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21st CENTURY SCIENCE & TECHNOLOGY

Winter 1990

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21st CENTURY SCIENCE & TECHNOLOGY

Vol. 3, No. 4

Winter 1990

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On the cover: Earth—from the Mediterranean to Antarctica—seen from the Apollo 17 in 1972. Photo courtesy of NASA; cover design by Virginia Baier.

Fraud in Science

When electrochemists Martin Fleischmann and Stanley Pons announced in March 1989 that they had achieved fusion at room temperature, using a simple apparatus that could easily be replicated in a university laboratory, they became instantaneous media celebrities. Immediately, the antiscience mob used the hope of achieving low-cost cold fusion to lend credibility to their attacks on the feasibility of hot fusion with established approaches like the Princeton TFTR tokamak. In the United States these fusion programs are now virtually in the scientific dead-letter file for lack of adequate funding to proceed to the next level of devices for energy breakeven and energy production—devices that in the 1970s were planned to be operating by now. Fleischmann and Pons themselves argued for continuance of the mainline fusion program and disputed the claim that their results made hot fusion programs unnecessary, while some of the antiscience Malthusian zealots argued that any kind of fusion would be bad because it would lead to a cheap and virtually unlimited source of energy, and hence growth.

The University of Utah, where Fleischmann and Pons were working, set up the National Cold Fusion Institute in Salt Lake City to provide the means for carrying out experimental work on a grander scale and for bringing together international researchers in the field. Scientists around the world took up the challenge of replicating and extending the work of Fleischmann and Pons, as *21st Century* has reported. Much of the successful work in cold fusion is now in the process of being patented—and is therefore not discussed in great detail—because of the potential of commercial applications.

Predictably, the manic phase of press publicity was followed by its opposite. With the support of the heavies in the scientific establishment, especially the American Physical Society, a campaign of rumors and articles was launched to suggest that Fleischmann and Pons were incompetent and that other researchers who succeeded in producing cold fusion results were also incompetent.

Most recently, outright fraud has been intimated. In late October, Fleischmann's unavailability (due to illness) at a review meeting in Utah was coupled with rumors that Pons had sold his home to concoct a story that both scientists had skipped the country, perhaps to evade prosecution for fraud. This story was prominently featured in the *New York Times* by science writer William J. Broad, who implied that Fleischmann and Pons disappeared because they could not defend their research. A Nov. 1 editorial in *Nature* went even further to proclaim the death knell for cold fusion. And *Science* magazine Nov. 9, titled its story, "Cold Fusion: Only the Grin Remains," with a first sentence stating that

"Like the Chesire Cat, cold fusion has slowly faded away."

The truth is that Stanley Pons did appear at a review committee meeting November 7 and that meeting actually substantiated the promise of experimental work in cold fusion, not only at the Cold Fusion Institute but at other laboratories.

The attempt to claim that cold fusion is a fraud is not the result of a misunderstanding occasioned by the possibility that Pons may be seeking a sabbatical from the University of Utah to work with scientists in France or Japan; it is deliberate. In a June 15 *Science* article, author Gary Taubes suggested baldly that the Texas A&M detection of tritium could only be explained by fraud and implied that the university was remiss for not investigating rumors that someone had "spiked" the cold fusion experiments with tritium. As letters to the editor of *Science* later documented, even if minute amounts of tritium may have "contaminated" some experiments, this could not possibly have accounted for the tritium results.

The Obvious Conclusion

Certain "hot" fusion scientists such as Winston Bostick, whose latest theoretical work appears in this issue, have met with the same harsh treatment over the years. Bostick is a pioneer in work with the plasma focus machine. Like the zeta pinch and mirror machines, the plasma focus utilizes geometrical configurations that appear in the plasma to achieve containment. Like cold fusion, these experiments are relatively low-cost.

The obvious conclusion in both these cases is that the physics establishment has been taken over by a Malthusian ideology and does not want to see the kind of industrial revolution that can follow from the application of plasma processes to manufacturing. It does not want a relatively limitless source of cheap, safe energy to be made available to the world's population. It would prefer a world in which resources—as well as population—are artificially limited and where political control is in the hands of a small elite.

Fortunately, the Malthusians have not yet achieved their aim of suppressing all honest science and committed scientists, despite their deceitful claims of fraud. If there is fraud, it is on the part of magazines like *Nature* and *Science* that attempt to suppress scientific discoveries for the sake of their own nasty political agenda.

Even if Fleischmann and Pons were proven to have been mistaken in the end—something we do not believe will happen—honest mistakes are the lifeblood of science, as much a part of the progress of discovery as successful experiments.

Letters



On Leonardo's Christianity

To the Editor:

I read the article titled, "The Eye Is the Window of the Soul": Leonardo da Vinci's Science of 'Prospettiva' in the Nov.-Dec., 1989 issue of your magazine [by Robert L. Gallagher, p. 28].

Leonardo said that the eye is the window of the *animo*. *Animo* translated into English means mind and heart; the word *anima* in English means soul. Leonardo never said that the eye is the window of the soul.

Leonardo was an agnostic. He did not believe in a personal god or personal soul. For a scientific magazine this is a great gaffe. . . .

Averard Cavaliere
Fresno, California

The Editor Replies

You are right about the difference between *anima* and *animo* in Italian, but wrong in denying Leonardo's belief in the soul. He uses both words, very precisely.

The rumor that Leonardo was an agnostic, or to be precise, "no Christian," first appeared in the 1550 edition of Vasari's *Lives of the Painters*, three decades after Leonardo died. This shows the risk of uncritically believing secondary sources—even very old ones. Evidently someone set Vasari straight, because in his second edition in 1564 this assertion no longer appears. Although Leonardo had his battles with certain elements in the clergy, no one need imagine that the painter of some of the world's greatest religious paintings did not believe in God and the individual soul. Consider the following impassioned notation that Leonardo put on one of his beautiful anatomical studies:

"And you, O Man, who will discern in this work of mine the wonderful

works of Nature, if you think it would be a criminal thing to destroy it, reflect how much more criminal it is to take the life of a man; and if this, his external form, appears to thee marvelously constructed, remember that it is nothing as compared with the soul that dwells in that structure [Italian: "nulla rispetto all'anima che in tale architettura abita"]; for that indeed, be it what it may, is a thing divine. . . ."

The headline of the article is quoted from Leonardo's "Treatise on Painting." The original Italian reads, according to the standard transcription by J.P. Richter, "L'occhio che si dice finestra dell'anima è la principale via, donde il comune senso può piu copiosa e magnificamente considerare le infinite opere di natura." Translated this is: "The eye, which is called the window of the *soul*, is the principal means by which the central sense can most completely and abundantly appreciate the works of nature. . . ." [Emphasis added].

It was an oversight that the specific source of this quote was not cited in our article.

J.P. Richter published both the original Italian and his English translation of the many quotes appearing in the *21st Century* article that attest to Leonardo's attitude toward the soul, *anima*. You can easily check these references in the inexpensive two-volume Dover edition of *The Notebooks of Leonardo da Vinci*.

Continued on page 4

Note to Readers

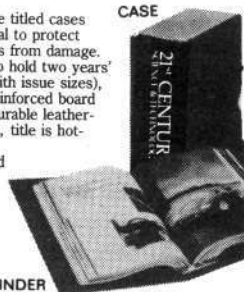
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This issue, called Winter 1990 (instead of Fall 1990 as announced previously) completes Volume 3. We have expanded the number of pages in this issue in order to publish in full the two essays by Dr. Winston Bostick.

We apologize for the delay in mailing the third and fourth issues this year and hope that with continued subscriber support *21st Century* will prosper and grow in 1991!

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Extent and nature of circulation, Sept. 1990

	Average no. copies each issue during preceding 12 months	Actual no. copies of single issue published nearest to filing date
Total copies printed	51,200	40,000
Sales through dealers, street vendors, counter sales	20,629	17,355
Mail subscription	22,357	20,939
Total paid circulation	42,986	38,294
Free distribution	2,000	1,606
Total distribution	44,986	39,900
Copies not distributed	6,214	100
Returns from news agents	0	0
TOTAL	51,200	40,000

The Redshift and the Speed of Light

To the Editor:

In the Spring 1990 issue's article titled "Big Bang Cosmology Meets an Astronomical Death," author Paul Marmet contends that observed redshifts can be accounted for by photons losing energy as they collide with particles of intergalactic gas and dust.

The idea that photons might lose energy through these interactions seems plausible, but Marmet's model is in conflict with what I presumed to be empirical facts about how light travels through a gas. Marmet states that light traveling through 100 meters of air will slow down, so that it will travel 3 cm less than light traveling through 100 meters of vacuum, in the same amount of time.

According to Marmet's explanation, we should expect light to continue slowing down even further through each succeeding 100 meters. But this is in total conflict with the idea that light travels at a specific velocity through a given medium with a specific index of refraction.

Another question also comes to mind. When white light passes from one medium to another, the index of refraction is different for different wavelengths, with the higher frequencies bending more. On long journeys the higher frequencies would lose more energy than the lower frequencies and a broad spectrum would be narrowed.

Also, how are we to explain the way light is slowed, then sped up, as it passes from vacuum to air to vacuum?

William Jennings
Seattle, Washington

The Author Replies

It is a fact that the average light velocity is slowed when light passes from vacuum to air. This fact (and also the fact that it is sped up) is clearly stated in the last sentence of your letter. It is at the vacuum-air frontier that the average velocity is reduced. When photons travel in gases, their group velocity is reduced with respect to the velocity c that is the velocity in

vacuum.

The article states that photons "lose energy in interacting with atoms and molecules." A photon having lost energy is redshifted according to the equation: $E = hf$ (f = frequency), giving it a lower frequency when E (energy) is smaller. Those photons having a smaller energy are not "slowed down," they are redshifted. These photons will continue to lose energy and continue to be redshifted, but they always move at the specific speed of light for the medium. They cannot "continue slowing down" since they never slow down at all.

The second statement in the letter is correct. Yes, a broad spectrum is narrowed. For example, if all frequencies are redshifted (divided) by a factor of 2, the width of the broad spectrum will also be divided by 2. This is a natural consequence of any "Doppler type" of redshift, whatever the interpretation may be.

The third question can be understood using the model described in the article. One has to realize that in fact, on a microscopic scale, light is not slowed down or sped up. Light always travels at velocity c in vacuum between air molecules. In air, there is a delay of about 10^{-19} second at each interaction. During that period, the photon does not move, but its energy exists as a perturbation of the molecule before being reemitted in the forward direction. In vacuum the average velocity is larger because there are no such delays.

A Blueshift Defense of The Big Bang

To the Editor:

In the article "Big Bang Cosmology Meets an Astronomical Death" by Paul Marmet (Spring 1990, p. 52), the redshift of Figure 2 is based on the assumption that the reverse process—a blueshift obtained by reversing the directions of the arrows—is much less likely than the redshift, because the atom is much less likely to absorb two photons than one. This is true under nonequilibrium conditions in which the long-wavelength radiation has not yet reached its maximum concentration throughout intergalactic space.

In an infinite and eternal universe, however, an equilibrium can be reached in which the blueshift cancels the redshift because the energy density of the long-wavelength radiation is large enough to make two-photon absorption (leading to a blueshift) as likely as the single-photon absorption which yields the redshift.

The cosmic redshift predicted by the Big Bang paradigm is unambiguous because there is no competing mechanism to cancel it, whereas the competing blueshift casts some doubt on Marmet's model.

Kenneth J. Epstein
Chicago, IL

The Author Replies

It is true that if there were nothing else than the simplified description given in the article, a blueshift might appear at equilibrium that would cancel out the effect. One of the references given in the article shows that the emission of a secondary photon is only a first approximation. In fact, an infinite number of secondary photons is emitted for each primary photon. However, the sum of the energy of all those secondary photons is finite. This has been predicted by quantum electrodynamics and is clearly shown by Jauch and Rohrlich (*The Theory of Photons and Electrons*, 2nd edition, New York, 1980).

A similar prediction follows from my semiclassical model in the following way: Due to the axial momentum transfer of the colliding photon, the electron is accelerated and emits bremsstrahlung. It is clear that the secondary photon emitted (at right angles) produces a recoil on the electron that generates a third photon. The recoil due to the third photon generates a fourth photon and so on, for the fifth, sixth, etc., photons. At each order (n), the energy of the next photon is smaller by 10^{13} times (in the example). The total energy of all the secondary, tertiary, etc. photons is the sum $\Sigma (10^{-13})^n$, where n ranges from 1 to infinity. A little mathematics shows that this sum is finite.

We understand now that in order to reverse the mechanism, one must have an infinite number of secondary photons conveniently located to coin-

Continued on page 6

The Lightning Rod

My dear friends:

It was with great alarm that I read the following account of "The New System" sent to me by an unnamed Friend. I am not in the habit of publishing such anonymous letters, but I have done so in this case because of the reason for anonymity given by the writer as well as the importance of subject matter. I hope my dear Readers will concur:

The New System

"It was a hot, humid August day, and the courtroom smelled like a barnyard. The small room was packed with spectators; every seat was filled and there was not even any more standing room. The air was so heavy with sweat and tension that it was hard to breathe.

"The jury looked as uncomfortable as the courtroom spectators, yet despite the evident discomfort, the jury members listened intently to the judge's instructions. It was impossible to tell from their strained faces what kind of a verdict to expect.

"It was a difficult case, the first of its kind to come to trial under the New System. That there was such a trial was, in fact, pointed to by the authorities as a sign that the New System was already having a beneficial effect among the population. There had been many of the alleged crimes committed over the past months, especially in the more rural areas, but until now, none of the perpetrators had been indicted and come to trial. Instead, an unfortunate type of justice had been rendered at the hands of vigilante groups before the authorities had a chance to act. Under these circumstances, the authorities said—evidently directing their comments to those who were still not believers in the New System—that the accused in this case had lived to be served with the indictment and stand trial demonstrated the advance of the New System over the old.

"The jury was mixed. The new system provided for that, and it was, if not strictly speaking a jury of 12 peers, at least a jury where those most obviously by their very nature bearing malice toward the accused had been excluded in the jury selection.

"The judge's charge to the jury was complicated; the New System's laws were difficult to understand, especially for those brought up in the old tradition. The New System, you see, had ripped apart the very fabric of life for the old-timers. In previous days, there was black or white, right or wrong. One could feel a certain amount of security in dealing with others. In the new world, however, everything seemed to be a different but very precise shade of gray, the exact shade being determined by feelings. This alone was a hard enough transition for those educated in what used to be known as reason. But to make matters worse, the new determinants were not just human feelings, but the feelings of other living creatures. The old-timers were at a serious disadvantage in this latter respect. They were not trained, as the younger generations were, in the new disciplines that would enable them to represent these feelings accurately.

"The accused looked calm enough under the circumstances. He had an old-timer lawyer, one of the best in the country, who took on the case at the risk of much personal danger. Even though the eyes of the world were focused on this case, the accusers did not mask their hatred for the accused, and some of their members even threatened the life of the lawyer during the trial. The way it worked, of

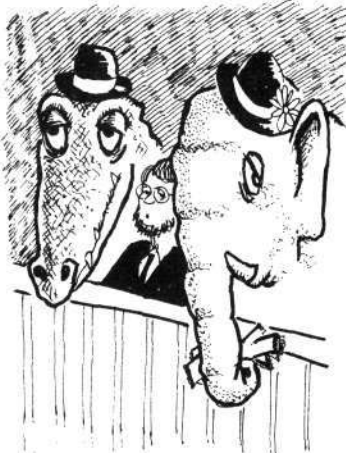
course, was that the legal arm of the group conducted itself with decorum in the courtroom (aside from a couple of outbursts), while more militant members, acting outside the courtroom and with the help of their media friends, set the public climate in which the trial took place.

"(The climate is such, in fact, that I write this anonymously as an old-timer who intends to stay around certainly long enough to see how this landmark case will turn out, and hopefully long enough to wage a fight against the New System. At any rate, I have seen enough of the group's vigilante actions not to cross them in public until I have mustered my forces.)

