly those used on tomatoes, should have their allowable limits lowered and presumably should be added to the FDA sampling program. Nevertheless, the estimate of 45 micrograms of possibly carcinogenic pesticide residues consumed in a day is likely to be a reasonable one, as is our conclusion that the possible hazards from these residues are *minimal* in comparison to the background of nature's pesticides.

For comparison, there are about 500 micrograms of carcinogens in a cup of coffee (hydrogen peroxide and methylglyoxal), 185 micrograms of carcinogenic formaldehyde in a slice of bread, about 2,000 micrograms of formaldehyde in a cola, 760 micrograms of carcinogenic estragole in a basil leaf, 1 gram of burnt material from cooking our food, plus nitrosamines formed in gas ovens.

An alternative to synthetic pesticides is to raise the level of natural plant toxins by breeding. However, it is not clear that this approach, even where feasible, is preferable. One consequence of disproportionate concern about tiny traces of synthetic pesticide residues, such as ethylene dibromide, is that plant breeders are developing highly insect-resistant plants, thus creating other risks. Two recent cases are instructive. A major grower introduced a new variety of highly insect-resistant celery into commerce. There was soon a flurry of complaints to the Centers for Disease Control from all over the country, because people who handled the celery developed a severe rash when they were subsequently exposed to sunlight. Some detective work revealed that the pest-resistant celery contained 9,000 parts per billion (ppb) psoralens (light-activated mutagenic carcinogens) instead of the level of 900 ppb psoralens in normal celery (Berkley et al. 1986; Seligman et al. 1987). It is unclear whether other natural pesticides in the celery were increased as well.

Solanine and chaconine (the main natural alkaloids in potatoes) are cholinesterase inhibitors that were widely introduced into the human diet about 400 years ago with the dissemination of the potato from the Andes. They can be

*Continued on page 45*

## RANKING OF POSSIBLE CARCINOGENIC HAZARDS\*

Possible hazard: HERP (%)	Daily human exposure	Carcinogen dose per 70-kg person	Potency of carcinogen: TD <sub>50</sub> (mg/kg)	
			Rats	Mice
<i>Environmental Pollution</i>				
0.001†	Tap water 1 liter	Chloroform, 83µg‡ (U.S. avg)	(119)	90
0.004†	Well water, 1 liter contaminated (worst well in Silicon Valley)	Trichloroethylene, 2800 µg	(-)	941
0.0004†	Well water, 1 liter contaminated, Woburn	Trichloroethylene, 267 µg	(-)	941
0.0002†		Chloroform, 12 µg	(119)	90
0.0003†		Tetrachloroethylene, 21 µg	101	(126)
0.008†	Swimming pool, 1 hour (for child)	Chloroform, 250 µg (avg pool)	(119)	90
0.6	Conventional home air (14 hours/day)	Formaldehyde, 598 µg	1.5	(44)
0.004		Benzene, 155 µg	(157)	53
2.1	Mobile home air (14 hours/day)	Formaldehyde, 2.2 mg	1.5	(44)
<i>Pesticide and Other Residues</i>				
0.0002†	PCBs: daily dietary intake	PCBs, 0.2 µg (U.S. avg)	1.7	(9.6)
0.0003†	DDE/DDT: daily dietary intake	DDE, 2.2 µg (U.S. avg)	(-)	13
0.0004	EDB: daily dietary intake (grains, grain products)	EDB, 0.42 µg (U.S. avg)	1.5	(5.1)
<i>Natural Pesticides and Dietary Toxins</i>				
0.003	Bacon, cooked (100 g)	Demethylnitrosamine, 0.3 µg	(0.2)	0.2
0.006		Diethylnitrosamine, 0.1 µg	0.02	(+)
0.003	Sake (250 ml)	Urethane, 43 µg	(41)	22
0.03	Comfrey herb tea (1 cup)	Symphytine, 38 µg (750 µg of pyrrolizidine alkaloids)	1.9	(?)
0.03	Peanut butter (32 g: one sandwich)	Aflatoxin, 64 ng‡ (U.S. avg, 2 ppb)	0.003	(+)
0.06	Dried squid, broiled in gas oven (54 g)	Dimethylnitrosamine, 7.9 µg	(0.2)	0.2
0.07	Brown mustard (5 g)	Allyl isothiocyanate, 4.6 mg	96	(-)
0.1	Basil (1 g of dried leaf)	Estragole, 3.8 mg	(?)	52
0.1	Mushroom, one raw ( <i>Agaricus bisporus</i> : 15 g)	Mixture of hydrazines, etc.	(?)	20,300
0.2	Natural root beer (12 oz: 354 ml; now banned)	Safrole, 6.6 mg	(436)	56
0.008	Beer, before 1979 (12 oz: 354 ml)	Dimethylnitrosamine, 1 µg	(0.2)	0.2
2.8†	Beer (12 oz: 354 ml)	Ethyl alcohol, 18 ml	9,110	(?)
4.7†	Wine (250 ml)	Ethyl alcohol, 30 ml	9,110	(?)
6.2†	Comfrey-pepsin tablets (nine daily)	Comfrey root, 2,700 mg	626	(?)
1.3	Comfrey-pepsin tablets (nine daily)	Symphytine, 1.8 mg	1.9	(?)
<i>Food Additives</i>				
0.0002	AF-2: daily dietary intake before banning	AF-2 (furylfuramide), 4.8 µg	29	(131)
0.06†	Diet cola (12 oz: 354 ml)	Saccharin, 95 mg	2,143	(-)
<i>Drugs</i>				
[0.3]	Phenacetin pill (avg dose)	Phenacetin, 300 mg	1,246	(2,137)
[5.6]	Metronidazole (therapeutic dose)	Metronidazole, 2,000 mg	(542)	506
[14]	Isoniazid pill (prophylactic dose)	Isoniazid, 300 mg	(150)	30
16†	Phenobarbital, one sleeping pill	Phenobarbital, 60 mg	(+)	5.5
17†	Clofibrate (avg daily dose)	Clofibrate, 2,000 mg	169	(?)
<i>Occupational Exposure</i>				
5.8	Formaldehyde: workers' avg daily intake	Formaldehyde, 6.1 mg	1.5	(44)
140	EDB: workers' daily intake (high exposure)	EDB, 150 mg	1.5	(5.1)

Reprinted with permission from B.N. Ames, R. Magaw, and L.S. Gold, 1987. "Ranking Possible Carcinogenic Hazards," *Science* 236:271.

\**Potency of carcinogens:* A number in parentheses indicates a TD<sub>50</sub> value not used in HERP calculation because it is the less sensitive species; (-) = negative in cancer test; (+) = positive for carcinogenicity in tests not suitable for calculating a TD<sub>50</sub>; (?) = not adequately tested for carcinogenicity. TD<sub>50</sub> values shown are averages calculated by taking the harmonic mean of the TD<sub>50</sub> of the positive tests in that species from the Carcinogenic Potency Database. Results are similar if the lowest TD<sub>50</sub> value (most potent) is used instead. For each test the target site with the lowest TD<sub>50</sub> value has been used. The average TD<sub>50</sub> has been calculated separately for rats and mice, and the more sensitive species is used for calculating the possible hazard. The database, with references to the source of the cancer tests, is complete for tests published through 1984 and for the National Toxicology Program bioassays through June 1986. We have not indicated the route of exposure or target sites or other particulars of each test, although these are reported in the database. HERP stands for human exposure dose/rodent potency dose.

*Daily human exposure:* We have tried to use average or reasonable daily intakes to facilitate comparisons. In several cases, such as contaminated well water or factory exposure to EDB, this is difficult to determine; these are assigned the value for the worst levels found. The calculations assume a daily dose for a lifetime; where drugs are normally taken only for a short period, we have bracketed the HERP value. For inhalation exposures, we assume an inhalation of 9,600 liters per 8 hours for the workplace and 10,800 liters per 14 hours for indoor air at home.

*Possible hazard:* The amount of rodent carcinogen indicated under carcinogen dose is divided by 70 kg to give a milligram per kilogram of human exposure, and this human dose is given as the percentage of the TD<sub>50</sub> dose in the rodent (mg/kg) to calculate the HERP.

† HERP from carcinogens thought to be nongenotoxic.

‡ µg is a microgram, or 1 millionth of a gram; ng is a nanogram, 1 billionth of a gram.

detected in the blood of all potato eaters. Total alkaloids are present in potatoes at a level of 15,000 micrograms per 200-gram potato, which is only about a sixfold safety margin from the toxic level for humans. Neither alkaloid has been tested for carcinogenicity, but both are teratogens.

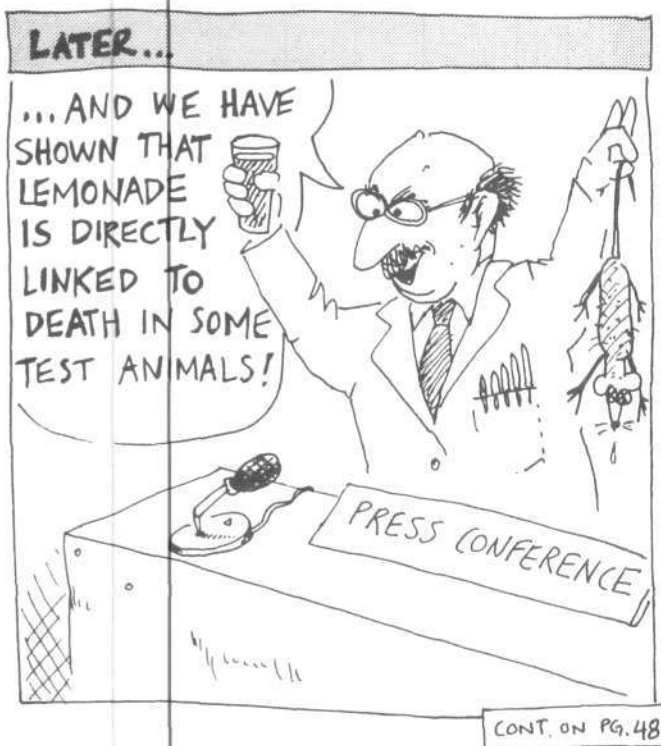
By contrast, the pesticide malathion, the main synthetic organophosphate cholinesterase inhibitor present in our diet (17 micrograms/day), has been thoroughly tested and is not a carcinogen in rodents. Plant breeders produced an insect-resistant potato that had to be withdrawn from the market because of its acute toxicity to humans, a consequence of higher levels of solanine and chaconine.

There is a tendency for laymen to think of chemicals as being only man-made and to characterize them as toxic, as if every natural chemical were not also toxic at some dose. Even a 1987 National Research Council/National Academy of Sciences report states that "Advances in classical plant breeding . . . offer some promise for nonchemical pest control in the future. Nonchemical approaches will be encouraged by tolerance revocations if more profitable chemical controls are not available. . . ." The report was particularly concerned with some pesticides used on tomatoes. Of course, tomatine, one of the alkaloids in tomatoes, is a chemical too, and was introduced from the New World 400 years ago. It has not been tested in rodent cancer bioassays, is present at 36,000 micrograms per 100-gram tomato, and is orders of magnitude closer to the toxic level than are man-made pesticide residues.

### The Idea That Nature Is Benign

The notion that evolution has allowed us to cope with the toxic chemicals in the natural world is not compelling for several reasons: First, there is no reason to think that natural selection should eliminate the carcinogenic hazard of a plant toxin that causes cancer past the reproductive age, although there could be selection for resistance to the acute effects of particular carcinogens. For example, aflatoxin, a mold toxin that presumably arose early in evolution, causes cancer in trout, rats, mice, monkeys, and probably people, although the species are not equally sensitive (Ames, Magaw, and Gold 1987b; IARC Monographs 1987). Many of the common metal salts are carcinogens, for example, lead, cadmium, beryllium, nickel, chromium, selenium, and arsenic) despite their presence during all of evolution.

Second, it is argued by some that humans, as opposed to rats or mice, may have developed resistance to each specific plant toxin or chemical in cooked food. This is unlikely, because both rodents and humans have developed many types of general defenses against the large amounts and enormous variety of nature's pesticides. These defenses include the constant shedding of the surface layer of cells of the digestive system, the detoxification of alkylating agents by glutathione transferases, the active excretion of hydrophobic toxins out of liver or intestinal cells, numerous defenses against oxygen radicals, and DNA excision repair. The fact that defenses usually are general, rather than specific for each chemical, makes good evolutionary sense and is supported by various studies. Experimental evidence indicates that these general defenses are effective



against both natural and synthetic compounds, since basic mechanisms of carcinogenesis are not unique to either (Jakoby 1980).

Third, the human diet has changed drastically in the last few thousand years, and most of us are eating recently introduced plants (coffee, potatoes, tomatoes, and kiwi fruit) that our ancestors did not eat.

Fourth, the argument that plants contain anticarcinogens that protect us against plant carcinogens is irrelevant: Plant antioxidants, the major known type of ingested anticarcinogens, do not distinguish whether oxidant carcinogens are synthetic or natural in origin, and thus help to protect us against both.

Fifth, it has been argued that synthetic carcinogens can be synergistic. However, this is also true of natural chemicals and is irrelevant to the argument that synthetic pesticide residues in food or water pollution appear to be a trivial increment over the background of natural carcinogens.

### Dioxin Compared to Alcohol and Broccoli

Common sense suggests that a chemical pollutant should not be treated as a significant hazard if its possible hazard level is far below that of common food items. Dioxin (TCDD) is a substance of great public concern, because it is an extremely potent carcinogen and teratogen in rodents, yet the doses humans are exposed to are very low relative to the effective level in rodents. Dioxin can be compared to alcohol, as an example. Alcohol is an extremely weak carcinogen and teratogen, yet the doses humans are exposed to are very high relative to the effective dose in rodents (or humans). Indeed, alcoholic beverages are the most important known human teratogen, and the effective dose level of alcohol in humans (in mg per kg of body

weight) is similar to the level that causes birth defects in mice.

By contrast, there is no convincing evidence that dioxin is carcinogenic or teratogenic in man, although it is in rodents. If one compares the teratogenic potential of dioxin to that of alcohol for causing birth defects, after adjusting for their potency in rodents, then a daily consumption of the Environmental Protection Agency (EPA) "reference dose" (formerly called the "acceptable dose limit") of dioxin, 6 femtograms/kg per day, is equivalent in teratogenic potential to the amount of alcohol ingested daily from 1/3,000,000 of a beer, the equivalent of drinking one beer (15 g ethyl alcohol) over a period of 8,000 years. [A femtogram is  $1 \times 10^{-15}$  grams.] A daily slice of bread or glass of orange juice contains much more natural alcohol than this.

Alcoholic beverages are clearly carcinogenic in man (at a daily dose of about five drinks), although only one of several tests on ethyl alcohol in rats was positive. This test should be replicated as confirmation that ethyl alcohol is the active ingredient, although the evidence for that is fairly strong. A comparison of the carcinogenic potential of dioxin with that of alcohol, adjusting for potency in rodents, shows that the equivalence for the dioxin reference dose of 6 femtograms/kg per day is one beer every 345 years. Since the average per capita consumption of alcohol in the United States is equivalent to more than one beer per day, the great concern over dioxin at levels in the range of the reference dose seems unreasonable.

The assumption of a worst-case linear dose-response, often used for carcinogens, is not plausible for dioxin, yet extrapolations to man using such assumptions have generated great concern. Dioxin binds to a receptor in mammalian cells, the Ah receptor, and the evidence suggests strongly that all of dioxin's effects are mediated through this binding. Moreover, a wide variety of natural substances bind to the Ah receptor, and, as far as they have been examined, they have all of the properties of dioxin. A cooked steak contains polycyclic hydrocarbons, which bind to the Ah receptor and mimic dioxin. In addition, our diet contains a variety of flavones and other substances from plants, which bind to the Ah receptor. The most interesting of such substances is indole carbinol, which is present in large amounts in broccoli (500 mg/kg), cabbage, cauliflower, and other members of the *Brassica* family.

The two substances induce the same set of enzymes. When given before aflatoxin or other carcinogens, indole carbinol protects against carcinogenesis, as does dioxin. However, when it is given after aflatoxin or other carcinogens, indole carbinol is a strong promoter of carcinogenesis, as is dioxin. This stimulation of carcinogenesis has also been shown for cabbage itself. When indole carbinol is exposed to acidity equivalent to that of the stomach, it is converted to a series of dimers and trimers that are similar to dioxin in size and shape, bind to the Ah receptor, and induce the set of dioxin-inducible enzymes, thus mimicking dioxin. The 360 femtogram/day dioxin EPA reference dose should be compared with 50 billion picograms of indole carbinol per 100 g of broccoli, that is, one portion [a picogram is  $1 \times 10^{-12}$  grams]; the affinity of the indole derivatives in binding to the Ah receptor is less by a factor

of about 8,000, suggesting that the broccoli portion might be roughly 20 million times the possible hazard. Although these indole carbinol derivatives appear to be much more of a possible hazard than dioxin, it is not clear whether, at these low doses, either represents any danger.

Another study also shows that when sunlight oxidizes tryptophan, a normal amino acid, it converts it to a variety of indoles (similar to the broccoli indole carbinol dimers), which bind to the Ah receptor and mimic the action of dioxin (Rannug et al. 1987). It seems likely that many more of these "natural dioxins" will be discovered in the future.

### Water Pollution

The possible hazards from carcinogens in contaminated well water (such as in the Santa Clara or "Silicon" Valley in California, and Woburn, Massachusetts) should be compared to the possible hazards of ordinary tap water (see table). Of the 35 wells shut down in Santa Clara Valley because of a supposed carcinogenic hazard—low traces of trichloroethylene—only two were of a possible hazard greater than ordinary tap water. Well water is not usually chlorinated and therefore lacks the 83 ppb chloroform present in average chlorinated tap water. Water from the most polluted well had a relative hazard that was orders of magnitude less than that for the carcinogens in an equal volume of cola, beer, or wine, or many natural carcinogens in our daily diet. The consumption of tap water is only about 1 or 2 liters/day, and the animal evidence provides no good reason to expect that chloroform in water or current levels of man-made pollution of water would pose a significant carcinogenic hazard.

The trace amounts of chemicals found in polluted wells should be a negligible cause of birth defects, when compared to the background level of known teratogens such as alcohol. Most agents causing birth defects would also be expected to be harmless at low doses. Important risk factors for birth defects in humans include age of mother, alcohol ingestion, smoking, and rubella virus.

### Air Pollution

A person inhales about 20,000 liters of air in a day. Thus, even modest contamination of the atmosphere results in inhalation of appreciable doses of a pollutant. Indoor air pollution is, in general, considerably more of a health hazard than outdoor air pollution, partly because of cigarette smoke, formaldehyde, benzene, and radon. The most important indoor air pollutant is radon gas.

Radon is a natural radioactive gas that is present in the soil, gets trapped in houses, and gives rise to radioactive decay products that are known to be carcinogenic in humans. It has been estimated that one million homes in the United States have a level of exposure to products of radon decay higher than that received by today's uranium miners. Two particularly contaminated houses had a risk estimated to be equivalent to receiving about 1,200 chest X-rays a day. Approximately 10 percent of the lung cancer in the United States has been tentatively attributed to radon pollution in houses. Many of these cancers may be preventable, because the most hazardous houses can be identified and modified to minimize radon contamination (Nero 1988).

General outdoor air pollution is a small risk relative to indoor air pollution or to the pollution inhaled by a smoker: a person breathing Los Angeles smog for a year inhales the same amount of burnt material that a smoker inhales in two packs of cigarettes (Ames, Magaw, and Gold 1987; Ames 1983). It is difficult for epidemiologists to determine cancer risk from outdoor air pollution because smoking and radon exposure must be accurately controlled.

#### Cooking Food

The cooking of food generates a variety of mutagens (agents that damage DNA) and carcinogens. The total amount of browned and burnt material eaten in a typical day is at least several hundred times more than that inhaled from severe outdoor air pollution (Ames 1983). Nine heterocyclic amines, isolated on the basis of their mutagenicity from proteins or amino acids that were heated in ways that reproduce cooking methods, have now been tested; all have been shown to be potent carcinogens in rodents (Sugimura et al. 1986; Sugimura 1986). Many others are still being isolated and characterized. Three mutagenic nitro-pyrenes present in diesel exhaust have been shown to be carcinogens, but the intake of these carcinogenic nitro-pyrenes from grilled chicken is estimated to be much higher than that from air pollution.

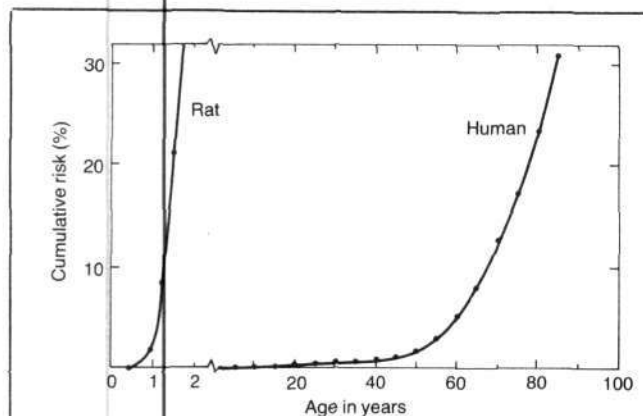
Gas flames generate nitrous oxide ( $\text{NO}_2$ ), which can form both the carcinogenic nitro-pyrenes and the potentially carcinogenic nitrosamines in food, such as fish, cooked in gas ovens. It seems likely that food cooked in gas ovens may be a major source of dietary nitrosamines and nitro-pyrenes.

#### Error 4: Extrapolating Risks Without Understanding Carcinogenesis Mechanisms

It is prudent to assume that if a chemical is a carcinogen in rats and mice at the maximum tolerated dose, it is also likely to be a carcinogen in humans at the maximum tolerated dose. However, until we understand more about mechanisms of carcinogenesis, we cannot reliably predict risk to humans at low doses, often hundreds of thousands of times below the dose where an effect is observed in rodents. Thus, *quantitative risk assessment currently is not scientifically possible.*

The study of mechanisms of carcinogenesis is a rapidly developing field and is essential for rational risk assessment. Both mutations and cell proliferation (that is, promotion) are required in carcinogenesis. There is an enormous spontaneous rate of damage to DNA from endogenous oxidants, which we have discussed in relation to cancer and aging. There is also a basal spontaneous rate for cell proliferation in some organs, like the colon, but not in others, like the liver. Thus, increasing either mutation or cell proliferation should be carcinogenic.