"How will the trial turn out? The outcome is anybody's guess, because it is so uncertain how this mixed jury will respond and how aware they are of the world-historical nature of the case. The further complication is the nature of the defense argument, the very starkness of which might confound this type of jury. You see, the accused did not deny that he committed the deed he was accused of; he told the truth. His defense was based solely on natural law, as his lawyer put it so eloquently, yet simply.

"In contrast to this simple yet profound defense, the accusers, who under the New System are co-prosecutors with the state authorities, paraded many dramatic witnesses, including television and movie personalities. These performers put on an emotionally gripping show for the jury, some of whom cried and at times started to clap, forgetting they were in court. There were also psychiatrists, religious leaders, and other assorted professionals, who explained the nuances of the new science and presented an overwhelming amount of new data to make the case for a guilty verdict.

"Despite the co-prosecution's great show, my sympathies, as you might guess, remained clearly with the accused. I took great delight in every point scored by the defense and I looked carefully at the faces and bodies of the jury members, trying to gauge their reactions and read their body language, when I thought the defense lawyer made a devastating attack on the joint prosecution team, authorities and accusers.



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"The highpoint of the defense was the testimony of the ornithologist and the zoologist. The defense lawyer brilliantly made the point that by nature the victim himself did the same thing that the accused did: He killed to eat meat, in this case, the meat being earthworms. Then, clearly, for all to see, the zoologist showed that the earthworm fulfilled the criteria established by the accusers: It had a 'face,' sexual urges, a mother and father, and it ran from its predator.

"Most dramatic was the juxtaposition of the testimony from the authority who developed these criteria, John



Robbins, and the intrepid zoologist. Imagine the advances in modern technology that enabled the zoologist to show the earthworm egg and spermatozoa and to present this process on a large screen not only in color but in three-dimensions—microscopic movies, so to speak. (It occurred to me that it is a lapse in New System law not to have outlawed such 'x-rated' films.)

"In my mind, this presentation made the case. The accusers, the PAAM group (People and Animals Against Meat), I thought were really shaken and clearly surprised by this unexpected move by the defense. But how the jury will decide, I don't know. I can barely conceive of a mixed jury such as this coming to any sort of rational decision. How the people on the jury communicate with the animals on the jury is a mystery to me as an old-timer unschooled in the new disciplines of science.

"There is no uncertainty, however, about the feelings of the accused. He's

a handsome orange tabby with a proudly held fluffy tail, and he demonstrated without a shadow of a doubt that not only did he think there was nothing wrong with killing a junco bird, but that he would do it again. When the joint-prosecution showed him an audio-hologram of a junco, complete with its raspy, ugly sound, the accused lunged right for it."

So ends my correspondent's letter. I remain, dear Readers,
Your obt. svt.

Letters

Continued from page 4

cide with the atom in time and space. This is unthinkable. Furthermore, it is clear that the secondary photons are long radio waves and will be destroyed rapidly by plasma in space.

The redshift explained in the article is unambiguous and no competing mechanism cancels it. However, this redshift mechanism explains the redshift on the solar limb, the one related to binary stars and many other phenomena that are impossible to explain by the Doppler redshift interpretation.

Don't Protect People Against Themselves

To the Editor:

Concerning your article, "Yes, We Can Win the War on Drugs," (Jan.-Feb. 1990, p. 22): Sure, and we can stop world hunger, poverty, and human rights violations the same way. All we need are billions of dollars and honest commitment. I have two questions: Whose money and who's committed?

The whole solution projected in the article is hopelessly unrealistic in a country which cannot even balance the national budget.

What people need to consider is decriminalization of recreational drugs is

not giving up or giving in. It is just a viable alternative for those people who are going to destroy themselves no matter what the law says or does.

If drugs were legal, would you use or abuse them? Of course not, and neither would I, and neither would the majority of the population.

It's time to stop protecting people who don't want to be protected.

George T. Mermagen
Springwater, N.Y.

The Editor Replies

Your first sentence is right: we can stop world hunger, poverty, and human rights violations, and win the war on drugs. Creating the cultural optimism that encourages citizens to take responsibility for getting this job done is what our magazine is about. We also aim to present some specifics on how to do it—Great Projects to industrialize the developing sector, advanced technologies to increase productivity, a return to the American System of economics.

The main ingredient is political will. It is not a question of "balancing" the budget, but of investing in the science and technology whose applications to the economy will foster growth and prosperity. The nation's investment in the Apollo program, for example, not only put man on the Moon, but also put prosperity into the civilian economy, giving the economy its best post-war years.

A society based on the pessimism expressed in your view that it's "good riddance" to let those people who choose to destroy themselves do it, is bound for destruction itself. We intend to keep fighting, so that the United States does not go the way of the Roman Empire.

A Modest Hypothesis

To the Editor:

I believe that the following statement merits repeated consideration by persons everywhere who communicate with others in any possible situation where freedom is permitted. It appeared in the "It Has Been Said" section of the quarterly *Perspectives in Biology and Medicine* in 1989, where it is translated from the French of novelist

André Maurois:

"Conversations and discussions would be greatly improved by the more frequent use of four simple words—I do not know."

This could be of great value in 21st century science, and in virtually any activity, if it were more widely known.

B.P. Sonnenblick
Professor Emeritus
Rutgers University
New Brunswick, N.J.

CFCs Hit the Ground Fast

To the Editor:

The alleged relationship between the ozone layer and CFC-12 doesn't really exist.

I own an auto-air repair shop in Cocoa, Florida. We leak-test systems and components using electronic leak detection equipment. So do our peers worldwide.

One generally overlooked fact I wish to share with your readers is that CFC-12 stratifies rapidly and sharply. CFC-12 does not mingle with air except temporarily during turbulence. It does not waft out nor drift gently toward the ground.

If an evaporator (heat exchanger unit) containing several tiny pinholes were pressurized with 50 percent air and 50 percent CFC-12, those leaks in the upper half would ooze only air. Those in the lower half would ooze only CFC-12. Even when we have pinpointed the exact spot of the leak, our sensitive detector cannot pick it up unless its sensor is held directly beneath it or within an inch or two horizontally. We have conducted this test numerous times, even with the evaporator within a chamber to collect the leaking gases to verify emissions over hours of time.

Therefore, I conclude, it is extremely unlikely that any appreciable quantity of CFC-12 could defy gravity to rise as high as the stratosphere (10 to 15 miles). There is almost no air turbulence at that altitude, ever.

Where does escaped CFC-12 really go? Simple! It goes back into the Earth and oceans for breakdown and rebirth as new compounds.

Bob Holzknacht
Cocoa, Fla.



The 'Greenhouse Effect' Is a Hoax!

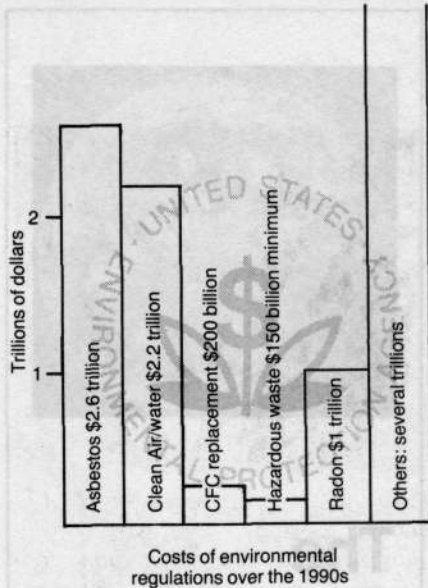
EIR's Special Report, "The 'Greenhouse Effect' Hoax: A World Federalist Plot," analyzes the scientific truth and the political reality behind the latest environmentalist hoax: Kremlin leaders and their Trilateral Commission friends are using "ecological emergency" as the pretext to destroy the sovereignty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

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NEWS BRIEFS



Costs of environmental regulations over the 1990s

CLEAN AIR LAWS COULD COST WELL OVER \$1 TRILLION THIS DECADE

The costs of the Clean Air Act of 1990, signed into law Nov. 15, together with those of the Clean Air Act of 1970, could amount to well over \$1 trillion by the year 2000. The combined cost of environmental regulations over the decade could top \$10 trillion, not including shutdowns of production and workforce dislocations, according to recent government and private studies. Major items include \$2.6 trillion to clean up asbestos; \$2.2 trillion to comply with Clean Air and Clean Water laws; \$1.28 trillion to reduce radon levels in households; \$200 billion for chlorofluorocarbon (CFC) replacements and replacement of all refrigeration and air conditioning equipment; and \$150 billion or more to clean up Superfund Hazardous Waste sites. Private sources estimate Superfund may cost up to \$1 trillion by 2000, mostly for legal fees. The ban on logging and on pesticides, insecticides, and fungicides will cost added trillions.

As *21st Century* reports in this issue, these expenditures are of dubious benefit and are often based on public perception instead of scientific fact. One certainty is that the Clean Air Act will increase the number of bureaucrats and environmental "police."

WILL U.S. RETURN TO VIGOROUS NUCLEAR POWER DEVELOPMENT?

Minoru Okabe, president of the Japan Atomic Power Company, told the American Nuclear Society annual meeting in Washington, D.C., Nov. 12: "This country, the United States, has a tremendous influence upon the international community. . . . It is not only I and my associates but also others in the world who await the day when the United States will rise out of its current stagnant state of nuclear power development and regain its full vitality as soon as possible."

Japan must build 46 gigawatts of nuclear power capacity over the next 20 years, Okabe said. He summarized a study of Japan's energy future released in June, in which his government projects that nuclear power will go from providing 26 percent of electricity today, to 43 percent by 2020. In the United States, nuclear is the source of about 20 percent of electric power.

GROUND BROKEN FOR CONTESTED MOUNT GRAHAM OBSERVATORY

The University of Arizona broke ground Oct. 2 for the first telescopes of the Mount Graham International Observatory near Tucson, in a victory over radical environmentalists. Groundbreaking followed the lifting of a temporary stay; the greens' lawsuit has not yet been tried, however. The centerpiece of the observatory is to be the Columbus Project, a huge binoculars with two 8-meter mirrors, scheduled to see first light in 1994. Combined, the mirrors will have the light-gathering power of a single 11.3-meter mirror, the resolving power of a 22-meter mirror, and unprecedented pointing and tracking accuracy. Columbus is the second-largest of 12 large, new-technology telescopes planned for the 1990s.

After the observatory was announced in 1984, the Sierra Club discovered the Mount Graham red squirrel, a subspecies, as a reason against it. Though the squirrel had been near extinction for years, the Fish and Wildlife Service issued hunting licenses for it until 1987. The university has spent \$1 million studying the possible effect of the observatory (24 acres) on the squirrel's habitat (12,000 acres), and concludes that between 3 and 10 squirrel middens would be affected.

FIRST IMAGES OF HUMAN HEART WITH SYNCHROTRON X-RAYS

The first human heart images using X-rays from the National Synchrotron Light Source at Brookhaven National Lab were obtained Oct. 5, demonstrating the feasibility of studying coronary artery disease without catheterization, and hence without risk to the patient. Clinically useful images are expected within a year, when the X-ray flux is increased. The technique could lead to the development of compact synchrotrons for screening patients at risk for coronary artery disease.



Brookhaven National Laboratory

The National Synchrotron Light Source at Brookhaven National Lab. Inset is one of the first images of the human heart obtained with synchrotron X-rays.

FUSION FOUNDATION FILES DAMAGES SUIT AGAINST GOVERNMENT

The Fusion Energy Foundation, publisher of *Fusion* magazine (predecessor of *21st Century*), filed a multi-million-dollar damage suit Oct. 19 against the U.S. government for its illegal shutdown of the foundation on April 21, 1987. The suit follows more than three years' litigation in which a federal bankruptcy judge and an appeals court judge both ruled that the government's forced bankruptcy of *Fusion* and two political publishing companies associated with Lyndon H. LaRouche was conducted in "bad faith," and was a "constructive fraud against the court." After the ruling by Federal Bankruptcy Judge Martin V. B. Bostetter in 1989 and the appeals court in August 1990, the Solicitor General of the United States announced Oct. 1 the government would not appeal further.

"These decisions represent a victory for the U.S. Constitution and free speech. Now we are suing for damages to rebuild the fighting scientific institution that the government deliberately squashed," said Carol White, speaking for the Committee to Defend Scientific Freedom, a group initiated after the forced bankruptcy.

"Never before in the peace-time history of the United States has any newspaper or magazine been put out of business under any pretext. This extraordinary action of forced bankruptcy was devised by the government because it was determined to stop publication of *Fusion* magazine and the activities of the foundation in general. Why? Because Lyndon H. LaRouche was a member of the foundation's board of directors and a contributor to its scientific work. This political vendetta against LaRouche summarily put out of business a nonprofit scientific institution," White said.

GEOMETRY, NOT ALGEBRA, IS KEY TO COLLEGE SUCCESS OF MINORITIES

Black and hispanic high school students who take a year of geometry vastly improve their chances of admission to college and a bachelor's degree, according to a study done for the College Entrance Examination Board released in September. The study found that the gaps between college-going rates of whites and minorities virtually disappeared among those with a year of geometry. It also looked at whether students had taken laboratory sciences or foreign languages, and did not find as strong a relation to college enrollment and completion as for geometry.

"When the students who took only algebra are separated from those who took algebra and geometry, the importance of geometry becomes clearer," the study concludes.

MICROWAVE PROCESS REDUCES NUCLEAR WASTE VOLUME BY 87 PERCENT

A new microwave process could reduce the volume and weight of some nuclear waste by 87 percent, announced EG&G Rocky Flats, the firm that oversees the defense waste plant at Rocky Flats, Colorado. The newly patented device uses microwaves to melt and vitrify sludge-type waste at temperatures up to 2,800°F. The glass-like product is denser, more leach resistant, easier to handle, and safer to store. The process reduces moisture content from 70 percent to between 10 and 20 percent.

LAB ANNOUNCES CONCEPT FOR TRANSMUTING LONG-LIVED WASTE

Radioactive wastes requiring isolation for tens of thousands of years may be converted to stable elements or to ones with short half-lives, if a concept announced Sept. 12 by Los Alamos National Lab proves viable. In the proposed system, an intense beam of protons is directed into a lead-bismuth target, producing very large numbers of neutrons. The waste is circulated in a heavy water moderator surrounding the target. The heavy water slows the neutrons to speeds at which they can be absorbed by the undesirable nuclei in the waste, transmuting them. The process is efficient only for concentrated waste.



Stuart Lewis

Carol White, former editor-in-chief of *Fusion* magazine, chats with the *Fusion* lawyer David Kuney at a press conference held in December 1989 to announce the bankruptcy case victory—and to celebrate what would have been the 15th anniversary of the Fusion Energy Foundation.

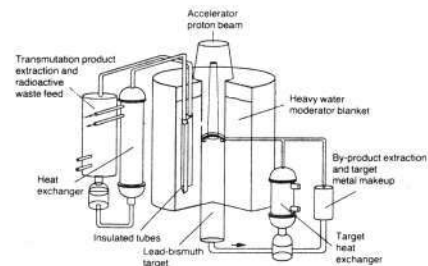


Illustration by Jim Mahan/LANL

A proposed reactor for converting very long-lived radioactive wastes to short-lived or stable ones.

U.S. Policy Protects Wetlands, Promotes Human Disease

The rush to save and re-create wetlands has some serious risks that are largely ignored. Wetlands are usually the home of disease-transmitting mosquitoes, as well as other wildlife, and mosquito-transmitted diseases can be serious and even deadly. Mosquitoes can also be annoying pests.

Estimates of 90 percent loss of wetlands in the United States are commonly cited as a reason to preserve all that are left. The reduction in human and livestock death and disability that has accompanied the reclamation of historical wetlands is overlooked in our rush to return to the good old days of living in tune with nature.

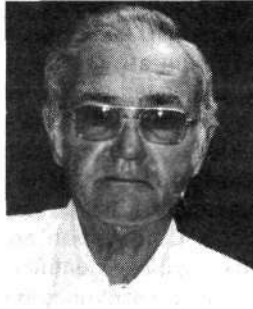
The consequences of wetland preservation are seldom considered in the political stampede to preserve nature. The truth is that humans are animals that are subject to the same harsh consequences of natural laws, unless natural conditions are altered to benefit humans over the other animals. Protection from diseases is one of the ways society has tried to help people survive longer and avoid these harsh consequences.