Additional complications are that several mutations appear necessary for carcinogenesis and that there are many layers of defense against carcinogens. These considerations suggest a sublinear dose-response relationship, which is consistent with both the animal and human data, and indicate that multiplicative interactions will be common in human cancer causation. Administering chemicals in cancer



**Figure 2**  
**CUMULATIVE NET RISK OF DEATH FROM CANCER FOR RATS AND HUMANS**

*Cancer is fundamentally a degenerative disease of old age in mammals, in both short-lived species like rats and mice and long-lived species like man. About 30 percent of rats and mice have cancer by the end of their 2- to 3-year lifespan and about 30 percent of humans have cancer by the end of their 85-year lifespan. Cumulative cancer risk, shown here, increases with approximately the fourth power of age.*

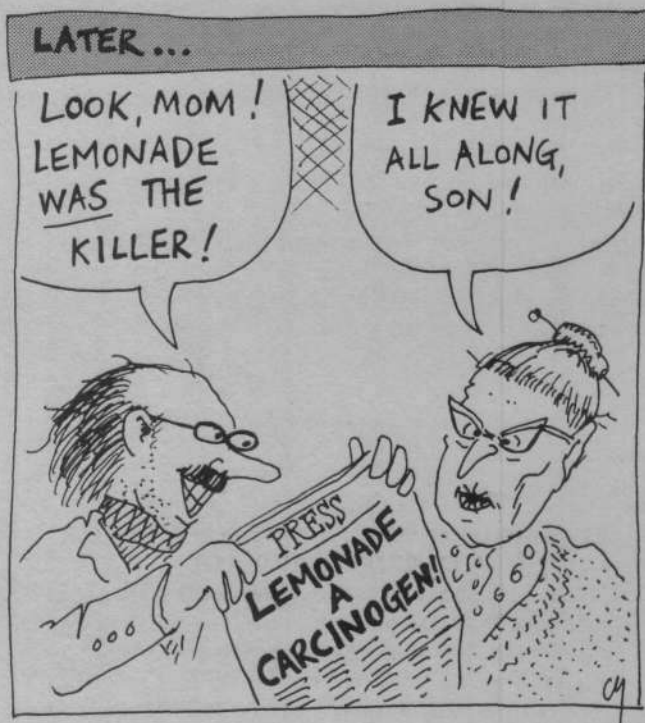
Source: Ames et al. 1985.

tests at the maximum tolerated dose commonly causes cell proliferation and inflammatory reactions. Inflammatory reactions with release of oxygen radicals from phagocytic cells are equivalent to irradiating the tissue. If a chemical is nonmutagenic and its carcinogenicity is caused by cell proliferation resulting from near-toxic doses, one might commonly expect a threshold.

#### The Dose-Response Curve

*The fact that high doses of a chemical cause tumors does not necessarily mean that small doses will. Most chemicals may, in fact, be harmless at low levels. A list of carcinogens is not enough. The main rule in toxicology is that the "dose makes the poison": at some level, every chemical becomes toxic, but there are safe levels below that. A scientific consensus evolved in the 1970s that we should treat carcinogens differently—that we should assume that even low doses could possibly cause some harm, even though we do not have the methods to measure effects at low levels. This idea evolved because most carcinogens appeared to be mutagens (agents that damage the DNA). The precedent of radiation, which is both a mutagen and carcinogen, gave credence to the idea that there could be effects of chemicals even at low doses. Some recent work on radiation, however, suggests that low doses may be of no harm or even protective (Wolff et al. 1988; Yalow 1988; Ootsuyama and Tanooka 1988; Kondo 1988).*

The idea that most of the classical carcinogens were mutagens that damaged DNA (about 90 percent in our studies), along with work on oncogenes, reinforced the mutagen-carcinogen connection. However, in recent years there has been a change in the picture. About half of all chemicals



tested in animals are carcinogens, but only about half of these appear to be mutagenic. It is now standard in cancer tests to be rigorous about giving the maximum tolerated dose of the chemical for the lifetime of the animal, and this may be a factor. It seems quite reasonable that nonmutagens cause cancer, and mutagens in part cause cancer, because administering the maximum tolerated dose accelerates the promotional step of carcinogenesis.

Promotion, or cell proliferation, can also be accelerated by viruses, such as the human carcinogenic hepatitis B viruses, a major cause of liver cancer around the world, or human papilloma virus 16 (HPV-16), a contributor to cancer of the cervix. Both cause chronic cell killing and consequent cell proliferation. Promotion can also be induced by hormones, which cause cell proliferation. Hormones appear to be major risk factors for certain human cancers, such as breast cancer, and appear to only increase cell proliferation. The promotional step of cancer causation can also be accelerated by chemicals. Alcohol, for example, causes cirrhosis of the liver, leading to cancer. The classical chemical promoters, such as phenobarbital and tetradecanoyl phorbol acetate, would be expected to be, and are, carcinogens when tested in thorough animal tests at the maximum tolerated dose.

There is increasing evidence to show that low doses of promoters are not active (Pitot et al. 1987; Farber 1987). It seems likely, therefore, that a high percentage of all chemicals, both man-made and natural, will cause cell proliferation at the maximum tolerated dose and be classified as carcinogens, but most of these may be acting as promoters and therefore may not be of interest at doses much below the toxic dose.

Thus, the common water pollutants, such as trichloroethylene (TCE) and perchloroethylene (PCE), are unlikely to be of public health significance because (a) the amounts we are exposed to in pollution are trivial relative to the background of natural carcinogens, and (b) the evidence is that

they are likely to be acting as promoters, not as DNA-damaging carcinogens, and therefore should be ignored at low concentrations.

### Error 5: Storks Bring Babies and Pollution Causes Cancer and Birth Defects

The number of storks in Europe has been decreasing for decades. At the same time, the European birth rate has also been decreasing. We would be foolish to accept this high correlation as evidence that storks bring babies. The science of epidemiology tries to sort out from the myriad chance correlations those that are meaningful and involve cause and effect. However, it is not easy to obtain convincing evidence by epidemiologic methods because of inherent methodological difficulties. There are many sources of bias in observational data, and chance variation is also an important factor. For example, because there are so many different types of cancer or birth defects, by chance alone one might expect some of them to occur at a high frequency in a small community. Toxicology provides evidence to help decide whether an observed correlation might be causal or accidental.

*There is no convincing evidence from epidemiology or toxicology that pollution is a significant source of birth defects and cancer.* For example, the epidemiologic studies of Love Canal, dioxin in Agent Orange, Contra Costa refineries, Silicon Valley, Woburn, and the use of DDT provide no convincing evidence that pollution was the cause of human harm in any of these well-publicized exposures. Even in Love Canal, where people were living next to a toxic waste dump, the epidemiologic evidence for an effect on public health is equivocal. Analysis of the toxicology data on many of these cases suggests that the amounts of the chemicals involved were much too low relative to the background of natural and traditional carcinogens to be credible sources of increased cancer risk to humans (Ames, Magaw, and Gold 1987). A comparative analysis of teratogens using a HERP-type index expressing the human exposure level as a percentage of the dose level effective in rodents would be of interest (see Error 3), but this has not been done in a systematic way.

Environmental exposure to TCE, PCE, trichloroethane, ethylene dibromide (EDB), and other pollutants is thousands of times lower than the exposure to these same agents in the workplace. Thus, if parts per billion of these pollutants were causing cancer or birth defects, one might expect to see an effect in the workplace. The studies on these chemicals to date do not provide any evidence for a causal association, although epidemiologic studies are inherently insensitive (IARC Monographs 1987).

Historically, cases of cancer due to workplace exposure resulted mainly from exposures to chemicals at very high levels. For example, the permissible and actual EDB levels for workers were shockingly high (see table). I testified in California in 1981 that our calculations showed that the workers were allowed to breathe in a dose higher than the  $TD_{50}$  in rats. California lowered the permissible worker exposure by more than 100-fold. Despite the fact that the epidemiology of EDB in highly exposed workers does not



show any significant effect, the uncertainties in our knowledge make it important to have strict rules because workers can be exposed to extremely high doses.

## Error 6: Technology Is Doing Us In

Modern technologies are almost always replacing older, more hazardous technologies. The reason that billions of pounds of TCE (one of the most important industrial non-flammable solvents) and PCE (the main dry-cleaning solvent in the United States) are used is that they have low toxicity and are not flammable. Is it advisable to go back to the age when industry and dry cleaners used flammable solvents and fires were frequent? Eliminating a carcinogen may not always be a good idea. For example, EDB, the main fumigant in the United States before it was banned, was present in trivial amounts in our food: The average daily intake was about one-tenth of the possible carcinogenic hazard of the aflatoxin in the average peanut butter sandwich, a trivial risk in itself (see table).

Elimination of fumigation results in insect infestation and subsequent contamination of grain by carcinogen-producing molds. This might result in a regression in public health, not an advance, and would also greatly increase costs. The proposed alternatives could possibly be more hazardous than EDB, as well as more expensive. Similarly, modern pesticides replaced more hazardous substances such as lead arsenate, one of the major pesticides before the modern era. Lead and arsenic are both natural, highly toxic, and carcinogenic. Pesticides have increased crop yields and brought down the price of foods, a major public health advance.

Every living thing and every industry "pollutes" to some extent. How much does society wish to spend to get the last part per billion of TCE out of the wells in Silicon Valley, or to remove PCE from dry-cleaning plants? We are currently spending enormous amounts of money trying to eliminate lower and lower levels of pollution; one estimate is about \$80 billion annually (Ames and Gold 1987). The fact that scientists have developed methods to measure parts per billion of carcinogens and are developing methods to measure parts per trillion does not mean that significant pollution is increasing, or that the pollution found is a cause of human harm.

Spending all of one's effort on trivia without focusing on important problems is counterproductive. If we divert too much of our attention to traces of pollution and away from important public health concerns such as smoking, alcohol, unbalanced diets, acquired immunodeficiency syndrome, radioactive radon in our homes, and high-dose occupational exposure, we do not improve public health, and the important hazards are lost in the confusion. It is the inexorable progress of modern technology and scientific research that will continue to provide the knowledge resulting in steady progress to decrease cancer and birth defects and lengthen life span.

### Acknowledgements

The author thanks Lois Gold and David Freedman for helpful discussion and criticisms. This work was supported by Outstanding Investigator Grant CA-

39910 from the National Cancer Institute and by National Institute of Environmental Health Sciences Center Grant ES-01896.

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# Gaia: Ecologists Embrace the Earth Goddess

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by Rogelio A. Maduro

*James Lovelock's Gaia thesis, popular in scientific circles for its concept of the Earth as a living system, has become a quasi-religion for New Age environmentalists, including pagan worship of an Earth goddess and a hatred of the human species that "defiles" her.*

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**G**aia, the subject of two books and many articles by British ecologist James Lovelock, has done more than popularize the notion of the biosphere as a living being. It has become the pseudoscientific robe draped over the naked paganism that characterizes much of the environmentalist movement today. In this antihuman view, the Earth (or Gaia, the name of the ancient Greek Earth goddess) is sacred, while man is not. Thus, the Earth must be preserved, even at the expense of man.

Lovelock first propounded the Gaia thesis in the 1960s, basing it on work he did for the National Aeronautics and Space Administration on how to determine whether life exists on Mars. He found that one guide to the existence of life on Earth is the unique character of Earth's atmosphere, whose composition demonstrates the presence of life. Lovelock also studied the feedback mechanism that prescribes certain boundary conditions—for example, that between the carbon-dioxide/oxygen balance—which moderate the temperature of the planet.

This scientific aspect of his work is of interest, although it should be noted that much of it is drawn from the Russian scientist V.I. Vernadsky. However, the science is not the

basis for the current vogue of the Gaia hypothesis; nor, one suspects, was science Lovelock's actual agenda, even as early as the 1960s. As an active member of the environmentalist community, Lovelock fully subscribes to its axiomatic belief that the human population must be limited in order to protect the continued existence of the biosphere.

Lovelock's unique contribution to the environmentalist movement has been to reshape this essentially ugly Malthusian hypothesis into a more palatable form, imbuing the Earth with a living personality. In doing so, he has drawn out the primitive cosmology inherent in environmentalist propaganda. The core of this cosmology holds that the human soul is not sacred, nor is the Judeo-Christian God to be worshipped; rather, the Earth itself is personified as a goddess who dominates humankind. The Gaia movement is particularly dangerous because it opens up new segments of the population to the neopagan and outright Satanic belief systems that are threatening to overturn the traditional values of Western civilization (see box, p. 52).

For scientists like the Russian Vernadsky or the French Louis Pasteur, who also considered the question of the biosphere being composed of "living matter," the value of



extending human life and increasing the world's population was a given. Their concern was how to develop the knowledge and technology to accomplish this mission. Not so the modern-day ecologists, for whom man is an enemy of the biosphere.

The ecology movement, launched with the formation of the elitist Club of Rome in 1969, has as its purpose the deliberate limitation of world population growth. To that end it has fostered any lie or exaggeration that would help convince people that the obvious advantages of advanced technology are illusory, that there are limits to growth, and that the Earth has a finite carrying capacity. These Malthusians claim that technology must necessarily be destructive of what they called nature, and they deny that man has the ability to create new resources when apparent limits are reached.

#### The Birth of Gaia

From fairly unknown beginnings, Lovelock and his Gaia hypothesis began their road to fame at the 1975 Fogarty International Center conference on "The Atmosphere: Endangered and Endangering," where leading ecologists

gathered to discuss the problems of "overpopulation" and the atmosphere. Lovelock contends that the Earth is a living being that throughout the ages has influenced and controlled the chemical evolution of its environment to its own benefit. He and his coworker, microbiologist Lynn Margulis, look at the Earth as a biologist might look at a one-celled organism under a microscope, with clouds, rain, and rivers being the planet's circulatory system.

Lovelock provides a concise description of his Gaia hypothesis in a recent interview in *Orion Nature Quarterly* (West 1989). There, he describes his work at the Jet Propulsion Laboratory, designing instruments to analyze the soil of Mars and planning experiments to detect life on the planet. Working from Erwin Schrödinger's idea that what characterizes life is a reduction in entropy, Lovelock observed that if a planet's atmosphere is not in a state of chemical equilibrium, this would indicate the presence of life. What would Earth's atmosphere look like if one were a scientist on Mars? he asked. Its composition would show incompatible gases like oxygen and methane. Since these react in sunlight, calculations of the reaction rate could

*Continued on page 54*

# Mother Earth Marries Satan

by Carol White

*The growth of environmentalism over the past 20 years has spawned irrationality in our culture, to the point where Satanic practices are now promoted as "religion."*

Twenty years ago the United States was at a turning point typified by the concurrence of three major events: two rock music festivals (at Woodstock, N.Y., and Altamont, Calif.) and the world-historic first steps of man on the Moon. The Apollo program could have been the stepping-stone for an ambitious plan of space colonization. Indeed, 20 years ago, there were plans being discussed for a manned Mars landing no later than 1983. Instead, the opposite path was taken, and the Apollo program was phased out with nothing to take its place. Thus were created the conditions for the proliferation of irrationality and pure evil that afflict our culture today.

From a can-do nation, we have become a country in which people are afraid—for good reason—to have their children attend school, lest they become addicted to drugs, or worse yet, become the victims of the Satanical cults that are proliferating unchecked. How have we come to this?

The climate for Satanism has been created by the success of the environmentalist movement over the past 20 years. Environmentalism is the spawning ground for irrationality. A new ideology has sprung up that claims that all life is equal. This ideology holds that in the context of the biosphere, man is no more important than the lowliest pine beetle. Thus environmentalists deny the divine immortality of man's soul. What is this but Satanism?

At first the environmentalist movement simply opposed itself to science and technology, in the name of improving the quality of life for mankind—or at least some of mankind, since part of the environmentalist plan was to reduce the Earth's population. But now the environmentalists brashly contend that man himself is the enemy of the biosphere. What is this but Satanism?

The environmentalist movement operates by stimulating irrational fears in the population of imaginary dangers—radiation, pesticides, global warming. The best way to cope with actual pollution, particularly from incomplete combustion, is to develop new technologies based on advances in lasers, nuclear fission, and fusion. Yet, these are the technologies targeted by the greenies for extinction.

Stagnating technology cannot support a growing population. As a result, the arguments of the Malthusians that childbirth should be restricted and euthanasia practiced gain a certain credibility from those whose moral values have otherwise been eroded. Hedonist values replace the work ethic, and, not too surprisingly, children even in elementary school begin to experiment with promiscuity, drugs, and even the most evil cult practices.

It is not the values of the Apollo program that have become hegemonic over the past 20 years, but instead those of the two rock music festivals. This paradigm shift in values has not been happenstance. The attack on our Judeo-Christian civilization is not merely the outgrowth of a cultural pessimism that has seeped into the pores of our society. The environmentalists are explicitly calling for an end to the Jewish and Christian religions and a return to the pagan blood-sacrifice cults celebrated in the Roman empire. These are the same cults that demanded and were given the blood sacrifice of the Christian and Jewish martyrs.

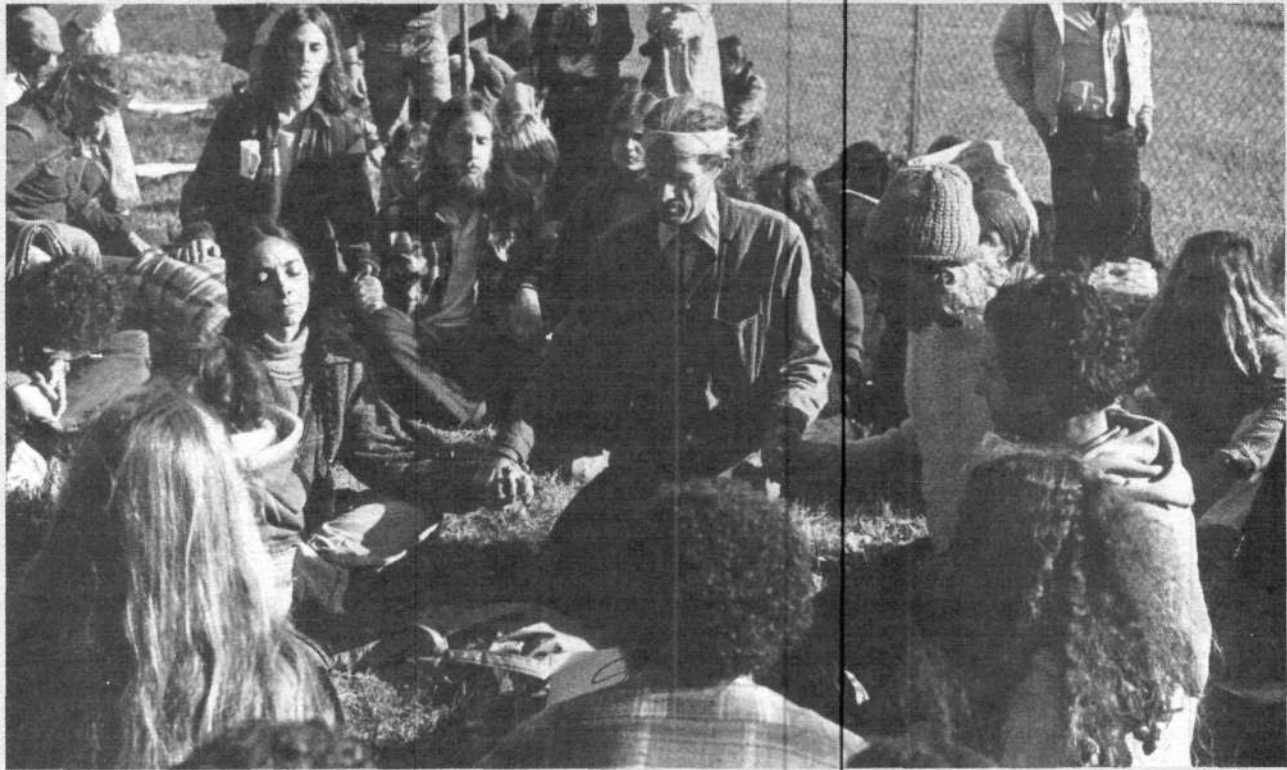
## Gaia, Satan, and Death

James Lovelock and his Gaia hypothesis have given these environmentalists a new religion and a new god—Gaia, the Earth goddess. As he writes in *The Ages of Gaia*:

How did we reach our present secular humanist world? In times that are ancient by human measure, as far back as the earliest artifacts can be found, it seems that the Earth was worshipped as a goddess and believed to be alive. The myth of the great Mother is part of most early religions. The Mother is a compassionate, feminine figure, spring of all life, of fecundity, of gentleness. She is also the stern and unforgiving bringer of death. As Aldous Huxley reminds in *The Human Experience*: "In Hinduism, Kali is at once the infinitely kind and loving mother and the terrifying Goddess of destruction, who has a necklace of skulls and drinks the blood of human beings from a skull. This picture is profoundly realistic; if you give life, you must necessarily give death, because life always ends in death and must be renewed through death."

Satanism is a cult of death, the death of the body and the death of the spirit. Satanic and witchcraft cults are death cults—and in many instances, murder cults as well. A culture that espouses the Malthusian lie that there is an absolute limit to the number of people who can be supported, must and will spawn such death cults as the most extreme expression of the society's degradation. A society that prioritizes the limitation of population growth must always deny the sacredness of life. A society that denies the promise of science and technology must be Malthusian.

Children today—and adults—are being dragged into ritual practices that include the sacrifices of animals and



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*Getting in touch with their irrationality: Antinuclear demonstrators at the site of the Seabrook nuclear plant in New Hampshire, October 1979.*

sometimes even of humans. There are also a growing number of child suicides. The most sensational cases are those children who have hanged themselves, because they believed either that they would be reincarnated to live a better life, or that they were fulfilling the terms of a pact with the devil, whom they expected to continue to serve after death.

As we probe these child suicides we find in many cases that these children have had even more sinister reasons for doing away with themselves; that they had been living under threat of death by torture if they were to try to break away from Satanic cults with which they had become involved. In some cases, the children were threatened with death if they did not murder members of their own families under orders from Satan—delivered by the priests of the cult.