President Bush is calling for "no net loss of wetlands," which is being translated into federal demands for wetland increases. The president likes to shoot ducks for sport, and this is his privilege, as long as his sport does not damage innocent people who may live near the places where his ducks seek refuge or where they reproduce. How much nicer the president's statement would be if he had added the words, "as long as it does not harm people."

Malaria in the Sacramento Valley

In the days before gold was discovered in California, the Central Valley as well as what is now the San Francisco Bay Delta repeatedly flooded, and large areas were wetlands.

Historians set the date of spring 1830 as the time when fur trappers from Oregon came into Northern California with malaria parasites in their blood. The Native Americans were said to be



Walter A. Houston

Dr. William E. Hazeltine

hunting where the winter floods had forced game onto the dry Sutter Buttes near Marysville. The trappers moved south, after the prevalent local mosquitoes had picked up the malaria parasites. When the trappers returned, going north in the fall, an estimated one quarter of the Native Americans in this area were dead from malaria.

The epidemic conditions existed because the parasite, the vector (the mosquito), and a susceptible population of people were all in the same place at the same time. Malaria parasites must complete part of their life cycle in mosquitoes, and without mosquitoes, the disease will die out.

During the gold rush days of California, locally transmitted malaria was a major cause of illness and death. The occurrence and increase of malaria mosquitoes were a natural consequence of natural wetlands in the valley, as well as of the water diversion and ditches in the foothills that were part of the California gold rush scene. Miners worked and lived with the *Anopheles* mosquitoes, which thrive in the kinds of environment the miners created.

"Fevers of unknown origin" were also present and were probably due in part to viral encephalitis, which is also transmitted by mosquitoes.

With the draining of the wetlands, creation of flood control systems, good mosquito control, and modern drugs, malaria has been largely elimi-

nated in most of California. Occasional outbreaks have occurred, such as in 1952, when a Korean war veteran had a malaria relapse in an area near a Girl Scout camp where *Anopheles* mosquitoes were present to vector (transmit) the parasite. Thirty-two cases were documented from this one parasite source. San Diego County cases of malaria have occurred repeatedly over the past few years, as workers from Mexico bring in the parasites and live in areas where the right kind of mosquitoes are present to transmit the disease agent to other workers in the same area.

There are occasional locally transmitted cases of malaria in the Central Valley and foothills of California, which remind health care professionals of the continued risks. As tree-shaded pools such as beaver ponds increase, the risks of malaria increase, because one of the good vectors of malaria thrives in this kind of habitat. The malaria risk goes up as wetlands such as woodland pools are allowed, and even encouraged, as part of planned urban development in many cities of California.

Encephalitis

Western and St. Louis encephalitis used to be common in California before the start of modern mosquito control, which has depended on chemicals, as well as water source elimination. This disease is vectored by *Culex* mosquitoes. From a health viewpoint, it makes more sense to eliminate mosquito breeding than to try to kill the adults after they have emerged and flown from these water sources.

The California incidence of human encephalitis transmitted by mosquitoes shows a decline over three decades and then an increase in the decade just ended (see table). During the last decade alone (1980-1989) there were 26 and 28 cases of human disease confirmed in just two of the years. One year the cases were in the Long Beach area, and the most recent episode was

MOSQUITO-TRANSMITTED ENCEPHALITIS IN CALIFORNIA

Decade	Human cases	Deaths
1950-1959	938	27
1960-1969	143	2
1970-1979	28	0
1980-1989	72	1

in the southern San Joaquin Valley. The Long Beach cases were thought to be associated with urban mosquito sources and the presence of a large nonimmune population that has no previous low-level disease exposure.

The 1989 cases were associated with the increased flooding of nonagricultural areas, primarily along drainage systems in Kern County. The implications are clear about more wetlands, and higher numbers of mosquitoes.

The worst recorded epidemic of encephalitis in California was in 1952, when there were 415 human cases and 10 deaths. This was predominantly caused by the Western Encephalitis virus. Mosquito control was recognized and supported at that time as the only way such diseases could be controlled. There is no cure, once viral encephalitis starts, and there is no available human vaccination to prevent it.

Survivors of the 1952 epidemic showed that Western Encephalitis can cause extensive residual brain damage, as well as death, with the most severe brain damage cases occurring in the very young. Another observation from this epidemic was that the disease in a pregnant mother can be passed on to her unborn offspring. This was proven in identical twins, both of which had severe motor function damage. Some of these cases are graphically recorded on a film made after this epidemic.

St. Louis encephalitis, caused by a different virus, is particularly severe in older people.

Organized mosquito control agencies in California now collect mosquitoes and test captive and wild birds and other wildlife, to see when any of the viruses that cause encephalitis are active. Based on this effort, we know that the viruses in nature are increased and probably transported in wild

birds, which mosquitoes use as a blood meal source. Jack rabbits and another kind of mosquito have a separate cycle that increases the same viruses in nature. Mosquitoes infected from feeding on a wild source are the source of the disease in humans. Experts believe there may be 100 or even more low-level undiagnosed flu-like illnesses for each diagnosed human case of encephalitis.

History also shows that the early season virus activity is associated with drainage systems, such as the Colorado River and in the San Joaquin Valley. In Northern California, the Sacramento River and the nearby extensive wetlands and refuges are the places where the virus is usually found first. Infected mosquitoes are typically found mov-

ing into urban areas two to four weeks after virus activity is seen in the wetland habitat.

Midwestern Encephalitis

Other areas besides California have experienced recent, periodic epidemics of Western and St. Louis encephalitis, along with other similar mosquito-vectored viral diseases. For example, in 1975, an epidemic that began in Mississippi spread north along the major river systems into the upper Midwest. Before this epidemic was over there were more than 4,000 confirmed human cases, with 95 confirmed deaths. Ohio experts alone reported 419 cases, and estimated another unreported 1,100 human cases. In one Ohio city, an average of 1 mosquito in 120 was infected.



U.S. Fish & Wildlife Service

"The activists are perhaps not clearly stating their intent, but the consequence of wetland and wildlife preservation coupled with a fight against pesticides, is to promote human disease."

Experts who worked on the early control effort in Mississippi reported violent protests by people in the poor areas, where the infected mosquitoes were the most prevalent. The local activists threw rocks at the spray trucks and shouted slogans that led the workers to conclude that their fear was based on a "genocide" program of the rich to get rid of the poor minorities. After the spraying was stopped, the first four deaths of the epidemic occurred in this area.

An epidemic in Houston, Texas in 1964 resulted in 34 deaths, and led to the creation of a control district there.

Other mosquito-vectored viruses closely related to those causing Western and St. Louis encephalitis have been found in large areas of the Midwest. These viruses typically cause only mild flu-like original symptoms in most people. Delayed serious brain damage or other symptoms, however, may occur in a small percentage of the cases up to three years later. This makes diagnosis of these cases very difficult. The brain-damage risk usual-

ly ends as brain growth ends at about 16 years of age. Experts estimate undiagnosed original cases may run as high as 3,000 for each case that is severe enough when first contracted to alert a physician to the need for blood-sample testing.

The same class of viruses that causes the delayed reactions in children in the Midwest has been found in California. Research is just beginning to see if similar delayed brain damage can occur in California.

Encouraging Disease Risks

The antipesticide movement has caused disastrous consequences for the protection of humans from diseases. Public health applications of pesticide cover small areas compared to agricultural uses and are usually applied at much smaller dosage rates. As a result, low-volume uses for health protection have been the first uses dropped by the manufacturers. This is simple economics. The federal Environmental Protection Agency (EPA) does *not* recognize the low-volume, high-benefit uses of pesticides for health protection as meriting any special consideration.

Current legislative trends to allow health-protection uses of pesticides while making all other uses uneconomical if allowed at all, creates an illusion. The "Green Initiative" on the November 1990 ballot in California would have allowed mosquito-control uses of carcinogenic pesticides, but failed to recognize that when all other registrations of such a product are canceled, there will be *no product available* for health uses. This is the worst kind of public misleading.

In Butte County, California, we have lost our best pasture mosquito control material because this chemical is only used for pasture mosquitoes and household pests and no official tolerance has been established for pasture grass. The state allowed the use on pastures in the past for health protection, but new rules now even prevent this use. Ironically, these pasture mosquitoes, in combination with jack rabbits, form one of the important endemic encephalitis virus cycles.

The only alternative for protection of people from this vicious mosquito is pyrethrin, a natural extract of a par-

ticular chrysanthemum flower, which is in very short supply and costs \$265 per pound. With mosquito control budget cuts, there is no assurance we will even be able to buy enough to kill the mosquitoes and the other vectors of encephalitis in dense urban areas, let alone in the pasture environments outside of towns.

Wetlands and Population Control

People want to have a decent place to live, and the increased population pressure has caused people to invade mosquito-ridden areas and even to try to re-create natural wetlands. There are some in our society who have used the wetlands issues as a way to discourage or stop urban growth. They have invoked the Federal Army Corps of Engineers' dredge and fill permits, as a way to prevent land reclamation. The activists are perhaps not clearly stating their intent, but the consequence of wetland and wildlife preservation coupled with a fight against pesticides, including diesel oil, is to promote human disease.

When a state or federal permit or an environmental impact report contains a mitigation that requires the preservation of a wetland area in a development project, this triggers the creation of a public nuisance under the California Health and Safety Code. That Code says that any breeding place for mosquitoes resulting from any use made of the land, or man-made change in the natural condition that results in mosquito breeding is a public nuisance. Such a nuisance may subject the land or property owner to an abatement order and civil penalties. This puts the landowner in the middle of a conflict between the wildlife and the public health advocates.

Environmental Law and Public Health

The California Environmental Quality Act (CEQA) is focused on the protection of the physical environment, and has very little language about protecting people *from* the environment. However, a mandatory finding of significant adverse effect is required for any project having serious adverse impacts on people. In decision-making, if the adverse impacts cannot be avoided or mitigated, the decision-making authority can allow a project to proceed, even with this defect. But at least



Be wary of groups promoting health freedom and 'holistic' medicine. Read this special report from the American Council on Science and Health.

For a copy of **The Unhealthy Alliance**, send a check or money order for \$2.00 and a self-addressed business size (#10) envelope with \$0.75 postage to: **The Unhealthy Alliance**, ACSH, 1995 Broadway (16th floor), New York, NY 10023-5860



The ACSH is an independent, nonprofit consumer education organization promoting scientifically balanced evaluations of food, chemicals, the environment, and human health.

the decision-makers are supposed to have been confronted with the public health consequences of their action, and any seller of such property is supposed to inform a buyer of this known defect. This seldom happens in real life.

CEQA also talks about having a healthful place to live, but this is largely neglected in the requirements to protect the nonhuman environment.

The National Environmental Policy Act (NEPA) has clearer human health protection requirements than CEQA, even if these requirements have been largely overlooked. NEPA policy includes the requirement that all federal agencies shall work to "attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable or unintended consequences." This clearly places health protection requirements above other environmental requirements.

The Council on Environmental Quality, the branch of the federal gov-

ernment that oversees NEPA implementation, is directed by NEPA to "... encourage the development of the means to prevent or reduce adverse effects that endanger the health and well-being of man." The Council itself recognizes the need for federal agencies to consult with the U.S. Public Health Service's Centers for Disease Control (CDC), but comments, "It is often true, however, that health factors are not adequately addressed, and that CDC is not contacted."

A new health protection consciousness is necessary at all levels of government, particularly when it is required by the laws that set the tone for environmental protection. People as well as the physical environment need protection.

Conclusions

The time has come to recognize the need for human health protection as part of a healthy environment.

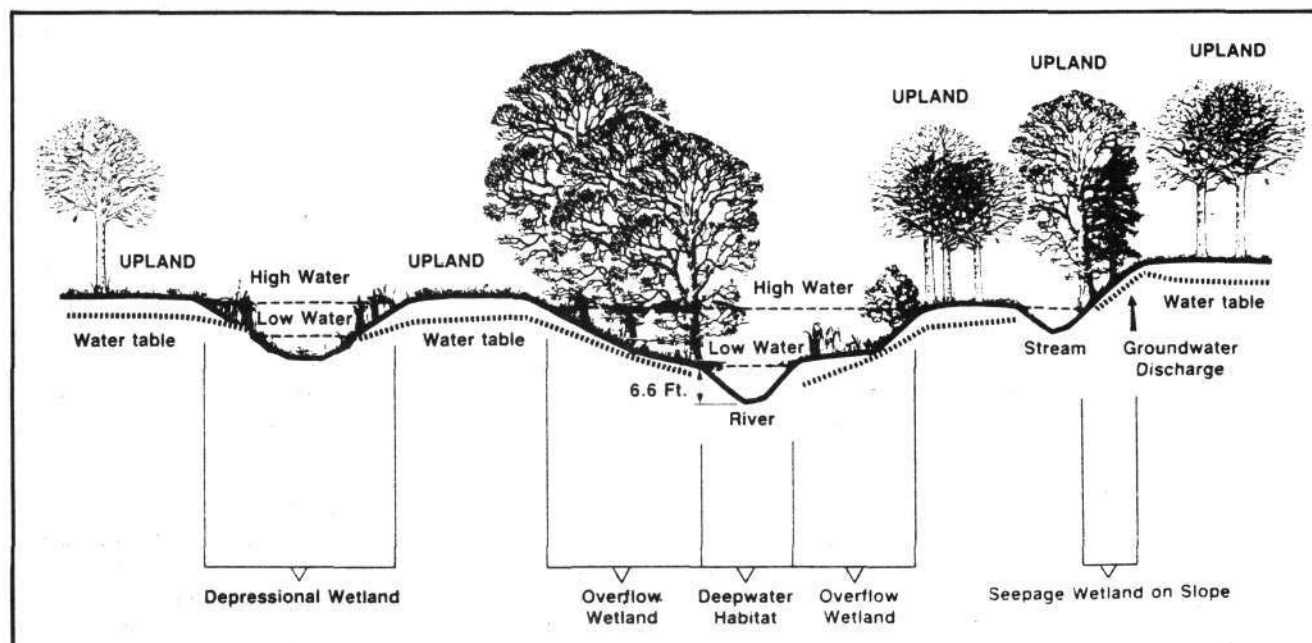
If wetlands are required to be created and preserved, there must be a requirement that they are adequately

managed in a way to prevent production of disease-vectoring mosquitoes. The closer wetlands are to urban development, the more intense this management must become. Any appropriation of funds for purchase or maintenance of wetlands made by state or federal legislation should include money for mosquito control.

The benefits of pesticides in protecting the health of people must be recognized and the availability of such needed control chemicals must be assured. Decisions on which chemicals are banned and which are allowed to be used must include consideration of the health protection of people as a benefit factor.

Activists who advocate more wetlands and no pesticide use must be recognized as advocates of human disease and discomfort.

William Hazeltine, an entomologist, heads the Butte County Mosquito Abatement District in California. He is active locally and nationally on behalf of policies that protect human health.



U.S. Department of the Interior

About 95 million acres in the United States are now classified as wetlands, and environmentalists are pushing to expand both the definition and the acreage. In general, wetlands lie between well-drained upland and permanently flooded deep waters of lakes, rivers, and oceans, but as indicated in this schematic, almost any land could be disputed as wetlands to prevent its development. President Bush's "no net loss" policy means that anyone who decides to develop a swamp, dig a drainage ditch, build a pier, and so on could be prosecuted, fined, and jailed.

The environmentalists bemoan the fact that 54 percent of the swamps and bogs that the colonists found here in the 1600s have since been developed; 87 percent of this loss, however, is due to agriculture and most of the rest to human habitation!

Gen. John Bruce Medaris: The Man Who Put America into Space

by Marsha Freeman

The death of Gen. J. Bruce Medaris at his home in Highlands, N.C., July 11, 1990 ended an extraordinary era in the history of spaceflight.

At the age of 88, General Medaris had not only seen the development of revolutionary new technologies of two world wars, but had played a central role in bringing to fruition the ideas and dreams of military space technology that for decades have laid the basis for space travel.

When Professor Hermann Oberth passed away at the age of 95 in December 1989, his death marked the end of the era of the scientific space pioneers—an era that included Robert Goddard in the United States and Konstantin Tsiolkovsky in the Soviet Union. Oberth's unique contribution was that he was able to teach and train his enthusiastic young followers so that they became the German rocket team that put Americans on the Moon.

The cream of Oberth's crop of scientists, engineers, designers, and dreamers came to the United States at the end of World War II. The team under Wernher von Braun accomplished the goal of landing men on the Moon, after opening the age of spaceflight in America under the guidance, discipline, and protection of General Medaris.

After 37 years in the military, General Medaris retired in 1960. He had lost his fight with President Eisenhower to keep the von Braun team under the command of the Army, and when the team was transferred to the new civilian National Aeronautics and Space Administration, Medaris bowed out.

Medaris did not "retire," however. After a stint in the business world and a near-fatal bout with cancer in the mid-1960s, he entered the clergy in 1970. At the time of his death, he was an Episco-

pal priest.

General Medaris never compromised on his principles or ideals. He never accommodated to what was "popular" in military or space policy. Talking with him recently, one could not imagine that talking with him 40 years ago would have been very different. Although his total energy and commitment was to the priesthood over the past 20 years, he never turned his back on his nation, nor his friends and colleagues.

He was a most remarkable man, commander, friend, and, undoubtedly, opponent. He has properly been laid to rest at Arlington National Cemetery, where the nation can pay its respects to a man who left an indelible mark on its history.

The Leap into Space

On Jan. 31, 1958, the United States orbited its first satellite, Explorer 1, three months after the Soviet Union had launched Sputnik. On May 5, 1961, astronaut Alan Shepard became the first American to venture into space. And on July 20, 1969, Neil Armstrong took that "giant leap" for mankind, onto the surface of the Moon.

All three of these firsts in the U.S. space program were made possible by the rockets developed by the team of scientists and engineers working in Huntsville, Alabama, under the leadership of Wernher von Braun. During the crucial years of 1956 to 1960, when the space age began, they worked under the guidance of Gen. John Bruce Medaris at the Redstone Arsenal.

The von Braun team designed, built, and tested the Nike series of rockets, which were proven capable of "shooting a bullet with a bullet" to protect the United States and its allies from nuclear attack—the first antiballistic missile defense. At the time, Medaris



A painting of General Medaris and the Redstone.

considered that active defense—and not retaliation, or what later became known as "assured destruction"—would be crucial in the nuclear age. He held this view throughout his life.

Medaris strongly believed that the resources of the Army could provide this nation with a forward-looking, first-rate space program—both military and civilian. He encouraged the von Braun team to present its ideas on the future of man in space, which the scientists had actually been developing since the mid-1930s, as his bid to keep the German rocket team, and the space program, under the Army. This was the Horizon program that was put together by the rocket team in late 1958.

Project Horizon proposed the establishment of an "operational lunar out-

post by late 1966, with the initial manned landings . . . in the spring of 1965." The launch vehicle was the Saturn V, already under conceptual development by Arthur Rudolph in the late 1950s.

The design and construction of the lunar outpost would be performed by the Army Corps of Engineers, which, the report notes, has a record of accomplishment and experience in the development of facilities "under extremes of environment." The global and lunar satellite stations for the communications networks would be under the wing of the Army Signal Corps, which was already developing such capabilities for NASA.

The Project Horizon report reached the conclusion that "military, political, and scientific considerations indicate that it is imperative for the United States to establish a lunar outpost at the earliest practicable date."

The objectives included, but were not limited to, extended and improved communications and surveillance, demonstration of U.S. military and scientific superiority, establishment and protection of U.S. interests on the Moon, support for scientific investigations of the Moon, provision of a facility with unique physical and environmental characteristics for scientific studies and special tests, and development of a site to support other U.S. space operations.

This ambitious effort required the launch of 229 Saturn vehicles, delivering 756,000 pounds of useful cargo, as well as astronauts and their equipment, to the lunar surface by the end of 1967. The report pointed out that since there would be a "booster recovery system," the total number of Saturn boosters required was only 73. By the end of 1967, Horizon projected, "Some 252 persons will have been transported into an Earth orbit, 42 will have continued to the Moon, and 26 will have returned from the Moon."

The total cost of the eight and one-half year program presented in Horizon was \$6.014 billion. Delaying the project by not being willing to expend the necessary resources, Medaris pointed out, would only increase the cost, while relegating the United States to the status of a second-rate power, behind the Soviet Union.

Although this plan was never implemented by the Army nor carried out under Medaris, it became the foundation for recommendations the fledgling NASA was developing, which would be later adopted by President John F. Kennedy. Wernher von Braun became the space program's most eloquent spokesman on the need for space exploration.

The Problem Today

In an interview with this author on July 16, 1989, published in *Executive Intelligence Review* magazine, General Medaris stated with great frustration: "We have no space program today. What we have is a collection of miscellaneous projects, each one having enough backing to get something done, but none of which bears on the others, none of which is part of an ongoing program with a true program objective."

"There is a vast difference between an array of projects and a program," he continued. "At the present time, it is my considered judgment that the government isn't running the space program at all; the aerospace industry is doing what they please, putting what they wish on the board to be done, each one after something that they can have a big chunk of, as far as budget is concerned, and with a lot of lobbying in Washington to get their individual, particular project under way."

In the late 1950s, the general ran the Army space effort with an iron hand, which intimidated every contractor and employee, but which accomplished the goals set for the programs. ". . . As long as we abandon the field to the aerospace industry and those who are involved in space-type operations to tell us what we can do to promote the projects, to promote the money out of Congress to do them . . . there's no question that we're wasting all kinds of money in what we are doing," he stated.

Medaris was of the generation of military commanders who organized programs through the system of arsenals. The Redstone Arsenal in Huntsville was the headquarters of the Army Ballistic Missile Agency. Through the arsenal system, the Army maintained the technical expertise to supervise the contractors.

Medaris stated in the interview, "We



Leo Scanlon

Medaris speaking in July 1985 at a Washington press conference on the Arthur Rudolph case sponsored by the Coalition for Constitutional Justice and Security.

do not have any competent, government-employed representatives to look at the plants, to be there, to see what's going on, to know what's happening in the field."

Referring to the organization he headed in the Army, Medaris continued, "I had men in every [manufacturing] plant that was of any size. There was at least one man there, just to see what was going on . . . to check the manufacturer's own quality control and see that he was enforcing it, and those men were able to report back to me on a red line, the minute they saw anything going wrong in any one of the plants.

"The result was that little people in the plants could come up and whisper in their ear and tell them, something was haywire and they'd better go look. If it was anything of any consequence, I was in my airplane out there the next day. . . . The result was that everything we did was done within budget and on time. . . . The overruns we have are strictly the result of no control, none at all."

Deeply distressed at how far the government responsibility for the space program has deteriorated, Medaris said, "It is incredible to believe that on the morning of the Challenger's di-

sastrous launch, there was *no one* at the launch site who could say, 'Shut it down.'

"We never had a launch where either Wernher von Braun, Kurt Debus, or myself was not present, and any one of the three of us could shut it down any minute we wanted to and say: 'That's enough. We're not going to do this one.'

"I used to sit in the control house with my earphones on and I could check in on everybody that was working on the stands," Medaris recounted. "I could check in on the bosses, and their conversations with their men in their group, and the conversations between the bosses. More than once, I called a halt—delay—simply because I could hear tension in the voices of the men. They were tired and they were beginning to make mistakes and I'd say: 'I'm calling a two-hour hold. Now get down off of there and go take a break.' Wernher did the same thing, if he was there and I wasn't. But I was usually there."

What do you need for a space program today? I asked the General. "You have to have an objective that is consistent, that is maintained, but that is always at least 15 years in front of you," he replied.

"As far as an objective for the next 15 years, I believe that there is nothing that could yield more benefit to this country and to the world at large than to place a permanent scientific colony on the Moon. . . . This is the perfect point of observation for everything, and there's nothing unreal or unrealistic about doing it. . . . If this were the objective, everything, including an intermediate space station and everything else, begins to meld into the program as a whole, you see."

Attack on the Constitution

Over the past five years, Medaris was extremely personally grieved, as well as distressed for the future of the country, at the attack on Dr. Arthur Rudolph and the other German rocket scientists, by the Justice Department's Office of Special Investigations (OSI). Although in frail health, he mobilized his personal resources, as well as those of other colleagues and friends, to try to reverse the injustice.

Rudolph, who had worked for the U.S. government for nearly 25 years on

military space systems and the Saturn V rocket, and had retired from NASA with its highest honors, was now accused of war crimes in connection with the production of V-2 rockets in Nazi Germany.

In remarks prepared for the June 1985 conference in memory of German rocket scientist Krafft Ehrlicke, Medaris said: "I cannot believe that the law under which the OSI of the Department of Justice is operating, to harass a particular group of naturalized citizens of this country, is constitutional."

"Unfortunately," he said, "those being harassed do not command the resources in court, let alone to carry the case to the Supreme Court, which would probably follow. To the best of my knowledge, no charges have been stated in specific terms and supported by proper, direct testimony from identifiable witnesses, and the ordinary rules governing the deportation of aliens have been completely ignored."

"Even the public statement of the OSI and other protagonists of these unjust actions have alleged guilt by association. Direct evidence supporting the innocence of Dr. Rudolph and others under attack is totally ignored. To allow continuation of this kind of treatment, smacking strongly of blackmail and the lawless methods of underworld enforcers, is to impose such a travesty of justice, that makes a mockery of the Constitution and of every so-called civil-rights law aimed at equal standing before the law for all the citizens of this nation."

A month before he wrote this, Medaris had written a letter to President Reagan, which was signed by 108 of the "Old Timers" in Huntsville—the remaining German scientists and some of the Americans who worked with them.

In the letter, Medaris described the OSI's tactics as "reminiscent of immoral, unjust tyranny." He summarized the contribution of Rudolph and his colleagues: They "served their adopted nation with great dedication, talent, and skill. They helped create three ballistic missile systems for our defense and that of the North Atlantic Treaty Organization as well as the mighty Saturn rocket, which propelled American astronauts to the Moon."

The former Commanding General of Arthur Rudolph ended his letter: "I urge you to review the secretive, deceptive, and totally unjust process by which Dr. Rudolph was literally forced to abandon his friends and deny his oath."

"He deserves nothing less than immediate restoration of citizenship and invitation to return in honor to his country of choice."

Happily, Medaris was still alive, although gravely ill, when Arthur Rudolph arrived in Toronto on July 1, to try to begin the fight to clear his name and regain his American citizenship.

The SDI: An 'Effective Defense'

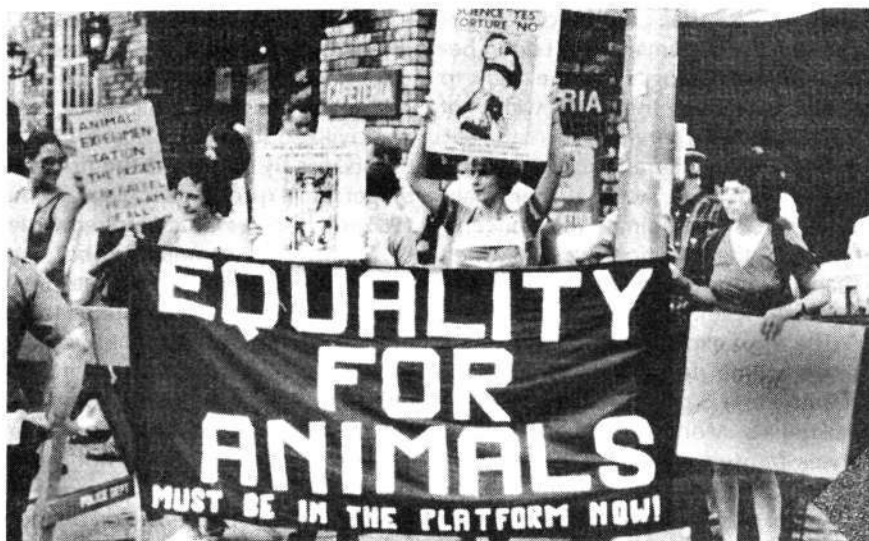
Medaris strongly supported the Strategic Defense Initiative and had great respect and admiration for its first director, Gen. James Abrahamson.

In his presentation to the Krafft Ehrlicke conference in 1985, he had said: "In the present case, it becomes madness not to turn our attention to an effective strategic defense that will make a nuclear holocaust so unsuccessful as to assure that it would not happen. In fact, the objective should be to make nuclear weapons so ineffective—and in fact to cause them to strike back against those who launched them—as to cause this type of weapon to disappear from the world's arsenal."

Very few people would describe Medaris as a modest man. Yet he said he was surprised at the honor accorded him.

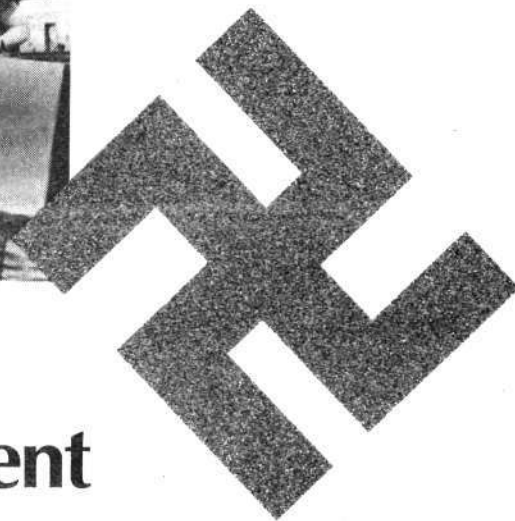
A few years ago he was called to Washington to sit on an advisory committee for the Strategic Defense Initiative program. As Medaris described the incident to this writer, when he arrived late at the room where the SDI advisory committee meeting was being held, he was astonished to find that the chair at the head of the table had been left for him. When he entered the room, all those who were present, regardless of rank, rose in respect. Medaris said he was genuinely honored, having ended his military career decades before, to be accorded such a show of esteem.

General Medaris was a remarkable man. Through many careers, including religious service, he left an indelible mark on the history of this nation.



Carlos de Hoyos

The cuddly creatures they use to promote animal rights are appealing, especially to children, but behind these furry friends is the same antihuman philosophy imposed by Adolf Hitler.



Animal Rights: The New Nazi Movement

by Kathleen Klenetsky

For the last two decades, environmentalist fanatics have been telling us that man is a cancer upon the Earth, that his existence has polluted the biosphere, and that unless he repents—by slashing his living standards and cutting his numbers—he will perish in an ecological cataclysm.

The antihuman bias of the radical environmentalists has been obvious. But in the past few years, a new movement has arisen to preach an even more radically misanthropic message. In the name of animal rights or animal liberation, this new movement seeks to reduce man to the level of the other animals, with no more rights or value than the warthog.

In the words of one of the movement's leaders, Ingrid Newkirk of PETA (People for the Ethical Treatment of Animals): "Animal liberationists do not separate out the human animal. A rat is a pig is a dog is a boy."

Devotees of this new cult are driven by a hatred of humanity so rabid that they argue openly in favor of killing

people, if that is what it takes to "save" one animal. They have sworn themselves to stopping the use of animals by man, period. To view animals as having been created for man's use is gross "speciesism" says Peter Singer, the movement's leading guru and author of its bible, *Animal Liberation*, first published in 1975.

They are carrying out well-financed crusades against biomedical research and meat-eating, and are not averse to using terrorism. They have decided that the notion of the sanctity of human life is evil and must be wiped out.