Many times people are introduced into cult activity before they understand what it is that they are really involved in. In some instances they are befriended by cult members who only gradually reveal their Satanic beliefs. In other instances, children, young adults, or others are first recruited to so-called White Witchcraft groups. These Satanic front groups now have their rights vigorously defended by federal agencies.

The Wicca cults describe themselves as neopagans, as does the Temple of Set. The Temple of Set is run by its high priest, a U.S. Army colonel who has been accused of being a practicing pederast as well, but whose religious

rights are protected. The United Nations-sponsored group WICCE includes lesbians and other radical feminists who call themselves witches. WICCE members assert that witchcraft was a respectable, semiprofessional medical calling for women in the Middle Ages and was maligned by the Catholic church. WICCE supports herbal medicine, midwifery, and the ecology movement.

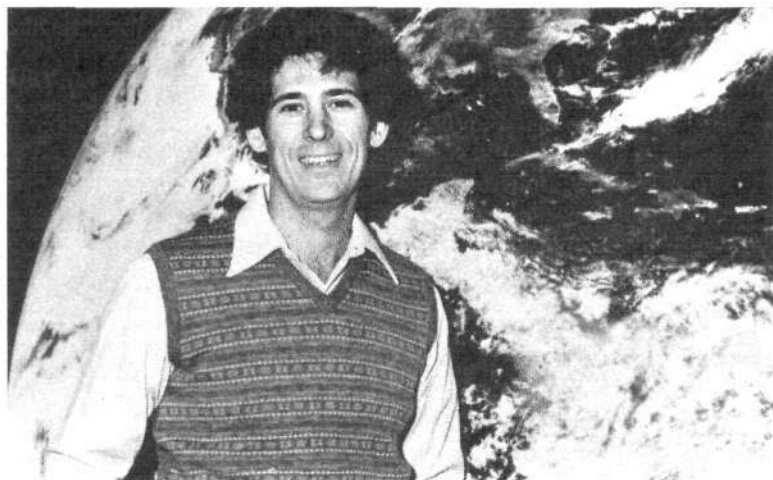
Groups like WICCE practice ritual magic, but they pretend that they are against Satan. They say that they are simply practicing the old, venerable pagan religions like Druidism, which existed before Christianity—and contemporaneously with Judaism. WICCE claims that Satan does not exist in their pantheon of gods. Of course, they lie on both counts. The old pagan religions were Satanic; both the Old and the New Testament spell this out graphically. That is why the avowedly Satanic Temple of Set worships the Egyptian God Set and why Satanists wear goats' heads to symbolize Pan.

The Gaia cult is typical of what is called the new or neopagan religions. The neopagan cults are truly Satanical because their leaders knowingly support policies that deny the sacredness of human life and intend to depopulate the world. The existence of these cults and the Malthusian policies they advocate create the environment in which it seems reasonable to protect—not prosecute—the hard-core Satanists.

*Carol White, editor-in-chief of 21st Century, is currently working on a book on the modern roots of Satanism.*



Illustration by Jane Meredith, 1988 Yearbook of Science and the Future, p. 35.



National Center for Atmospheric Research

"Greenhouse Effect" advocate Stephen H. Schneider: "To some the idea of planetary-scale homeostasis, the principal intellectual thrust behind the Gaia hypothesis, is more like religion than science. As religion Gaia can be deep, beautiful, and fascinating" (1988 Yearbook of Science and the Future, p. 43).

Continued from page 51

even give estimates of how much methane and oxygen were being produced by "some process at the Earth's surface—namely life—that is exerting a control." This scientific aspect of Lovelock's work is certainly useful; it builds upon the work of Louis Pasteur, Pierre Curie, A.V. Gurvitsch, and, especially V.I. Vernadsky, who coined the term biosphere for the concept of the Earth as a living system.

Vernadsky, in his 1944 paper "Problems of Biogeochemistry, II," states: "The processes in living matter of the biosphere increase its free energy (that is, diminish its entropy), expressing thereby the basic importance of living matter in the structure of the biosphere and consequently in that of the planet also." In "The Biosphere and the Noosphere" (1945) Vernadsky makes a systematic comparison between the properties of living and inert matter. "Isotopic ratios may be markedly changed by the processes in living matter," he states, while "isotopic ratios do not change markedly in inert natural bodies of the biosphere."

In inert bodies, such as planets without life, Vernadsky says, "The chemical composition . . . may correspond to nearly pure chemical compounds with precise stoichiometric [pertaining to atomic weights] relations between the elements." Lovelock asks what would determine this situation, and then introduces the Earth goddess at the command center. As he put it in his *Orion* interview, "there must be something regulating" the oxygen levels on Earth over the course of millions of years. That "something," he says, is Gaia, the Earth goddess. He then explains:

One thing one notices . . . in Ireland is the shrines to the Virgin Mary. These shrines are wonderfully tended. They're brightly painted and there are flowers always freshly gathered around them. In contrast, the churches are rather dull ugly places. Maybe these people are not thinking just of the Christian Virgin Mary, but of an older virgin, Gaia, the old Earth Mother.

After all it fits awfully well when you think of it. Gaia is to all intents and purposes immortal. She has lived

three and a half thousand million years, which is longer than quite a few stars have lived, and looks like going on for another stellar magnitude age. She is the source of life everlasting. She is certainly a virgin; there is no need to reproduce if you are immortal. She certainly is the mother of all of us in a sense, even Jesus. The whole thing fits as far as Christians go exceedingly well. . . .

And what of mankind's role? In his most recent book, *The Ages of Gaia*, Lovelock subsumes man under Gaia's domination (p. 212):

Gaia, as I see her, is no doting mother tolerant of misdemeanors, nor is she some fragile and delicate damsel in danger from brutal mankind. She is stern and tough, always keeping the world warm and comfortable for those who obey the rules, but ruthless in her destruction of those who transgress. Her unconscious goal is a planet fit for life. If humans stand in the way of this, we shall be eliminated with as little pity as would be shown by the micro-brain of an intercontinental ballistic nuclear missile in full flight to its target.

Lovelock, who calls himself "a positive agnostic," then adds (p. 236):

Gaia is not purposefully antihuman, but so long as we continue to change the global environment against her preferences, we encourage our replacement with a more environmentally seemly species. It all depends on you and me. If we see the world as a living organism of which we are a part—not the owner, nor the tenant; not even a passenger—we could have a long time ahead of us and our species might survive for its "allotted span." It is up to us to act personally in a way that is constructive. The present frenzy of agriculture and forestry is a global ecocide. . . .

Here, explicitly, is the cult religion of Gaia, replacing traditional Judeo-Christian values. Gaia says it is necessary to save Mother Earth even at the expense of individual human life. Thus, stopping the alleged "Greenhouse Effect" or "ozone depletion" becomes more important than saving hundreds of millions of human lives. Contrast Lovelock's Gaia and her "preferences" to one of the basic tenets of Judaism and Christianity, as spelled out in the Book of Genesis (Chapter 1, Verses 27-28):

So God created man in his *own* image. . . . And God blessed them, and God said unto them, Be fruitful, and multiply, and replenish the earth, and subdue it: and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth.

As one might expect, Lovelock took only those parts of Vernadsky's work that demonstrate the negentropic aspects of the biosphere. He purposely left out Vernadsky's insistence that the evolution of living matter proceeds in a definite direction, and that man is the most advanced product of creation. Vernadsky writes in "The Biosphere and the Noosphere" (p. 8):

For the first time in the history of mankind the interests of the masses on the one hand, and the free thought of individuals on the other, determine the course of life of mankind and provide standards for man's ideas of justice. Mankind taken as a whole is becoming a mighty geological force. There arises the problem of the *reconstruction of the biosphere in the interests of freely thinking humanity as a single totality*. This new state of the biosphere, which we approach without our noticing it, is the *noosphere*. . . .

The noosphere is a new geological phenomenon on our planet. In it for the first time man becomes a *large-scale geological force*. He can and must rebuild the province of his life by his work and thought, rebuild it radically in comparison with the past. Wider and wider creative possibilities open before him. It may be that the generation of our grandchildren will approach their blossoming. . . .

The important fact is that our democratic ideals are in tune with the elemental geological processes, with the laws of nature, and with the noosphere. Therefore we may face the future with confidence. It is in our hands. We will not let it go.

In other words, in order to carry out the actual laws of nature, man must increase the free energy of the biosphere. If man does not do that, then we will suffer a biological holocaust caused by the biosphere's entropic collapse. How do we increase free energy? Simply by ensuring the continued development and application of more advanced technologies that increase the energy density per unit area. The course of human progress demonstrates how this has occurred. Primitive societies, for example, burned wood for fuel. As technology advanced and wood became scarce, new energy sources were developed—fossil fuels, nuclear,



Anthony Howarth/Science Photo Library

*Lovelock on the birth of Gaia: "When life first began it would have occupied an otherwise dead planet, a mere ball of rock evolving by the laws of physics and chemistry. But soon there came a moment like that of conception when the sperm fuses with the egg. At that moment the evolution of the organisms and the evolution of the physical and chemical environment became a single process. And Gaia was born" (Orion Nature Quarterly, Winter 1989, p. 62).*

and next fusion, each orders of magnitude more energy dense. Thus the Gaia enthusiasts who promote "appropriate technologies" and "sustainable development"—which translates into wood burning and deforestation in the Third World—are actually causing the very ecocide they decry by insisting on less energy-dense fuels.

### The Popularization of Gaia

Many readers at this point might dismiss Gaia as nonsense. However, the Gaia hypothesis, now developed in two popular books by Lovelock, has taken such hold in the scientific community that the American Geophysical Union, one of the world's leading scientific associations, sponsored a four-day conference on Gaia in San Diego in 1988. The March 7-11 conference featured an impressive list of scientists who presented the pros and cons of the Gaia hypothesis from diverse perspectives.

Another indication of its fame is a 15-page glossy paean by the *Encyclopedia Britannica*, titled "Gaia: A Goddess of the Earth?" in its 1988 *Yearbook of Science and the Future*. Its author, Stephen Schneider, is a leading publicist for the "Greenhouse Effect." Schneider, who also spoke at the 1975 Fogarty International Center conference, has taken over editorial control of many scientific journals relating to climate, from his position at the National Center for Atmospheric Research in Colorado.

Gaia has even been the subject of several television specials, such as Public Broadcasting's NOVA series, which popularized it as "Goddess of the Earth." And Anchor Press/Doubleday has published a glitzy 272-page atlas, titled *Gaia*:

*An Atlas of Planetary Management*, which has become a bible for ecologists and is being used in schools and universities. The foreword announces that the atlas "show[s] how we are plundering our planet in the most profligate and dangerous way. . . . [A]ll the ills that beset us . . . can be traced back inexorably to three root causes: overpopulation, political stupidity, and wasteful misuse of the planet's treasures, both finite resources, and renewable living wealth."

The reason that responsible scientists would debate such a hypothesis rests in the fundamental fact that the Earth's biosphere is indeed composed of "living matter" and that this living matter demonstrates the qualities of self-organization found only in life: Specifically, living matter violates entropy, the Second law of Thermodynamics, and constantly organizes its energy throughput into higher levels of energy, a process known as negative entropy or negentropy. As this idea is being debated in scientific forums, however, Gaia enters through the back door.