Unfortunately, these kinds of depraved views are gaining many new adherents. Six years ago, PETA, the best-known U.S.-based animal liberation outfit, had 8,000 members, an annual budget of \$242,000, and a staff of eight. Now it has more than 300,000 members, a \$7 million annual budget, and employs nearly 100 people. According to the American Medical Association, the United States is currently home to more than 400 animal-protection soci-

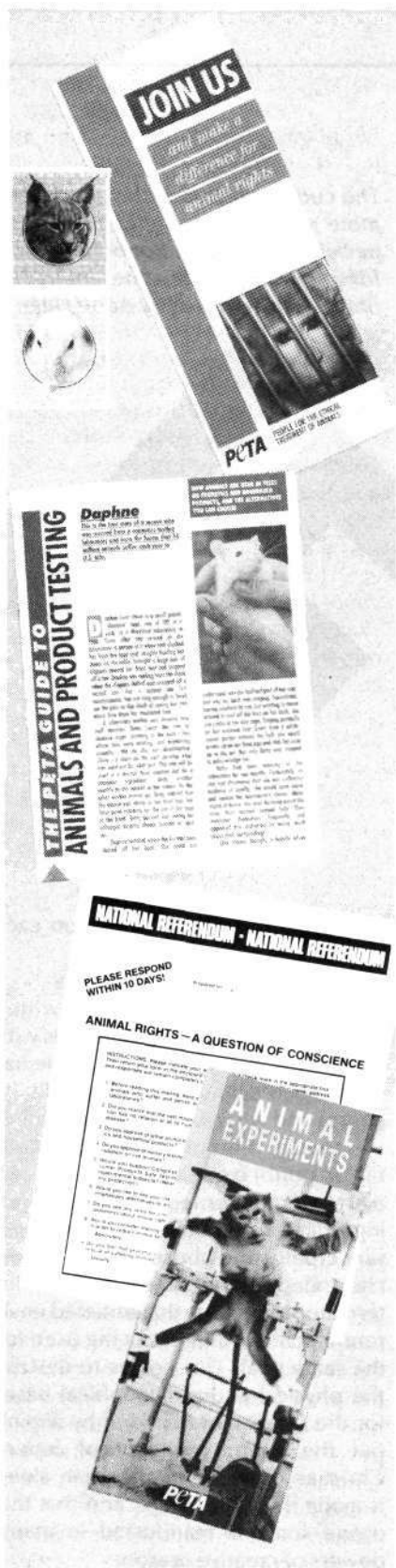
eties, which spend \$200 million each year.

A Bestial View of Humanity

Much of what has been written about the animal rights cult deals with its stated objectives. But very little has been said about who pulls its strings and what its ultimate goals are.

Although the movement's rank-and-file no doubt contains some naive animal lovers concerned simply with ending what they perceive to be unnecessary cruelty and abuse, the cult is orchestrated by the same high-level international factions that initiated environmentalism, and it is being used for the same goal. This goal is to destroy the physical and philosophical bases for the survival of mankind by wiping out the central concept of Judeo-Christian civilization: that man alone is made in God's image, and that this divine spark is manifested in man's powers of creative reason.

Instead, the animal cultists want us to return to the pagan worship of animals and nature—turning back the



PETA spends millions of dollars on publicity and materials for school classrooms.

clock of human progress approximately 4,000 years. The pagan nature of the animal rights movement is underscored by its attack on the concept of the sanctity of human life. "I don't believe human beings have the 'right to life,'" asserted Ingrid Newkirk of PETA in a 1986 interview.

The animal liberationists make no bones about the fact that their main objective is to eliminate this concept, which is the principal way in which man's superiority to the rest of nature has historically been expressed.

The most explicit statements to this effect come from the above-mentioned Peter Singer, a philosopher at Australia's Monash University who styles himself an expert on medical ethics, as well as animal rights.

Singer places himself in the tradition of British utilitarian Jeremy Bentham, who took love of animals to truly bizarre depths. In his writings, including *Animal Liberation*, Singer invokes Bentham's thesis that the most important characteristic of a being is its capacity to feel pleasure and pain. Singer argues that, since animals have this capacity, they should be treated essentially as humans—and vice versa.

This ridiculously simplistic view of what constitutes life leads straight down the path to the wholesale destruction of human rights, including the fundamental right to life. And Singer travels right down that path.

Save Animals, Sacrifice Humans

It is entirely consistent with his animal rights views that Singer also actively lobbies for infanticide and euthanasia—against humans, of course; not animals. The Oxford-educated Singer thinks that murdering people is a fine thing to do, if they don't meet his standards. He may be against killing animals for food or using them in medical research, but in his eyes (and the eyes of his multitudinous followers), certain humans—the elderly, the newborn, the handicapped—are all fair game.

Singer has stated publicly that it is more moral to kill a "defective" human newborn than it is to kill a healthy chimpanzee. To say otherwise, he charges, is an example of "speciesism."

In 1985, in reaction to the "Baby Doe" court decision protecting handi-

capped infants, he wrote a book titled, *Should the Baby Live? The Problem of Handicapped Infants*. In it, he wrote that the "doctrine of the sanctity of life, as understood in the Western tradition since Christianity prevailed, is not in any sense a fundamental tenet of a civilized society."

This was by no means the first time Singer had expressed such a view. In a 1983 article in *Pediatrics*, Singer wrote:

"Once the mumbo-jumbo surrounding the term 'human' has been stripped away, we may continue to see normal members of our species as possessing greater capacities of rationality, self-consciousness, communication and so-on, than members of any other species; but we will not regard as sacrosanct the life of each and every member of our species, no matter how limited its capacity for intelligent or even conscious life may be. If we compare a severely defective human infant with a nonhuman animal, a dog or a pig, for example, we will often find the nonhuman to have superior capacities, both actual and potential, for rationality, self-consciousness, communication, and anything else that can plausibly be considered morally significant."

Four years earlier, in a book titled *Practical Ethics*, Singer wrote that Bentham "was right to describe infanticide as 'of a nature not to give the slightest inquietude to the most timid imagination.'" He then argued for legislation that would "deny a full legal right to life to babies" for at least a month after birth. "Killing a defective infant is not morally equivalent to killing a person. Very often it is not wrong at all."

In the same volume he marshaled a host of arguments in favor of euthanasia—including "nonvoluntary euthanasia" and active euthanasia—against the elderly, the handicapped, and the terminally ill.

Singer's pronouncements bear a frightening resemblance to the Nazis, whose euthanasia program against "defective" German citizens led inexorably to the Holocaust. And no wonder. Singer himself, in attempting to justify euthanasia, has written that while the Nazis "committed horrendous crimes," this "does not mean that everything the Nazis did was horren-

Out of Their Own Mouths

"Animal liberationists do not separate out the human animal. A rat is a pig is a dog is a boy."

—Ingrid Newkirk of PETA

"I don't believe human beings have the 'right to life.'"

—Ingrid Newkirk, 1986

"If we compare a severely defective human infant with a nonhuman animal, a dog or a pig, for example, we will often find the nonhuman to have superior capacities, both actual and potential, for rationality, self-consciousness, communication, and anything else that can plausibly

be considered morally significant."

—Peter Singer, *philosopher, 1985*

"Killing a defective infant is not morally equivalent to killing a person. Very often it is not wrong at all."

—Peter Singer in *Practical Ethics*

"In every civil rights battle, eventually you see people taking the law into their own hands. . . . I cannot condone bombings or terrorist activities, but . . . the people who are committing the real atrocities are on the inside [i.e., the researchers]. . . ."

—Chris DeRose, *West Coast activist*

dous. . . . We cannot condemn euthanasia just because the Nazis did it."

War on Science

Nothing better proves the contention that the real purpose of the animal rights movement is to kill people, rather than to prevent cruelty to animals, than the movement's assault on biomedicine. For the past 10 years, animal liberationists have conducted a war against medical science and scientific researchers, claiming that the use of animals in any kind of research is fundamentally immoral.

In the 1980s, animal rights terrorists broke into more than 90 labs and research centers, smashing equipment, destroying data, stealing research animals, and causing an estimated \$10 million in physical damage. Animal liberationists have been dangerously successful in their efforts to close down medical research. In literally hundreds of cases, they have been able to bring important research projects to a halt, or to put them on indefinite hold.

Author Katie McCabe described several research projects that have been adversely affected by the animal cultists in an article published in the February 1990 *Washingtonian*—an article for which PETA subsequently used its fat warchest to sue her. One particularly striking case she cited concerns Dr. John Orem. Last year, members of the Animal Liberation Front (ALF)

broke into a lab run by Orem, a researcher at Texas Tech University who is doing ground-breaking work on the cause of sudden infant death syndrome (SIDS). They destroyed his equipment and uncaged his research animals.

His work suffered tremendously. "Every year we lose 8,000 babies to crib death, because we don't fully understand how the brain controls breathing during sleep," Orem says. "In the last two years, my work had begun to explode, to generate a multitude of questions that could lead us to a drug therapy to prevent SIDS."

As a result of the raid, "I can't even analyze the data I do have until we replace the equipment the ALF damaged. That analysis is the basis for the next stage of experimentation. How do you begin to translate all of that into human costs? I don't know."

The Cost to Humankind

The threat of such damage has forced many research centers to spend outrageous sums on upgraded security to prevent or deter damage or intrusions. "This is money that could have gone for more research, or for upgrading the conditions that lab animals are kept in," a spokesman for the Foundation for Biomedical Research points out.

Officials at the Yerkes Regional Primate Center near Atlanta recently had to allocate hundreds of thousands of

dollars on new alarms and other security measures, following two bomb threats and five attempted break-ins.

Worse, many scientists engaged in biomedical research have been subjected to such cruel treatment—ranging from organized hate-mail campaigns to death threats and physical attacks—that researchers are being frightened and harassed into leaving the field.

This end is openly sought by the animalists. "We're demoralizing the people who think there's a buck to be made in animal research," gloats PETA's medical adviser, Neal Barnard. "And they're starting to get scared, and they're starting to get angry and they're starting to give way."

The animal liberationists have managed to force through a variety of ordinances and regulations governing the treatment of animals in experimental research that have vastly increased its cost. A case in point is a series of amendments sponsored by Sen. Robert Dole (R-Kan.) that were attached to the 1985 Omnibus Farm Bill. These put stringent requirements on such things as cage size, feeding, and even the animals' psychological environment. Estimates of what it will cost to meet these requirements range from \$1 to \$2 billion.

Animal rightists insist that animal experimentation is not necessary, and that its results can be accomplished through methods such as computer modeling or work on cells. This is a lie.

"Many of the problems that we seek to address depend on a highly structured organization," explains Michael Jackson, dean of research at George Washington University in Washington D.C. "Diabetes, for example, can be regarded at a level of certain cells or parts of cells. But if we want to understand the entire problem we have to look on it as a multisystem disorder that affects tissues and organs like the brain, the liver, the heart, and the kidneys. And there is no way that a computer or an isolated cell system can simulate the organization of a tissue or organ."

There is virtually no disease for which a cure or treatment has been found that did not involve animal research. "It's easy to say animals have rights until you have to make a

choice," says Dr. Frederick Goodwin, head of the Alcohol, Drug Abuse, and Mental Health Administration. "If you stop using animals . . . you will slow down and eventually stop medical progress." "Virtually every major biomedical advance can be traced back to original critical studies using animals," says John A. Krasney, Professor of Physiology at the State University of New York at Buffalo.

Diabetes, typhus, polio, meningitis, syphilis, hemophilia, and diphtheria would still be killing millions each year had it not been for animal research. Viral research, angiograms, cardiac catheters, radiation therapy, X-rays, artificial joints, surgical techniques, blood transfusions, skin grafts, organ transplants—none of these life-saving advances would have been possible without the use of animals.

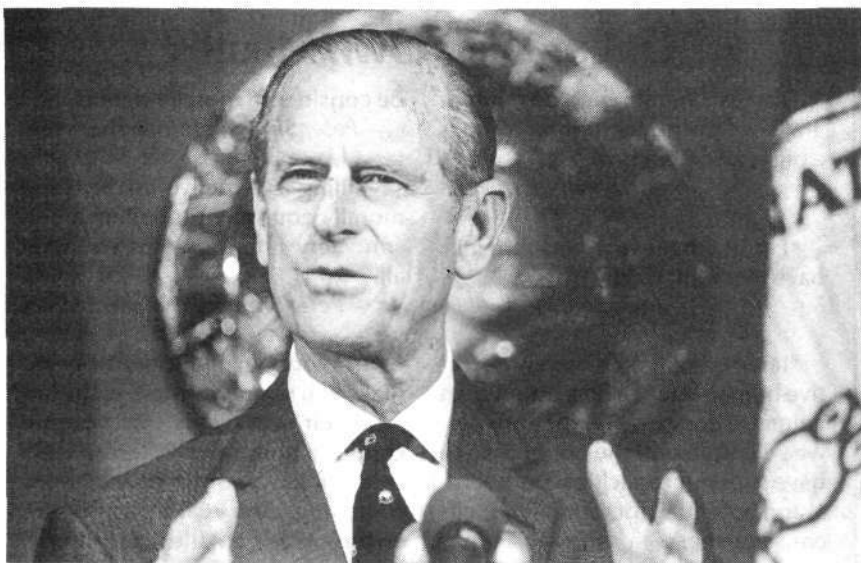
And it's not just humans who have benefited from animal research. Animals, too, have had their lives improved and their life-span lengthened by animal experimentation, the rabies vaccine being just one example.

Terrorism

Animal activists piously claim to be nonviolent, but their actions tell a different story. In June 1990, two assassination attempts were made on British scientists by animal rights fanatics; in one attack, an infant was severely injured. This was part of an escalating pattern of terrorism against researchers. In the last few years, scientists at Duke Medical Center, Cornell University, and the National Institutes of Health have received death threats.

In November 1988, a woman animalist was arrested outside the United States Surgical Corp. in Norwalk, Connecticut, and charged with planting a bomb near the parking place assigned to the company's chairman. According to author Kate McCabe, West Coast activist Chris DeRose, commenting on this apparent murder attempt, predicted that there would be many more in the future. "In every civil rights battle," he said, "eventually you see people taking the law into their own hands. . . . I cannot condone bombings or terrorist activities, but . . . the people who are committing the real atrocities are on the inside [i.e., the researchers]. . . ."

DeRose's comments are testimony



Stuart Lewis

Prince Philip says he would like to be reincarnated "as a deadly virus, in order to reduce the population explosion."

to the misanthropy motivating the animal rights movement, especially at the top. Many of those who rail against animal research propose conducting experiments on humans instead. Gracie Slick, the lead singer of the psychedelic 1960s band, "Jefferson Airplane," and now one of the movement's many celebrity supporters, has openly called for using death-row inmates in experiments that now employ animals.

A Pagan Cult

One of the leading patrons of both the animal rights and environmentalist movements is Britain's Prince Philip, who heads the rabidly zero-growth Worldwide Fund for Nature. Philip has made no secret of his contempt for human life. A few years ago he publicly stated that he wished to be reincarnated as a deadly virus, so he could help wipe out "excess" human population.

Just days before 20,000 animal liberationists demonstrated in Washington in June 1990, Philip told the *London Observer* that he had recently met with Pope John Paul II to argue that human population growth had to be drastically curbed, because it was "reducing the space available" for wild animals. In the same interview, the prince criticized the Bible for allegedly promoting cruelty to animals.

Philip's plug for the animal liberationists came only three weeks after he

gave a speech in Washington praising paganism for its "ecological pragmatism" and castigating Christianity for having tried to take people away from pagan nature worship. Philip was addressing the North American Conference on Religion and Ecology held May 16-19, which featured among its speakers leading animal-rights activist Michael Fox, of the Humane Society of the United States. In his presentation, Fox charged that man's "doministic" attitude toward the animal kingdom had resulted in a "holocaust." To establish the right relationship with nature, said Fox, humanity must abandon the "male, monotheistic religion of reason" and return to the "religious traditions of earlier times, which linked humanity to the animal kingdom through the Earth Mother, the matrix-creatix . . . Gaia, Pan, Diana."

Philip and his collaborators are using the animal rights movement, along with environmentalism, to re-create a global empire modeled on pagan imperial Rome, in which the vast majority of human beings would be treated as animals. Historically, the notion of "animal rights" has cropped up in the context of similar attempts to reverse human progress. The Cathars, for example, a religious sect flourishing in southern France from the 11th through the mid-13th centuries, refused to kill an animal, or to eat meat, eggs, or any other animal product, on

two grounds: first, that human souls transmigrate to animals; and second, that animals are the result of sexual intercourse.