#### Who Is Behind Lovelock?

Lovelock likes to describe himself as a quiet scientist who works in the isolation of his Devonshire, England, country home, in touch with Gaia. However, he is part of an organized fellowship, the Lindisfarne Association, that actively organizes for and promotes its Gaia ideology. As Lovelock describes it in his *Orion* interview: "There is a community of thinkers called the Lindisfarne organization affiliated with St. John the Divine in New York. Both Lynn Margulis and I belong, but also a number of other people who are not scientists. . . . They include priests, economists, and environmentalists—a kind of community of scholars one might call it—and they are embracing the idea and using it as part of their philosophy."

In the basement of the Episcopal Cathedral of St. John the Divine on West 110th Street in New York City is the Gaia Institute, as well as the Temple of Understanding and other cult and Satanic operations. The Gaia Institute, according to Priscilla Peterson, the director of the Temple of Understanding, aims to create "mother goddess" cults throughout the West. As Peterson put it, the Gaia Institute is involved heavily "in the ecological battle of preserving the Earth . . . a movement to create a new religion. . . . There is certainly no question that great goddesses or God in a feminine form has been worshipped by a lot of societies not just in Antiquity, but more recently."

To understand Gaia, Peterson suggests reading a book, *The Mist of Avalon*, which "talks about the fact that the pre-Christian religion of Britain was a goddess religion, in other words, the Druids. The author refers to the Spiral Dance by Starhawk of Wicca." Peterson warns that "one of the premises of some branches of Goddess religion is witchcraft, and that has been given a bad image or has been demonized because that was the pre-Christian religion of Europe. . . . A lot of people say that the Western religious tradition, the dominant one, is partly responsible for contempt of nature, which causes our ecological crisis."

In contrast, Peterson says, the Earth Goddess "is a religion that values nature as well as valuing women. Wicca [a group of people who consider themselves witches] is

one branch of this. As far as high priestesses, it is an art, it is a form of knowledge."

#### Gaia: 'A Way of Knowing'

The philosophy behind Gaia is put forward in *Gaia, a Way of Knowing*, published in 1987 by the Lindisfarne Press. The book is a compilation chiefly of papers presented by James Lovelock and other Lindisfarne Fellows at their 1981 conference at the San Francisco Zen Center. Gaia's purpose, the book says, is "to create a new ecology of consciousness, the basis for a new political and economic order which, because it arises out of the study of life, is life-enhancing

### MARGARET MEAD'S 1975 CONFERENCE:

## 'Mother Nature' Vs. Hungry People

The panic about the alleged Greenhouse Effect and dwindling ozone layer did not start during 1988's sizzling summer, nor in 1985, when the periodic thinning of Antarctica's ozone layer (the so-called ozone hole) was rediscovered. Both scare stories were developed 15 years ago at a 1975 conference organized by New Age anthropologist Margaret Mead, under the sponsorship of the Fogarty International Center and the National Institute of Environmental Health Sciences. Participating were the major science personalities today promoting hysteria around the Greenhouse Effect, including Stephen Schneider, William Kellogg, and George Woodwell. Also present was British biologist James Lovelock. Quite appropriately, it was here that he launched his Gaia thesis.

The proceedings of that 1975 conference, *The Atmosphere, Endangered and Endangering*, spell out the purpose behind today's calls to shut down modern industries. "The unparalleled increase in human population and its demands for food, energy, and resources is clearly the most important destabilizing influence in the biosphere," Mead stated bluntly during one conference discussion. As the proceedings summarized the first session (p. 73):

The session was concluded with the thought that we as a species are trying to maintain ourselves at the expense of other species; there seems to be a conflict between preserving nature and feeding the rapidly increasing population. Is our major objective really to feed the population, or do we realize we cannot continue to feed the world at any price? Where do we strike a balance between preserving nature and feeding the world?

In her keynote address, Mead proposed brutal steps to save Mother Earth from a hungry population—the very



and life-embracing." In addition to Lovelock and Lynn Margulis, the other contributors are all familiar names of the New Age movement today. The conference and the book were both orchestrated by William Irwin Thompson, who cofounded Lindisfarne along with Gregory Bateson (the British Intelligence operative of MK-Ultra whose special project was to introduce psychotropic drugs to the flower children of the 1960s), and Bateson's former wife, anthropologist Margaret Mead (see box). Bateson's contribution to the book is a transcript of a tape Bateson made in 1980, shortly before his death, giving his last instructions to the Lindisfarne Association.

Thompson concludes his introduction to the book: "As we move into the period of crisis for the modern world system of industrial nation-states, a period not simply of wars of resources, but also of ecological planetary damage from unbalanced industrialization, we will need to come together to envision a new world . . . [to] move from economics to ecology as the governing science of our era of stewardship."

In her chapter, New Age guru Hazel Henderson says that the "shift toward less resource-intensive, sustainable forms of production, consumption and investment . . . [is] a shift toward a dawning Solar Age, an Age of Light, where humans

same steps that are now being implemented or discussed for implementation (p. xix):

We are facing a period when society must make decisions on a planetary scale. . . . Unless the peoples of the world can begin to understand the immense and long-term consequences of what appear to be small immediate choices—to drill a well, open a road, build a large airplane, make a nuclear test, install a liquid fast breeder reactor, release chemicals which diffuse throughout the atmosphere, or discharge waste in concentrated amounts into the sea—the whole planet may become endangered. . . .

What we need from scientists are estimates, presented with sufficient conservatism and plausibility . . . that will allow us to start building a system of artificial but effective warnings, warnings which will parallel the instincts of animals who flee before the hurricane. . . .

Only by making clear how physically interdependent are the people of all nations can we relate measures taken by one nation to measures taken by another in a way that will draw on the necessary capacities for sacrifice . . . of which human beings—as a group—have proven capable. . . . It is therefore the statement of major possibilities of danger which may overtake humankind. . . on which it is important to concentrate attention.

To implement a global environmental dictatorship to carry this out, Mead proposed a "Law of the Atmosphere" that would regulate all relations among states. Today, dozens of international meetings are taking place on the "Greenhouse Effect," "ozone depletion," and sundry other hoaxes, all leading to a United Nations-run 1992 global conference in Switzerland with the aim of establishing a "Law of the Atmosphere." Not unrelated is the call by Soviet leader Gorbachov, delivered at the United Nations Dec. 7, 1988, for an "ecological security council" to defend the environment against the actions of nations.

What about solving environmental problems by developing advanced technologies? Mead denounced "prophets of paradisiacal impossibilities, guaranteed utopias of technological bliss, or benign interventions on behalf of

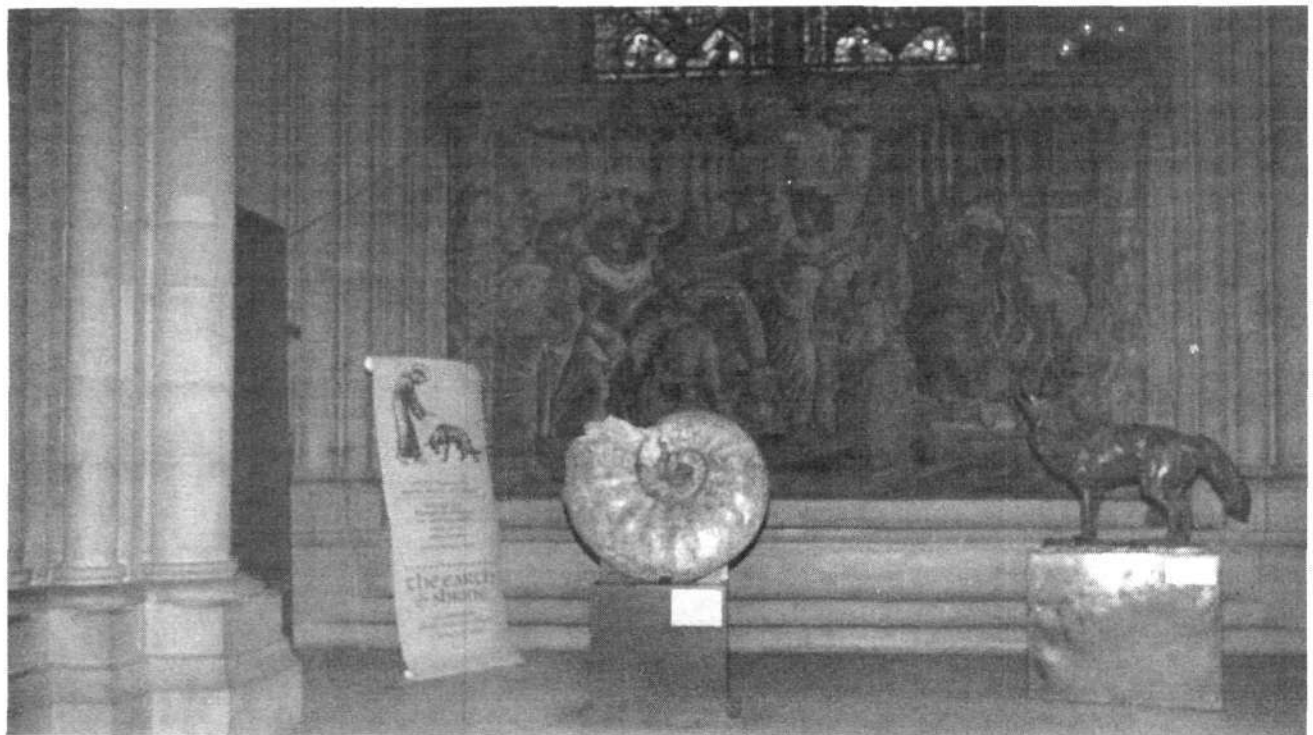


Jack Manning/NYT Pictures

*Making lies 'credible': Dame Margaret Mead, age 75, photographed in the Pacific Hall at the Museum of Natural History in New York City. She is standing with her cane in front of a reproduction of an Easter Island stone figure.*

mankind that are none the less irrational just because they are couched as 'rational.' " Such prophets, she said, "express a kind of faith in the built-in human instinct for survival, or a faith in some magical technological panacea."

Bringing people around to this point of view, Mead said, will happen "only if natural scientists can develop ways of making their statements on the present state of danger credible to each other." Then and only then, she said, "can we hope to make them credible (and understandable) to social scientists, politicians, and the citizenry."



Matt Moriarty

An August 1989 exhibit on Gaia in the Cathedral of St. John the Divine in New York City. The cathedral basement provides a home for the "Temple of Understanding" and other neopagan activities.

remembered that all processes on Planet Earth are dependent on the daily flow of photons, the life-giving light from the Sun, our mother Star." In plain words, the New Age is the Age of Lucifer, or the reign of Lucifer, the "angel of light."

The Gaia "way of knowing" has an international network with one of its coordinating centers in Scotland at the Findhorn Foundation, described by some as the "Vatican City" of the New Age movement. Certain of Findhorn's trustees, such as Ed Posey of London, are also codirectors of Britain's Gaia Foundation. The Gaia Foundation houses organizations called Forest People's Support Group and the Education of the Awakening Earth. It sponsored top Brazilian ecologist José Lutzenberger on a Gaia organizing tour of Britain in autumn 1988. Lutzenberger, who heads the Gaia Foundation in Brazil, was one of the recipients of the Right Livelihood Award, presented by the Gaia Foundation and its collaborators to individuals for their "vision and work contributing to making life more whole, healing our planet, and uplifting humanity." Recipients are chosen by an international jury panel, all of whom also serve as directors of the Right Livelihood Foundation. These jurors have included: Rodrigo Carazo, former president of Costa Rica, founder and president of the U.N. Peace University; Monika Griefahn, from Greenpeace; and Robert Muller, former Assistant Secretary-General of the United Nations and an important international collaborator of the Lucis Trust, an elite neo-Satanic organization that operates the Temple of Understanding and funds many environmentalist groups. Recipients of the Right Livelihood Award in the 1980-1986 period included Petra Kelly, cofounder of the West German Green Party.

The Gaia philosophy means death. The world faces one of the gravest crises in human history. Food reserves are at their lowest in decades as millions of human beings face hunger and death from starvation; the AIDS epidemic is raging out of control through the most malnourished popu-

lations with the potential to spread through the rest of the world killing everyone in its wake. At the same time, the environmentalist solutions are shutting down the technologies that could provide the "free energy" to ensure a way out. Either we return to a commitment to modern industrial civilization and scientific and technological progress, or the human race will be destroyed.

The next time Stephen Schneider—who boasts of his leadership of the fight to stop the "Greenhouse Effect"—steps onto the podium to demand police-state measures to stop the industrial emissions of carbon dioxide, ask him if human sacrifices to the "Earth Goddess" are part of his religious beliefs. After all, he's on record preaching that "as religion, Gaia can be deep, beautiful, and fascinating."

Rogelio Maduro, trained as a geologist, writes on issues of science and environment.

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# A Laser Experimenter's Diary

by David Cherry



Brian Pepin

Lasers are increasingly used in science fair projects, since at least some are not too expensive. It is a rare project that includes a home-made laser, however, and for very good reasons: They are difficult to make, difficult to get to work, and require very high voltages. If you look into a laser beam, you may lose your sight. A laser construction project, therefore, is not a safe project for learning electronics from scratch.

Brian Pepin of Elko, Nevada, however, already knew a good deal about electronics, having completed a four-year electronics program in high school that included subjects such as D.C. electronics, robotics, and lasers.

He thought up the idea of constructing a projecting microscope using laser light during a biology class. It would have the advantage of being much cheaper than the school projection microscope, which used expensive optics. Also, the laser microscope would have much greater *depth of field*—that is, objects would be in focus over a greater range of distance from the objective lens. His design is shown in Figure 1.

Pepin set out to construct an argon laser, both the gas excitation tube and the power supply, and to mount a fixed lens as well as a second, movable lens on a sliding track. He also wanted to build for the movable lens a control circuit for the stepper motor, a corresponding power supply, and a numerical display to show magnification.

For each phase of the project, Pepin kept a diary of his problems and progress. This article is largely limited to his laser-building phase.

## The Gas Excitation Tube

Pepin was acquainted with the theory and anatomy of several kinds of lasers, and also drew upon the practical advice of his electronics teacher. He began with a glass tube 2 inches in diameter. He polished the ends with a

*Continued on page 63*

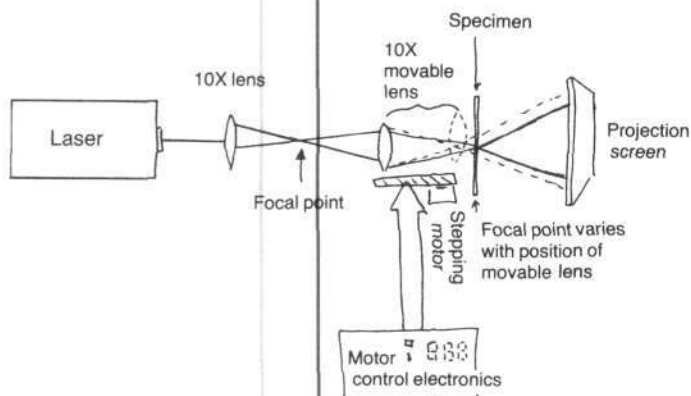


Figure 1

## THE PROJECTING LASER MICROSCOPE

*As movable lens travels toward the specimen, magnification increases and focal length becomes shorter. The size of the projected image area remains constant because of the fixed lens. The microscope was designed and constructed by Brian Pepin of Elko, Nevada. Both illustrations were drawn by Pepin.*

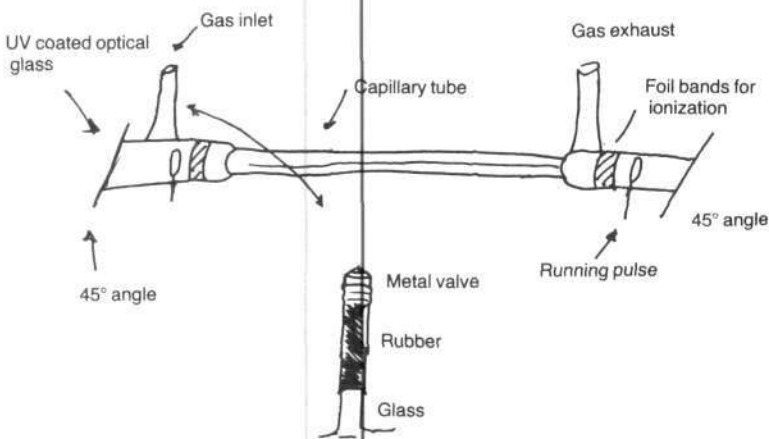
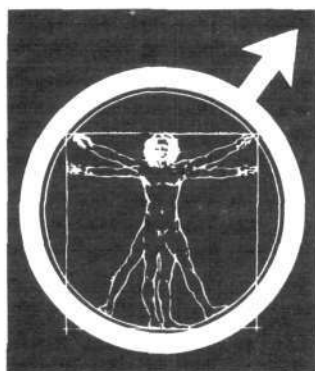


Figure 2

## THE ARGON LASER TUBE

*This is Pepin's design for his second and third laser tubes. Construction of a gas laser is not for beginners. Pepin did his laser work at the end of a four-year high school course in electronics that included the study of lasers.*

## THE CASE FOR MARS



AN AMERICAN ASTRONAUTICAL SOCIETY PUBLICATION

**The Case for Mars III**, This three-part set, based on a conference held July 18-22, 1987, Boulder, Colorado, will be published late 1988. Prepublication price for Part I (general) is \$20 (soft cover), Parts II & III (technical) \$60 (soft cover, both parts). No discount on these. Write for more information.

**The Case for Mars II**, Ed., Christopher P. McKay, 1985, Second Printing 1988, 730p, Hard Cover \$60; Soft Cover \$40 (\$4 postage & handling)

This book provides a blueprint for manned missions to Mars and a continued presence on the planet's surface, including what technology is required, and what kinds of precursor missions and experiments are required for this undertaking. The material is based on a conference held July 10-14, 1984, Boulder, Colorado.

**The Case for Mars I**, Ed., Penelope J. Boston, 1984, Second Printing 1987, 348p, Hard Cover \$45, Soft Cover \$25 included in this volume are mission strategy, spacecraft design, life support, surface activities and materials processing, social and political aspects.

Also numerous books on space published for the American Astronautical Society or distributed for other publishers are available from Univelt Inc. Write for a free catalog.

Among available books are:

**Space and Society - Challenges and Choices**, Volume 59, Science and Technology Series, Eds., Paul Anaejinou, Nathan C. Goldman, Philip J. Meeks, 1984, 442p, Hard Cover \$55; Soft Cover \$35.

Subjects included are American government and space, political economics and space, foreign space programs, space applications, and the future. Index.

**The Human Quest in Space**, Volume 65, Science and Technology Series, Eds. Gerald L. Burdett, Gerald A. Soffen, 1987, 312p, Hard Cover \$55; Soft Cover \$45.

As the title suggests, the human role in the space program is stressed. Emphasis is placed on medical problems in long-duration space flight and the development of closed ecological systems including the pioneer work being conducted on *Biosphere II* in Arizona.

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## BOOKS

# The Timely Nature of Cycloids

**The Pendulum Clock, or Geometrical Demonstrations Concerning the Motion of Pendula As Applied to Clocks**  
Christiaan Huygens  
Translated by Richard J. Blackwell  
Ames: Iowa State University Press, 1986  
Hardcover, 182 pages, \$38.95

I hope that this wonderful book again becomes a best-seller among all educated men and women as it was three centuries ago, because it is a masterful introduction to some of the most stimulating discoveries of modern science. This is the first English translation of one of the greatest works in the history of science, Christiaan Huygens's classic in geometrical physics, first published in Paris in 1673.

Huygens's geometrical approach to physics, especially his emphasis upon the unique features of geometries of negative curvature—cycloidal action and the isochronic property of space-time—had a profound effect on his younger collaborator, Gottfried Leibniz, among others. Huygens's geometric approach to physics was completely opposite to the algebraic approach of Newton and Descartes.

In his early 18th century writings on the history and origin of the differential calculus, Leibniz identifies Huygens's classic and the writings of Blaise Pascal on the cycloid as the two crucial springboards for his own discoveries.

The richness of Huygens's work is based on his elaboration of the geometrical method behind his pendulum clock: the geometrical nature of cycloidal motion, the evolutes of curves, and the centers of oscillation. This elaboration gives the reader a basic grounding in the method behind the the greatest scientific breakthroughs of the last few centuries.

The cycloid came to be the curve associated with the method of geometric physics used by Huygens, Leibniz and the Bernoulli brothers, as opposed to the nongeometric or algebraic approach of the physics of Newton and Descartes. In fact, Bernoulli and Leibniz humiliated the Newtonians and

CHRISTIAAN HUYGENS'

*The Pendulum Clock  
OR  
Geometrical Demonstration  
Concerning the Motion  
of Pendula  
as Applied to Clocks*



TRANSLATED WITH NOTES BY  
RICHARD J. BLACKWELL

INTRODUCTION BY  
H. J. M. BOS

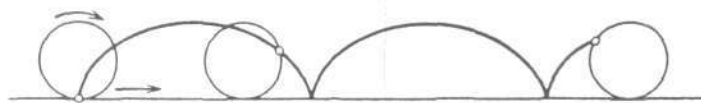
Cartesians for their failure, after repeated published challenges, to solve the "brachystochrone" problem: What is the curve along which a body requires the *least time* to reach the bottom? This curve is a cycloid!

### The Clock Technology

Part I of Huygens's work describes the technology of his famous clock, which is regulated by means of an ingenious pendulum and escapement mechanism. Although Huygens was not the first to use the pendulum to count off equal time intervals and measure time, his design was the first to connect (through handle and fork) a freely suspended pendulum with a clockwork driven by weight or spring that gave regularity to the motion.

The falling of heavy bodies and their motion on a cycloid is the subject of Part II; Part III deals with the evolution and dimension of curved lines; Part IV takes up the center of rotation or of motion; and Part V displays another construction of the clock in which the motion of the pendulum is circular and also announces theorems on centrifugal force.

Huygens's first clock was invented in 1657; the next year his invention was described in published form and he received patents as church clocks at Utrecht and Scheveningen received pendulums. Based on Huygens's design, that year the Utrecht clockmaker Coster guaranteed church officials that the clock would not deviate more than 8 minutes in a week.



(a)



(b)

### CONSTRUCTING A CYCLOID

As the circle rolls, the point on its circumference will trace the curve called a cycloid (a). It is also the curve along which a body will roll to the bottom in the least time (b). Try it!