Like their gnostic forebears, the Cathars believed that the God who created the material universe was evil and thus matter was evil. They therefore believed that sexual intercourse was the original sin of Adam and Eve, because it produced the greatest of all sins, children.

Compare this to the message of a new animal rights book by John Robbins, *Diet for a New America*, which is being hailed as the bible of the anti-meat crusade. Robbins writes: "Don't eat anything that has a face. Don't eat anything that has sexual urges, that has a mother or father, or that tries to run away from you." The source of these injunctions is the Manichaeon tradition of the Cathars.

There was another resurgence of animal rights in 19th century Britain, which directly overlapped two other pagan movements, Theosophy and the Fabian Society of H.G. Wells and George Bernard Shaw. Theosophy was

essentially another form of gnostic paganism. Annie Besant, a key figure in both Theosophy and the Fabian Society, became a devotee of the antivivisection cult through her friend, Anna Kingsford. Kingsford was a British occultist, with ties to MacGregor Mathers of the satanic Order of the Golden Dawn.

Kingsford hated the power of human reason and its ability to better the condition of man. She tried to use so-called magical powers to kill leading researchers of the time. Louis Pasteur was one of her first intended victims. Shortly after she cast a spell upon him, Pasteur fell ill, and Kingsford was convinced that her magic had worked. She directed her venom next against Professor Paul Bert, who coincidentally died.

Kingsford wrote in her diary: "Yesterday, November 11th at eleven at night, I knew that my will had smitten another vivisector! . . . The will can and does kill, but not always with the same rapidity. . . . I have killed Paul Bert, as I killed Claude Bernard; as I will kill Louis Pasteur and after him the

whole tribe of vivisectors, if I live long enough, Courage: It is a magnificent power to have, and one that transcends all vulgar methods of dealing out justice to tyrants."

Perhaps the most infamous of all animal cultists was Adolf Hitler, whose fixation on four-legged creatures was part of his own deeply rooted gnostic outlook. As Prof. John Casey of Caius College, Cambridge, wrote in the June 17 *Sunday Telegraph* of London: "The most famous animal lover of the 20th century happened also to be a fervent vegetarian. It is said that his dog was the only being which inspired human affection in him. If he saw anyone eating meat-soup, he berated them for consuming what he called 'corpse tea.' He thought that the world would be a better place with a smaller human population of the finest stock. His name was Adolf Hitler."

His name is also Prince Philip, and the other enemies of human progress who propose to "solve" the world's problems by destroying science, killing people, and raising animals to the status of gods.



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Cold Fusion Is Still Alive and Well

As cold fusion approaches its second birthday, disparaging and slanderous articles in the media are still accompanying the continuing experimental and theoretical advances in this infant technology.

In late October, for example, as *21st Century* went to press, important results from a University of Hawaii experiment were announced at an international cold fusion meeting at Brigham Young University. The Hawaii experiment produced excess heat (600 to 1,500 percent) at the same time that there was measurable helium-4, a by-product of the deuterium nuclear fusion reaction. The Hawaii experiment measured 4×10^9 atoms of helium-4 in palladium rods after 100 hours, significantly above any background levels.

There were 100 cold fusion researchers from 16 countries at this Oct. 22-24 meeting on anomalous nuclear effects in deuterium/solid systems, and nearly all of the experimental papers reported positive results in the measurement of neutrons above background level and/or tritium production.

The nation's press, however, ignored the Brigham Young conference and instead blared headlines like "Cold Fusion Scientist Missing As Key Review Nears" and "Utah to Start Search for Cold Fusion Scientist" (*New York Times*, Oct. 25 and 26).

The story reported was that, when the time came for the state of Utah to review the state-funded National Cold Fusion Institute's work, the science researchers were "missing." *Times* science writer William J. Broad implied that Fleischmann and Pons had skipped town to avoid facing the reviewers because they could not "defend" their research. Pons's house was for sale, Broad reported, and his phone disconnected.

In fact, both scientists had been at the University of Utah in Salt Lake City since June, waiting for the review to be scheduled. Just after Pons took his

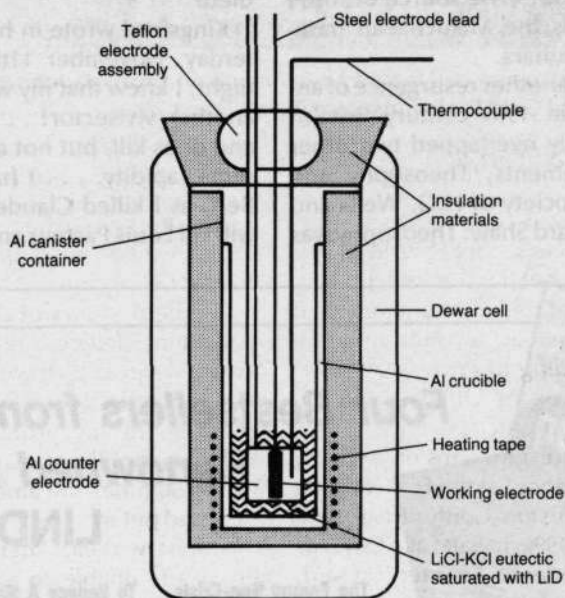
family on vacation to Europe, and after Fleischmann returned to his home in England for medical treatment, the October review date was set and the university could not reach either Pons or Fleischmann to tell them. As for Pons's house being for sale, he had moved to another address locally.

Both Pons and Fleischmann have stated that they will be present at the new review date, Nov. 7.

Knowledgeable observers in Salt Lake City commented that the U.S.

physics establishment in general, and at the University of Utah in particular, seems determined to shut down the National Cold Fusion Institute. One source said that the American Physical Society, which has led a nasty attack on cold fusion almost from the first day it was announced, threatened the university physics department with losing academic accreditation if it had contact with the university's Cold Fusion Institute.

—Marjorie Mazel Hecht



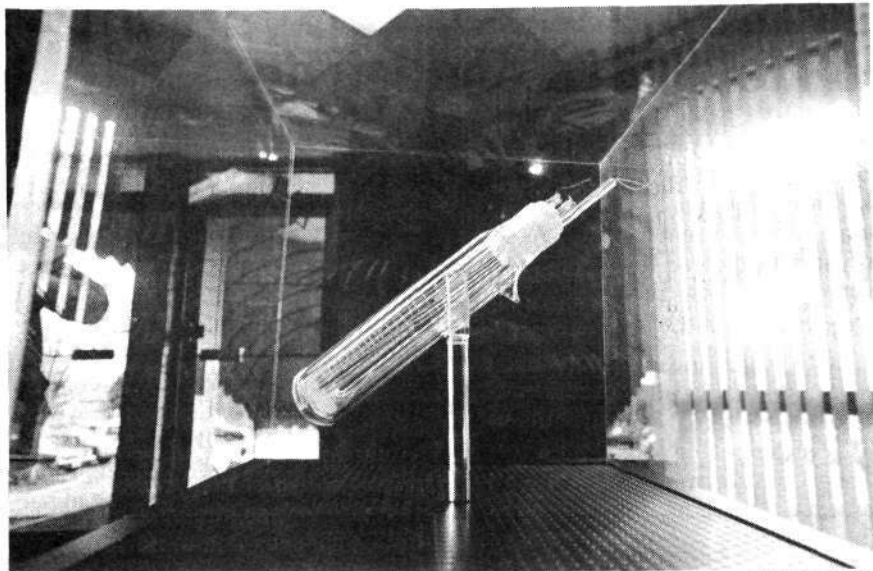
SCHEMATIC OF COLD FUSION MOLTEN-SALT CELL

This molten salt electrochemical cell was invented by Professors Bor Yann Liaw and Bruce E. Liebert of the University of Hawaii. Lithium deuteride is dissolved in a molten solvent of potassium chloride (KCl) and lithium chloride (LiCl). A palladium anode is immersed in the melt along with an aluminum cylinder as the cathode. Typical operating temperatures are about 370° Celsius. The palladium is precharged with deuterium negative ions at low current, and the current is then increased to 600 milliamps per square centimeter. The output at this current level ranged from 6 to 15 times as much energy out as energy put in. The input voltages are kept below the level at which chlorine gas would be evolved from the salts.

Liaw and Liebert said that because metal surface oxides are readily removed in the electrolyte, the system may make it possible to use less expensive materials than palladium. They foresee the possibility of high-grade heat and high thermodynamic efficiencies for utility applications.

Source: Adapted from *Fusion Facts*, October 1990

The 'Superradiance' Theory of Cold Fusion



University of Utah

A sample cold fusion cell from a Fleischmann and Pons experiment, on display at the National Cold Fusion Institute in Salt Lake City.

by Evanthia Frangou

At this point no one knows for certain what is happening in cold fusion experiments, but it is the search for an explanation of this phenomenon that may well cause a "revolution in science," according to Professor Giuliano Preparata of the University of Milan, a nuclear physicist.

Preparata presented his own theory of "superradiance" at the First International Cold Fusion Conference, held March 28-31, 1990, in Salt Lake City. His theory of condensed matter, he said, would also explain other curious phenomena like room-temperature superconductivity and the peculiar organization of water with "memory" observed in the experiments of Jacques Benveniste in 1988 (See *21st Century*, Nov.-Dec. 1988, p. 16).

What Is Cold Fusion?

Scientists Martin Fleischmann and Stanley Pons startled the world when they reported on March 23, 1989, that they had produced a fusion reaction in a simple electrochemical cell.

The Fleischmann and Pons apparatus consisted of palladium and platinum electrodes placed in a glass tube with heavy water. A voltage was applied across the electrodes that split the water, by electrolysis, into oxygen

and deuterium—a heavy isotope of hydrogen with one proton and one neutron in the nucleus.

This deuterium was absorbed by the palladium lattice, releasing much more energy in the process than could be accounted for if a merely chemical reaction was occurring. In fact, the Fleischmann-Pons experiment produced 50 times the amount of energy they had put in.

Almost two years later, conventional physics is unable to explain what is happening in cold fusion that leads to the excess energy and the other experimental products found, like neutrons, tritium, and, most recently, helium-4. Preparata's attempt to explain cold fusion centers on the electromagnetic effect of superradiance, which causes electrons in condensed matter like palladium to move in phase instead of chaotically. Molecules in the gas phase tend to move about randomly, but those in the liquid or solid phase (condensed matter) act in a unified manner as though they are aware of one another.

Coherent Behavior

Superradiation, a concept derived from quantum electrodynamics, is capable of acting beyond the distances

of the normal static forces between atoms. As Preparata explains it, superradiance coordinates the oscillations of the electrons, creating within the atomic lattice of palladium "holes"—spaces equal in number to the nuclei of palladium—of strong negative charge capable of reducing the repulsive force of the Coulomb barrier.

Deuterium atoms are pulled into these spaces where they, in turn, manifest a repulsive force that serves to keep away the other deuterons that then must find other empty spaces to occupy, Preparata says. If the chemical preparation of the palladium cathode favors the deuterium absorption by the palladium beyond the natural threshold ratio of 2:3 (that is, 2 deuterium atoms to 3 of palladium), the deuterium will eventually occupy all the spaces until it has a 1:1 relationship with the palladium.

At this point the superradiance effect between the nuclei of deuterium will lead to fusion.

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DEUTERIUM ATOMS IN THE PALLADIUM LATTICE

In the superradiance theory, the coherent oscillations of the electrons create spaces in the palladium that are strongly negatively charged. Deuterium atoms are then pulled into these holes. When all the spaces of the lattice are filled with deuterium, new deuterium atoms "tunnel" into already occupied holes, resulting in fusion. The circles denote palladium nuclei; the squares are deuterium nuclei.

INTERVIEW WITH GIULIANO PREPARATA

Coherent Self-Organization Is Key To Cold Fusion and Hot Superconductivity

Prof. Giuliano Preparata, a theoretical physicist at the University of Milan, recently spent a semester as a visiting professor with the National Cold Fusion Institute at the University of Utah in Salt Lake City. He is the author of more than 200 theoretical papers on high energy physics. Preparata was interviewed by Evanthia Frangou in Milan in June.

Question: Can you explain in more detail the notion of superradiance and how it is a possible explanation for the phenomenon of cold fusion.

Superradiance is the self-organization of matter in interaction with electromagnetic radiation. This occurs in a situation where the matter is highly condensed, as in a liquid or in a solid. This behavior does not hold, at least spontaneously, in a dilute system like a gas.

A gas is a phenomenon that is easy to describe physically: all the single molecules of the system, like balls, go on their own randomly. But if you take

this gas and compress it, and lower the temperature until it makes the transition into a liquid or a solid phase, then something different happens. As soon as you put all these "balls" or systems together they lose their individuality. They become part of a big family, and



Stuart Lewis

"We need a revolution in science." Preparata's theory, which involves the coherent self-organization of matter and electromagnetic radiation, explains both the cold fusion successes and the failures.

it does not look anymore like balls, but like plasma fluids throughout the crystal. The whole entity is endowed with completely different properties. The whole is really much more than the sum of its parts.

I have shown that under certain conditions the laws of quantum mechanics that everyone loves and cherishes, in fact, do allow for the kind of system of self-organization that occurs in condensed matter. When you simply look at it from the outside, nothing in particular seems to be happening. However, if you really look deep inside the system, you see all the elementary systems—the atoms, molecules, and so on—just oscillating in phase, at the same pace, and with a peculiar configuration of the electromagnetic field.

This radiation gets trapped inside and cannot get out; it is imprisoned in the matter. It is this order that makes possible the strange phenomena that we begin to see in cold fusion, for example.

Superradiance

Continued from page 23

When all the holes or spaces of the lattice are filled up, the new deuterium arrivals wander about the lattice and create the conditions for the slow effect known as the "tunneling effect." Here the deuterium atoms are able to cross over and enter a "hole" that is already occupied, resulting in the occurrence of fusion.

Preparata says, however, that the fusion that takes place within the atomic lattice is very different from the classical fusion that occurs in a vacuum where two nuclei of deuterium fuse and produce helium-3 plus neutrons, or tritium plus protons. In the palladium lattice, two nuclei of deuterium fuse to form helium-4 and liberate energy; no neutrons are produced. The

energy liberated is captured and dissipated by the lattice and appears in the form of heat.

The Presence or Absence of Neutrons

This corresponds to the Fleischmann and Pons experiment where a lot of energy was produced, but few neutrons. The fact that there have been neutrons observed in some experiments, Preparata says, might be explained by the various treatments of the palladium cathode prior to its use for cold fusion. The palladium used by many experimenters—but not Fleischmann and Pons—is often put through thermal cycles and high pressure gradients that create certain irregularities in the lattice. In these cases, the lattice does not have the conditions to behave coherently and the deuterium tunneling effect cannot take place, he says.

The fusion that does take place in

this case is similar to that that occurs in a vacuum; that is, producing in the same proportions tritium plus protons, and helium-3 and neutrons. However, this setup does not take advantage of the enormous enhancement that coherent fusion gives to the rate of this process, Preparata says. In fact, the majority of the heat produced comes from the coherent process that produces helium-4 and energy.

"The advantage of superradiance," Preparata says, "is also that it permits the numbers in our calculations to match up on the first attempt without the need of tedious modifications." In this way, also, he says, one can make a coherent picture out of the very diverse cold fusion experimental reports.

Evanthia Frangou, based in Milan, writes for the Italian-language magazine Fusione.

Question: How exactly does this radiation help the deuterons to fuse?

This fusion is really due to the fact that the various electrons are traveling; they are not static; they move at a peculiar pace, which creates the situation where it is much easier for the deuterons to get in touch and fuse. It is a very subtle and completely new way of behaving.

At first this somehow looks strange and ridiculous. You think, "there is a molecule here and another there, how do they know each other?" But they do, because essentially through radiation they are able to exchange long-range messages.

Question: Is this the way that the electrons are able to overcome the Coulomb barrier?

Yes, they are helped by these very strange plasma waves. Of course, this could not happen if matter is what everyone believes it is. But this is the point.

Question: You have also related this behavior of condensed matter to what may be happening in room-temperature superconductivity. What can you tell us about that?