#### The Unique Nature of the Cycloid

The pendulum provides *isochronic* movement; namely, oscillations such that each back and forth swing always takes the same amount of time, independent of the driving force of the clock. In other words, the pendulum's movement is said to be *isochronic*, when its period does not depend on the amplitude to which it swings out.

Huygens's brilliant design was based upon the unique geometric nature of the *cycloid*, the curve traced by a point on the outside of a circle or wheel as it rolls along a line (see figure). The cycloid consists of a broad central arc that arches to a cusp on either side.

Huygens fixed curved metal leaves at both sides of the suspension point of the pendulum, so that when it swings out, the thread winds up against the metal leaves, thus lifting the pendulum's bob above its normal circular path. The outer parts of the new path are steeper than the circular path.

The bob follows the path of a cycloid, the curve that Pascal demonstrated as the path of isochronic oscillation.

In order to get the bob to follow the cycloid curve, Huygens simply shaped the two bent metal leaves to come together into the cusp of a cycloid as well! This became the basis for Huygens (and later Leibniz) to pursue a general study of pairs of curves. The bent metal leaves define the "unwound" curve or *evolute*, while the bob's path is the "curve described by evolution" or the *evolvent* (also known as the involute).

by Huygens later gave birth to Leibniz's theory of envelopes and his *analysis situs*, or geometry of situation. In the 19th century, Gauss and later Riemann based their breakthroughs in mapping the complex nature of space-time upon the foundations laid by Huygens and, especially, Leibniz. Therefore, today's reader can have no better grounding in the most advanced discoveries of geometrical physics than this new translation of

Huygens found that two curves are in the relation of evolute to evolvent if and only if the tangents to one curve intersect the other curve perpendicularly.

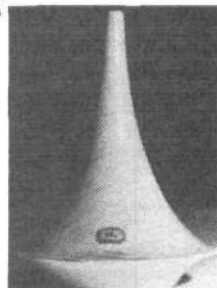
Huygens generates an entire geometry in Part III as he explores the evolutes of the parabola, ellipse, hyperbola, spheroid, conoid, and other curves. These wonderful discoveries Huygens's *Pendulum Clock*.

—Warren J. Hamerman

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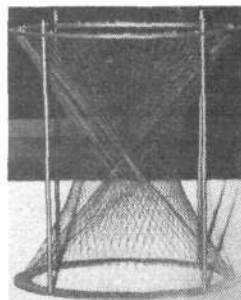
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# The 14th Element and Its Story



**Silicon and Silicones: About Stone-age Tools, Antique Pottery, Modern Ceramics, Computers, Space Materials and How They All Got That Way**  
Eugene G. Rochow  
New York: Springer-Verlag, 1987  
Paperback, 182 pages, \$16.95

This is a delightful book, written by a man who has not lost his curiosity to know how things work, nor his desire to explain it to others.

Author Eugene Rochow, emeritus professor of chemistry, is not your stereotypical image of a dry Harvard professor. He invented the modern synthesis of silicones in his laboratory on May 10, 1940, and has written this exposition for laymen that tells them the chemistry of everything from coated razor blades, to a replacement for PCB, to a silicone wood varnish that Rochow painted on the exterior of his house, which has weathered 30 New England winters.

Silicon, the 14th element in the periodic table, is the second most abundant substance found on Earth, making up 25.7 percent of the atoms in the Earth's crust. Since it falls right below carbon in the column of the periodic table known as Group IV, silicon

shares many properties with the life substance (carbon is found in every living thing), in particular its simple and beautiful method of tetrahedral bonding in which the carbon (or silicon) atom sits at the center of an imaginary tetrahedron where vertices are occupied by four other atoms or ions.

Silicon and oxygen form  $\text{SiO}_2$ , which is known in 22 pure forms, from quartz to silica glass, and tremendous numbers of metal silicates, some of which are found in every piece of dirt or sand anywhere in the world.

In 1851, Friedrich Wöhler had the idea of substituting silicon for carbon in compounds and wondered even about the possibility of living creatures based on silicon instead of carbon. Although the "silicon man" has yet to be discovered, a great deal else about this substance has been, as Rochow's book delightfully reports.

—Laurence M. Hecht

## BOOKS RECEIVED

**Space Shuttle—The Quest Continues**, by George Torres. Novato, Calif.: Presidio Press, 1989. Paperback, 134 pages, \$12.95.

**The Soviet Manned Space Program**, by Phillip Clark. New York: Orion Books, 1988. Hardcover, 192 pages, \$24.95.

**Kepler's Geometrical Cosmology**, by J.V. Field. Chicago: University of Chicago Press, 1988. Hardcover, 241 pages, \$37.50.

**Practical Astronomy With Your Calculator**, by Peter Duffett-Smith. Third edition, revised and enlarged. New York: Cambridge University Press, 1989. Hardcover, 185 pages, \$49.50.

**The Supernova Story**, by Laurence A. Marschall. New York: Plenum Press, 1988. Hardcover, 296 pages, \$22.95.

**The Starry Room—Naked Eye Astronomy in the Intimate Universe**, by Fred Schaaf. New York: John Wiley & Sons, 1988. Hardcover, 264 pages, \$19.95.

**Interstellar Matters—Essays on Curiosity and Astronomical Discovery**, by Gerrit L. Verschuur. New York: Springer-Verlag, 1989. Hardcover, 320 pages, \$29.95.

**Mercury**, edited by Faith Vilas, Clark R. Chapman, Mildred Shapley Matthews. Tucson: Univ. of Arizona Press, 1988. Hardcover, 794 pages, \$45.

**Meteorites and the Early Solar System**, edited by John F. Kerridge and Mildred

Shapley Matthews, with 69 authors. Tucson: University of Arizona Press, 1988. Hardcover, 1269 pages, \$55.

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**The Provident Sea**, by D.H. Cushing. New York: Cambridge University Press, 1988. Hardcover, 329 pages, \$65.00.

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New York: Facts on File Publications, 1988. Hardcover, 256 pages, \$29.95.

**Nuts and Bolts of the Past—A History of American Technology, 1776-1860**, by David Freeman Hawke. New York: Harper & Row, 1988. Hardcover, 308 pages, \$18.95.

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**The Universe From Your Backyard—A Guide to Deep-Sky Objects From Astronomy Magazine**, by David J. Eicher. Cambridge: Cambridge University Press, 1988. Hardcover, 188 pages, \$24.95.

**The Amateur Radio Astronomer's Handbook**, by John Potter Shields. New York: Crown Publishers, 1986. Paperback, 104 pages, \$19.95.

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**Marvels of the Molecule**, by Lionel Salem. New York: VCH Publishers, 1987. Paperback, 91 pages, \$18.

## Future Scientists

Continued from page 59

belt sander using 120-grit paper, and attempted to seal the ends with round, optical quality glass plates.

He could not get a good seal, and switched to square plates. He cut two holes in the side of the tube with a die grinder for gas inlet and exhaust and used high-temperature epoxy to cement short, 1/4-in diameter glass pipes over these holes so that rubber tubes could be fitted over them.

A die grinder can be obtained at any good tool store. He obtained a cylinder of argon from a welding supply company.

Some problems soon became apparent. Pepin wrote, "I did some reading, and decided that my tube was too big in diameter." It would require tremendous power to energize. Also, instead of a small amount of argon in an otherwise evacuated tube, he had filled the tube at more than atmospheric pressure; this, too, meant that great power would be needed.

Pepin had made electrodes by wrapping two strips of metal foil around the outside of the tube. Again, much less power is required if the electrodes are inside the tube. He wrote: "Nov. 5, 1986. . . . I changed the foil bands to internal electrodes, and got better response (large 'fingers' of excited argon gas were visible with a startup voltage of about 400,000 volts), but it still was not enough to make the tube lase."

His next attempt was with a 3-foot glass tube with inside diameter of only 1 mm, and a short segment of 1/2-in glass tube fitted over and fused onto each end (Figure 2). In order to evacuate the glass tube, copper rather than rubber tubing was joined to the inlet and exhaust and held tight by sliding segments of surgical tubing over the joints. To the other end of each copper tube, a valve from a bicycle inner tube was attached with epoxy. Pepin used a vacuum pump of the kind used in the repair of refrigerators and evacuated the tube to 20 microns. It still didn't work.

To be continued

## Cold Fusion

Continued from page 14

been identified by either F&P or anybody else.

"We do not know the 'if and only if' conditions for the F&P effect, and until we do, failure to produce the effect means failure to adhere to the unknown conditions of success, and no more. . . ."

"The F&P heat effect has now been shown genuine, but its origin remains unknown. It could be fusion, or it could be something else. The something else is a shoulder shrug, but fusion would break some accepted theoretical rules. . . ."

Also useful are the remarks of fusion scientist George H. Miley, editor of *Fusion Technology*, in an August 1989 reply to a letter from someone at Lawrence Livermore National Laboratory who asks, "Do you really want to rapidly publish a bunch of 'half-baked' work on cold fusion?"

Miley replied, referring to his own work on cold fusion at the University of Illinois: "...The experiments at Illinois have not yet produced definitive results. However, based on other reports, I am personally convinced that solid-state catalyzed cold fusion occurs, and this is an unexpected and very important new regime of physics. The fusion I refer to, however, is the conventional D-D reaction, and the reaction rate is quite low. There is not yet sufficient data to evaluate the possibility of a high-reaction-rate heat-producing reaction such as reported by the University of Utah workers. . . . For the present discussion I will simply assume that this is possible and consider some of the consequences. . . ."

"Based on this view, I doubt that the field will 'die' even if the 'unidentified' heat-producing reaction fails to be thermonuclear in origin. Muon-catalyzed fusion exists and may even be enhanced with the deuterium held in a solid lattice. This area, combined with the low reaction rate type of cold fusion reported by Brigham Young University scientists, could open a whole new field of basic physics for fusion. The result might never lead to fusion power plants, but who knows what interesting and important applications may emerge?"

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## In This Issue:

### CHICKEN LITTLE: A SPECIES IN NEED OF EXTINCTION

This issue arms *21st Century* readers with the facts they need to combat the proliferation of a dangerous species, the Chicken Little, whose cries can be heard far and wide, from the White House, to the nightly news, to the United Nations. The truth about chemicals and cancer, clean air and power plants, whales and seals, naturally produced ozone, and Gaia (the updated Mother Earth thesis) are some of topics covered here.

What should also be clear from these presentations are four facts about the environmentalist movement: (1) Its real agenda is not "cleaning up the environment"—which can be accomplished only by developing advanced technologies. Behind the multimedia scare stories is a conscious effort to deindustrialize and depopulate the world.

(2) Environmentalists lie, distort, misrepresent, falsify, and take out of context scientific data in order to compose irrational scare stories that will be believed by a scientifically illiterate public.

(3) Environmentalism is a big business, making millions of dollars by playing on people's fears that they are being poisoned, that the planet is terminally ill from pollution, and that appealing animals are being tortured.

(4) Environmentalism has become a pseudoreligion, worshipping Mother Nature and relegating man to a planetary position of equality with the other Earthly inhabitants—plants and animals alike. This new religion discards the Judeo-Christian ethic, especially the sacredness of human life.

We urge readers to combat Chicken Littles wherever they appear by hitting them with the truth.