I hope that by the end of this year I will have a theory on room-temperature superconductivity. The idea of having an ordered structure that remains so at high temperatures, or room temperature, is not trivial. Low temperature order in superconductors is order by default, because you can't have anything else. Room temperature order is order by choice, because there are so many other choices, all of them disordered to fight against, yet you choose the most unlikely possibility. This goes also for cold fusion at room temperature.

The basic mechanism that makes superradiance work is that there must be a system that can communicate electromagnetically only on a well-defined, sharp frequency. If you have a lot of frequencies, this radiation simply disperses itself. If electrons emit always at one peculiar frequency, then you have a tremendous amplification effect. So the real question for high temperature superconductors is to find out which are the discrete, peculiar frequencies on which the interac-

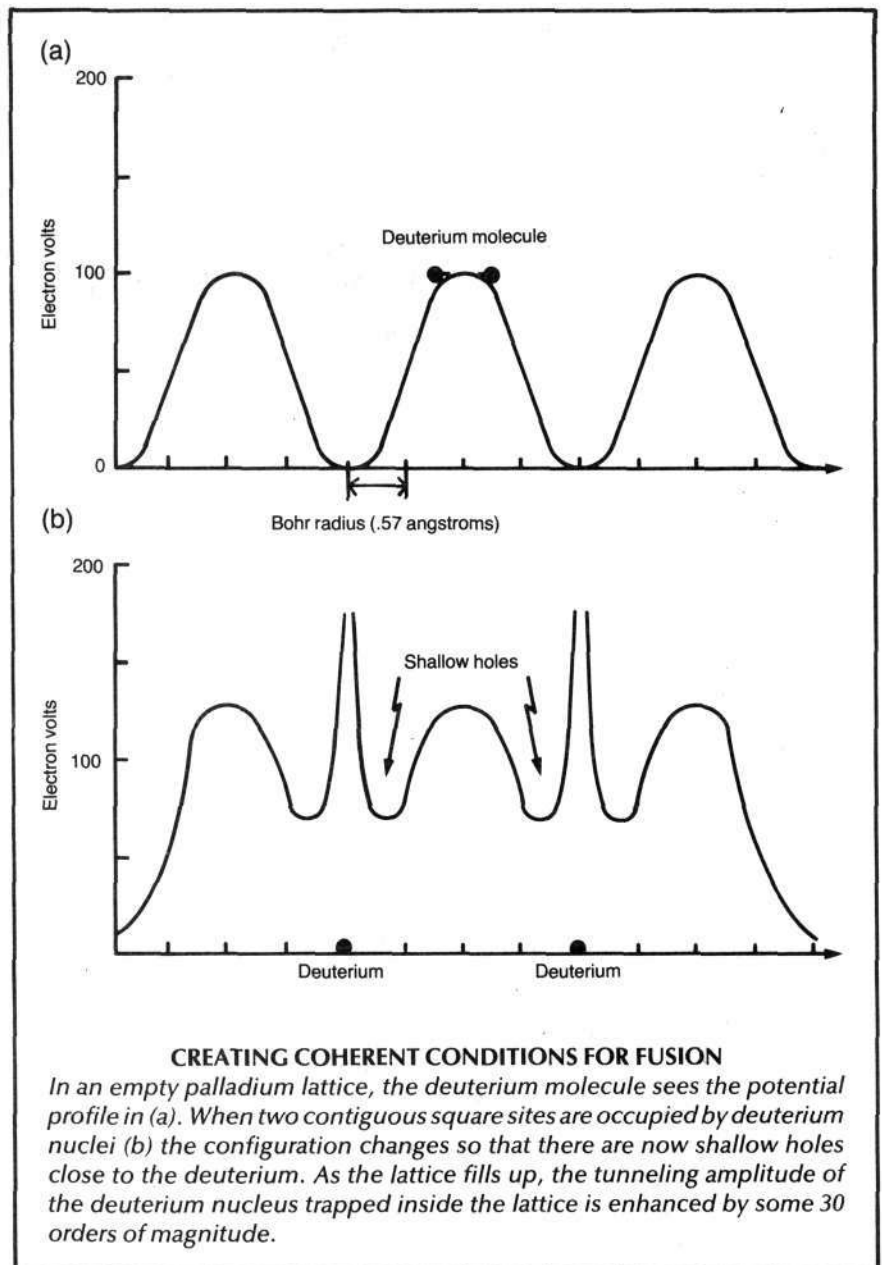
tion works out among electrons—the fluid that carries current into this type of material.

I think there is a very interesting hint in the antiferromagnetic structure of this material. You know that all the materials used in achieving room temperature superconductivity have this property. The copper spins tend to be aligned one opposite to the other. Now this looks very much like an undulator, a complicated magnetic structure like the one used in the FEL or free electron laser. So I got the very simple idea of using the single frequency that you have in the FEL to do that, and I

believe that idea works out.

Of course, I have not been able to work out all the specifics yet. A superconductor, even from a conceptual point of view, is a very complicated system. There's the question of pair condensation and so forth, but these are just technicalities. Again, the concept is that when a particle moves on a magnetic structure that undulates, then it works with a single frequency. That is the frequency in which the electrons can talk to each other, get ordered, and condense.

This is a dynamic order, not a static
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Interview

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order. These are relationships not in space but in time. This is because you want to have at the same time order and plasticity. You don't want this order to be frozen; you want this order to move like water and yet keep its formation even though it moves.

Superradiance is an ordering that comes from the fact that the matter

systems—say, electrons, atoms, molecules, nuclei, whatever—communicate with each other in particular frequencies of the electromagnetic field. It is a superradiating process because the radiation is enormously amplified by the fact that there are many systems that radiate precisely, the same way it happens in a laser.

Question: You have also proposed that this behavior of condensed matter can explain some peculiar properties of water that may play a part in the observed

water with "memory" of the Benveniste experiment?

Here a similar thing could be happening, only with different actors in the play, shall we say. But these actors tend to play always in the same way [see box].

Question: How did you arrive at the notion of superradiance?

Throughout my life I have concentrated on quarks, on the behavior of matter at very deep layers where there are still frontiers. It is not an area where the laws are yet established, so you still struggle to understand what the forces are, what the fields are, and how they behave. It is not like ordinary matter, where scientists know precisely what the forces and the actors of the collective drama of matter are. For some reason, because of certain steps I took in my life, I was able to transfer to this area the things I had understood for quarks. About three years ago, by chance I got interested in this area. Putting two and two together, a picture of matter emerged that made a tremendous amount of sense.

How H₂O Molecules 'Communicate'

Giuliano Preparata discusses structured water and the Benveniste experiment in Paris in 1988, in which water seemed to have a "memory." His remarks are condensed from an article he wrote for the Italian daily La Stampa, in August 1988.

I would like to present a few recent theoretical developments on the structure of water that, far from explaining the results of the Benveniste group, do however shed light on the capacity of water, up to now unknown, to organize itself around biological molecules in dynamic structures of considerable complexity. It allows for phenomena that imply that water assumes an active role in biological reactions.

...
Some months ago, my colleagues, E. Del Giudice and G. Vitiello, and I decided to apply some ideas that I had developed in the area of laser physics, to the fundamental substrate of living material: water. We decided to concentrate on the most simple aspects of water. We described it as a collection of a large number of molecules that are shaped like a wide "V," with oxygen at the vertex and the two hydrogen atoms at the ends. These rotate without stop, trailing behind them a sort of radio antenna because of asymmetry of the electric charges of the atoms of hydrogen (positive) and of the oxygen atoms

(negative).

Soon it became clear to me that this rotating antenna created a communication of the molecules via "radio" of within a distance of some tens of microns, the typical dimension of the cell. This radio contact informs the molecules to combine together at precise cadences, transforming the initial chaos into a dynamic order, very similar to what happens to the photons in a laser.

Water, in fact, behaves like a laser! In the "preordered" system of this myriad of walky-talkies that are constantly exchanging information, we attempt now to place a biological molecule also equipped with a walky-talky (which is usually the case). This new molecule will be able to "give orders" to the water around it at a distance equal to that of the cell's dimensions, generating in this way around itself a state of water that is very "personalized," that depends on the type of "orders" that were given.

That molecules of water could communicate electromagnetically on particular frequencies has been known for a long time. It used to be thought, though, that the signals were too weak to have appreciable consequences. What has been understood recently is that, due to a mechanism that occurs also in lasers, the mechanics of quanta enormously amplifies these signals.



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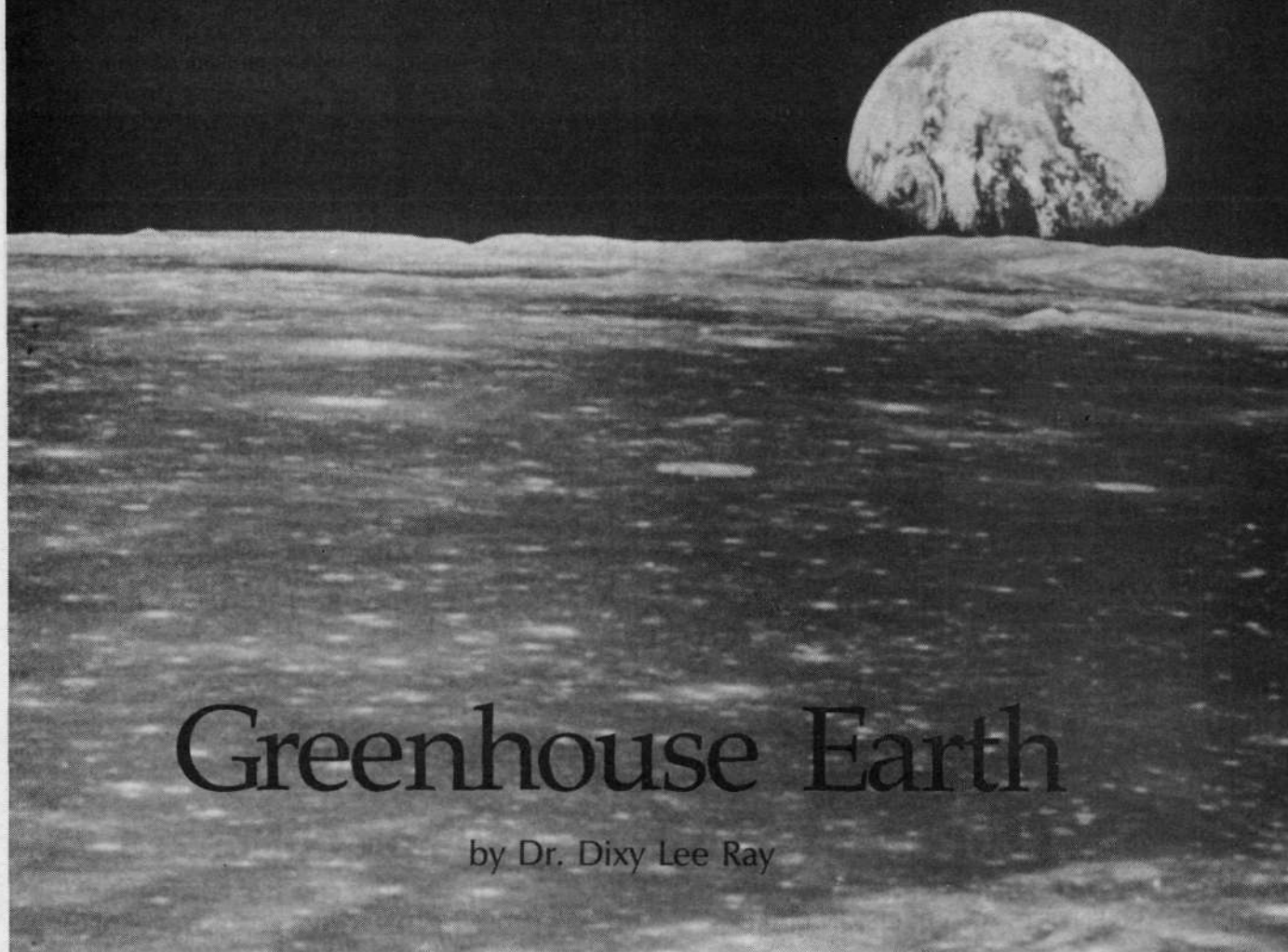
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Greenhouse Earth

by Dr. Dixy Lee Ray

The year 1988 ended on a high note of environmental hysteria about global warming, fueled by an unusually hot, dry summer in the United States. Testifying at a Senate hearing, James E. Hansen of NASA's Goddard Institute for Space Studies claimed that the high temperatures presaged the onset of the long-debated greenhouse effect caused by increased carbon dioxide (CO₂) in the atmosphere.

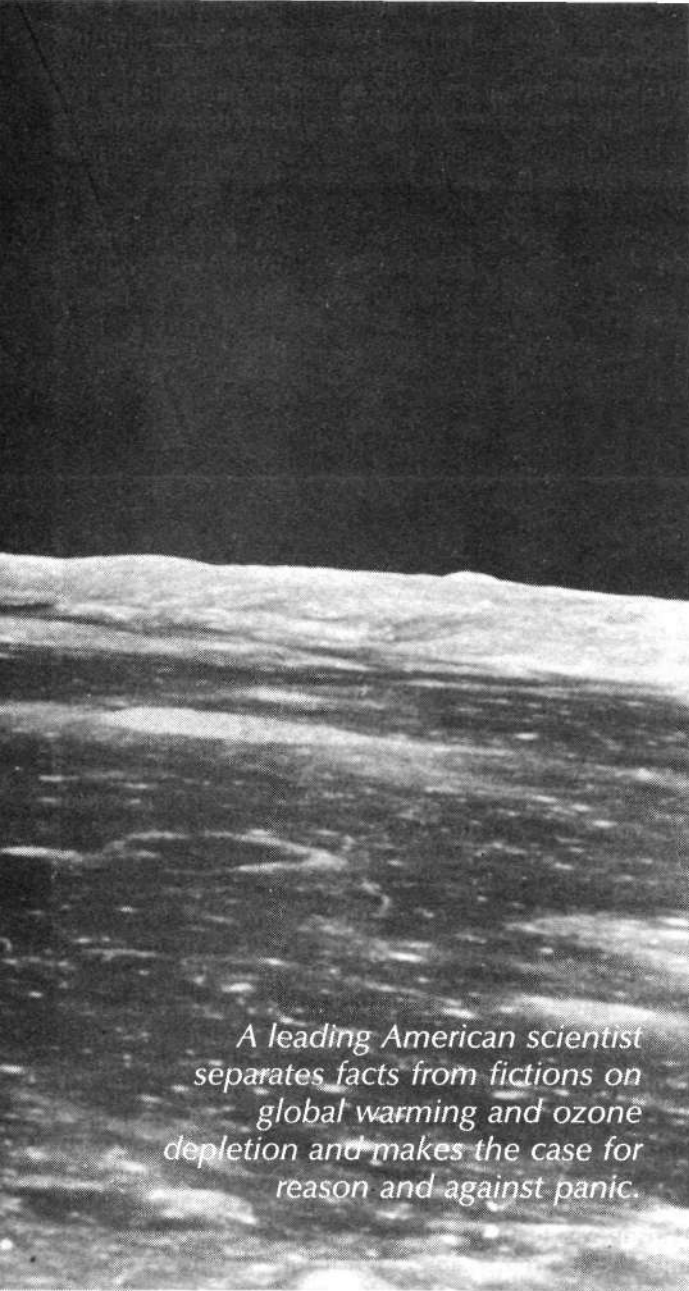
Forgotten was the harsh winter of 1982, or of 1978, when, for example, barges carrying coal and heating oil froze in river ice and more than 200 people lost their lives in the cold weather.

Only days after *Time* magazine featured a doomed, overheated Earth as its "man of the year" for 1988, Alaska experienced the worst cold in its history. The freezing weather set in on Jan. 12, 1989. Twenty different locations in our most northerly state recorded their lowest-ever temperatures, mainly in the range of -50 to -65° Fahrenheit. At Tanana near Fairbanks, -75°F was reached. The all-time low recorded anywhere in Alaska was -80° in January 1971 at a

Prospect Creek pipeline station. The cold persisted; it did not moderate and begin to move south until the first week of February. Old-timers agreed that no such cold had ever been experienced before, and they expressed amazement that the temperature remained a chilly -16°F along the coast even with an 81-knot wind blowing. This was unheard of, since usually it is coldest when the wind is quiet. In early February, the cold seeped down from Alaska along both sides of the Rocky Mountains, bringing near-record lows both to the Pacific Northwest and throughout the Midwest, south to Texas and eventually to the mid-Atlantic and New England states. Proponents of the "greenhouse-is-here-global-warming-has-begun" theory were very quiet during these weeks.

To be fair, even if the projected greenhouse warming should occur, no one would expect it to happen all at once or without intervening cold spells. So let's examine the situation more closely.

Of course, the Earth, with its enveloping blanket of atmosphere, constitutes a "greenhouse." This fact has never



A leading American scientist separates facts from fictions on global warming and ozone depletion and makes the case for reason and against panic.

been at issue. Indeed, were it not for the greenhouse function of air, the Earth's surface might be like the Moon, bitterly cold at night (-270°F) and unbearably hot during the day ($+212^{\circ}\text{F}$).

Although the amount of solar energy reaching the Moon is essentially the same as that reaching the Earth, the Earth's atmosphere acts like a filter. Of the incoming solar radiation, about 20 percent is absorbed in the atmosphere, about 50 percent reaches and warms the Earth's surface, and the rest is reflected back into space. As the Earth's surface is warmed up, infrared radiation is emitted. It is the presence of CO_2 (and water vapor, methane, hydrocarbon, and a few other gases) in the atmosphere that absorbs the long wavelength infrared radiation, thereby producing the warming "greenhouse effect." This accounts for a net warming of the Earth's atmosphere system of about 55°F . Without this natural greenhouse, it would be difficult to sustain life on this planet.

All the important "greenhouse gases" are produced in nature, as well as by humans. For example, CO_2 comes

The Earth, with its enveloping blanket of atmosphere, constitutes a "greenhouse." Indeed, were it not for the greenhouse function of air, the Earth's surface might be like the Moon, bitterly cold at night and unbearably hot during the day. Here, the Earth as seen from the Moon.

naturally from the respiration of all living organisms and from decaying vegetation. It is also injected into the atmosphere by volcanoes and forest and grass fires. Carbon dioxide from man-made sources comes primarily from burning fossil fuels for home and building heat, for transportation, and for industrial processes. The amount of CO_2 released into the atmosphere is huge and it is commonly believed that it is divided about evenly between natural and man-made sources.

Hydrocarbons come from growing plants, especially coniferous trees, such as fir and pine, and from various industries. In the transportation arena, hydrocarbons result from incomplete oxidation of gasoline. Both hydrocarbons and methane also enter the atmosphere through the metabolism of cows and other ruminants. It is estimated that American cows produce about 50 million tons of these gases per year—and there is no control technology for such emissions. Methane seeps into the air from swamps, coal mines, and rice paddies; it is often "flared" from oil wells. The largest source of greenhouse gas may well be termites, whose digestive activities are responsible for about 50 billion tons of CO_2 annually. This is 10 times more than the present world production of CO_2 from burning fossil fuel. Methane may be oxidized in the atmosphere, leading to an estimated 1 billion tons of carbon monoxide per year. All in all, the atmosphere is a grand mixture of gases, in a constant state of turbulence, and yet maintained in an overall state of dynamic balance.

But now this balance appears to be disturbed as CO_2 and the other major greenhouse gases are on the rise, increasing their concentration in the air at a rate of about 1 percent per year. CO_2 is responsible for about half of the increase. Analysis of air bubbles trapped in glacial ice and of carbon isotopes in tree rings and ocean sediment cores indicates that CO_2 levels hovered around 260 to 280 parts per million (ppm) from the end of the last ice age (10,000 years ago) till the mid-19th century, except for an anomalous rise 300,000 years ago. And these measurements also show that CO_2 concentrations have varied widely (by 20 percent) as the Earth has passed through glacial and interglacial periods. While today's 25 percent increase in CO_2 can be accounted for by the burning of fossil fuels, what caused the much greater increases in the prehistoric past?

The present increase has brought the CO_2 level to 340 ppm, up about 70 ppm. If we add the greater amounts of methane, hydrocarbons, and so forth, there is now a total of about 407 ppm of greenhouse gases. This is large enough so that from the greenhouse effect alone we should have experienced a global warming of about 2 to 4 degrees F. But this has not happened.

Warming: The Evidence Doesn't Fit

The observed and recorded temperature pattern since 1880 does not fit with the CO_2 greenhouse warming calculation.



Philip Ulanowsky

All the important "greenhouse gases" are produced in nature as well as by humans. Cows in the United States alone produce about 50 million tons, and termites, through their digestive activities, produce about 50 billion tons annually.

tions. During the 1880s, there was a period of cooling, followed by a warming trend. The temperature rose by 1°F during 1900 to 1940, then fell from 1940 to 1965, and then began to rise again, increasing by about 0.3°F since 1985. When all these fluctuations are analyzed, it appears unlikely that there has been any overall warming in the past 50 years. And if the temperature measurements taken in the northern hemisphere are corrected for the urban effect—the so-called heat-island that exists over cities due mainly to the altered albedo from removing vegetation—then it is probable not only that there has been no warming, but that there may have been a slight cooling. It all depends on whose computer model you choose to believe.

Clearly, there is still something that is not understood about global conditions and about the weather links between the oceans and the atmosphere. Have the experts fully taken into account the role of the sea as a sink or reservoir for CO₂, including the well-known fact that much more CO₂ dissolves in cold water than in warm? Interest in the greenhouse gases and projections of global warming has stimulated greater interest in the role that the oceans play in moderately influencing or even drastically changing global climate. The oceans hold more CO₂ than does the atmosphere—60 times more. Complex circulation patterns that involve waters of different temperature, together with the activities of marine organisms that deposit carbonate in their skeletons, carry carbon dioxide to the depths of the ocean.

Recall that all the public furor about global warming was

triggered in June 1988, when NASA scientist James Hansen testified in the U.S. Senate that the greenhouse effect is changing the climate now! He said he was 99 percent sure of it, and that "1988 would be the warmest year on record, unless there is some remarkable, improbable cooling in the remainder of the year." Well, there was. Almost while Hansen was testifying, the eastern tropical Pacific Ocean underwent a remarkable, improbable cooling—a sudden drop in temperature of 7°. No one knows why. But the phenomenon is not unknown; it is called La Niña to distinguish it from the more commonly occurring El Niño, or warm current, and it has happened 19 times in the past 102 years.

Hansen did not consider the possibility of La Niña, because his computer program does not take sea temperature into account. Yet the oceans cover 73 percent of the Earth's surface.

When people, including scientists, talk "global," it is hard to believe that they can ignore 73 percent of the globe, but obviously they sometimes do. It is all the more astonishing to ignore ocean-atmosphere interactions, especially in the Pacific, when it is well established that El Niño has profound and widespread effects on weather patterns and temperature; does it not follow that La Niña may also? Indeed, some atmospheric scientists credit the severely cold winter of 1988-1989 to the earlier temperature drop in the tropical Pacific.

Once again, since the greenhouse gases are increasing, what's keeping the Earth from warming up? There are a

number of possible explanations. Perhaps there is some countervailing phenomenon that hasn't been taken into account; perhaps the oceans exert greater lag than expected and the warming is just postponed; perhaps the sea and its carbonate-depositing inhabitants are a much greater sink than some scientists believe; perhaps the increase in CO₂ stimulates more plant growth and removal of more CO₂ than calculated; perhaps there is some other greenhouse gas like water vapor that is more important than CO₂; perhaps varying cloud cover provides a greater feedback and self-correcting mechanism than has been taken into account; perhaps. . . . *The fact is, there are simply not enough good data on most of these processes to know for sure what is happening in these enormous, turbulent, interlinked, dynamic systems like atmosphere and oceanic circulation.* The only thing that can be stated with certainty is that they do affect the weather. So also do forces outside the planet, and in a moment we'll look at the Sun in this regard.

The Question of Forestation

First, we must acknowledge that some zealots in the greenhouse issue make much of deforestation, especially in the tropical rain forests, but this topic is marked more by emotion bordering on hysteria than on solid scientific data. Good measurements on CO₂ uptake and oxygen production in tropical rain forests are lacking. Such information could be critical because we know that in temperate climates mature trees and climax forests add little in the way of photosynthetic activity and consequent CO₂ removal from the atmosphere. Mature trees, like all living things, metabolize more slowly as they grow old. A forest of young, vigorously growing trees will remove 5 to 7 tons more CO₂ per acre per year than old growth. There are plenty of good reasons to preserve old growth forests, but redressing the CO₂ balance is not one of them. If we are really interested (as we should be) in reducing atmospheric CO₂, we should be vigorously pursuing reforestation and the planting of trees and shrubs, including in urban areas, where local impacts on the atmosphere are the greatest.

Reforestation *has* been going on through enlightened forestry practices on private lands by timber companies and as a result of changes in agriculture and land use. In the United States, the average annual wood growth is now more than three times what it was in 1920, and the growing stock has increased 18 percent from 1952 to 1977. U.S. forests continue to increase in size, even while supplying a substantial fraction of the world's timber needs.

Finally, it should be kept in mind that when a tree is cut for timber it will no longer remove CO₂ from the atmosphere, but it won't release its stored carbon either—until or unless it is burned or totally decayed. In the whole deforestation question, it would be interesting to try to determine what effect the deforestation of Europe had on temperature and climate in the 19th century and, similarly, what the effect was of the earlier deforestation of the Mediterranean area and the Middle East.

If we study history, we find that there is no good or widely accepted explanation for why the Earth's temperature and climate were as they were at any particular time in the past,

including the recurring ice ages and the intervening warm periods. What caused the "little ice age" of the late 17th century and why was it preceded by 800 years of relative warmth? Is all this really due to human activity? What about natural phenomena? Recent studies of major deep sea currents in the Atlantic Ocean suggest a causative relation to the onset of ice ages. Occasional unusual actions by nature can release great quantities of CO₂ and other greenhouse gases to the atmosphere.

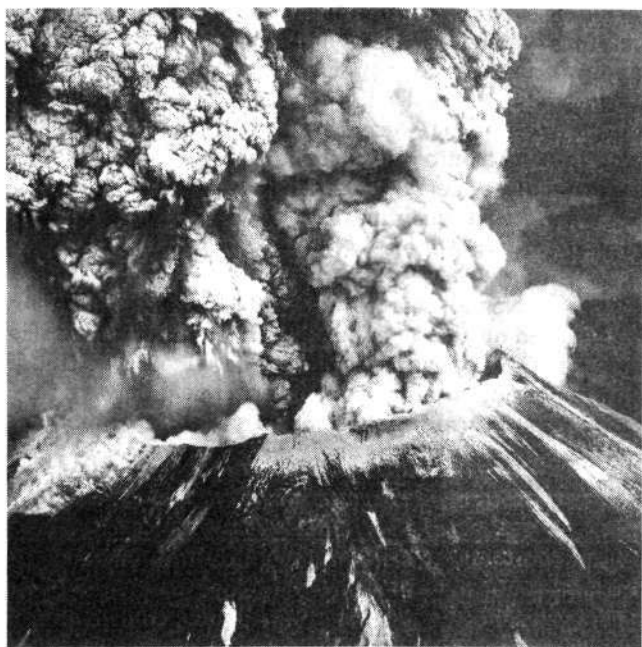
Natural Sources of Greenhouse Gases

I received my lesson in humility, my respect for the size and vast power of natural forces on May 18, 1980. For those who might not instantly recognize that date, it was a Sunday, a beautiful spring morning, when at 8:31 Mount St. Helens erupted with the force of more than 500 atomic bombs. Gases and particulate matter were propelled 80,000 feet, approximately 15 miles, into the stratosphere and deposited above the ozone layer. The eruption continued for nearly 12 hours and more than 4 billion tons of earth were displaced.

Because Mount St. Helens is relatively accessible, there were many studies conducted and good data are available on the emissions—at least those that occurred after May 18. For the remaining seven months of 1980, Mount St. Helens released 910,000 metric tons of CO₂, 220,000 metric tons of sulfur dioxide, and unknown amounts of aerosols into the atmosphere. Many other gases, including methane, water vapor, carbon monoxide, and a variety of sulfur compounds were also released, and emissions still continue to seep from the crater from fumaroles and crevices.

Gigantic as it was, Mount St. Helens was not a large volcanic eruption. It was dwarfed by Mt. St. Augustine and Mt. Redoubt in Alaska in 1976 and 1989 and El Chichon in Mexico in 1982. El Chichon was an exceptionally sulfurous eruption. The violence of its explosion sent more than 100 million tons of sulfur gases high into the stratosphere. Droplets of sulfuric acid formed; these continue to rain down onto the Earth's surface. The Earth, at present, appears to be in a period of active volcanism, with volcanic eruptions occurring at a rate of about 100 per year. Most of these are in remote locations, but they must be considerable. Some estimates from large volcanic eruptions in the past suggest that all of the air-polluting materials produced by man since the beginning of the industrial revolution do not begin to equal the quantities of toxic materials, aerosols, and particulates spewed into the air from just three volcanic eruptions: Krakatoa in Indonesia in 1883, Mount Katmai in Alaska in 1912, and Hekla in Iceland in 1947. Despite these prodigious emissions, Krakatoa, for example, produced some chilly winters, spectacular sunsets, and a global temperature drop of 0.5°F—but no climate change. From written records, we also know that the famous "year without a summer" that followed the eruption of Mount Tambora in 1816 meant that the summer temperature in Hartford, Connecticut, did not exceed 82°F. No doom.

We can conclude from these volcanic events that the atmosphere is enormous and its capacity to absorb and dilute pollutants is also very great. This is no excuse, of course, to pollute the air deliberately, which would be an



U.S. Department of the Interior

All the air-polluting materials produced by man since the beginning of the industrial revolution do not begin to equal the quantities of toxic materials, aerosols, and particulates spewed into the air from just three volcanoes—Krakatoa, Mt. Katmai, and Hekla. Here, Mt. St. Helens in 1980.

act of folly. But it does give us some perspective on events.

Extraterrestrial Effects on Weather

So far, we have considered only those phenomena that occur on Earth that might influence global temperature, weather, and eventually the climate. "Weather" means the relatively short-term fluctuations in temperature, precipitation, winds, cloudiness, and so forth, that shift and change over periods of hours, days, or weeks. Weather patterns may be cyclic, more or less repeating themselves every few years. The "climate," on the other hand, is generally accepted to be the mean of weather changes over a period of about 30 years. Weather may change rapidly, but the climate may remain essentially the same over thousands of years, as it probably has for the past 8,000 years.

Now what about the effects on weather of extraterrestrial phenomena? After all, it is the Sun that determines the climate on Earth—but the role of the Sun, with its ever-shifting solar radiation, is generally ignored as being inconsequential in affecting shorter-term weather patterns. But is this really so?

Consider: the Earth shifts in its position relative to the Sun. Its orbit is eccentric, varying over a period of 97,000 years. The inclination of the Earth's axis shifts with respect to the ecliptic over a cycle of 41,000 years, and the precession of the equinox varies over a period of 21,000 years. How do these shifts affect the amount of solar radiation reaching the Earth? Some astronomers believe that at least for the past 500,000 to 1 million years, these phenomena are related to the initiation and dissipation of glacial and interglacial intervals.

Although it may seem to us that the Sun is stable and stationary, it is in fact whirling through the Milky Way galaxy, taking its family of planets with it. Activity on the Sun itself goes through periods of relative quiet and then erupts into flares and protuberances, sunspots, and gigantic upheavals that "rain" solar material out into space. One recent solar storm was measured at 43,000 miles across. This produced the largest solar flare ever recorded. Some of the increased solar radiation from such storms reaches the Earth and disrupts radio communication and television transmission and increases the aurora borealis. Solar activity in the form of storms seen as sunspots has a span of roughly 11 years. It seems that the sunspots whirl clockwise for about 11 years, then reverse and go counterclockwise for another 11 years. This interval is an average and may vary from 7 to 17 years. The controlling mechanism for this reversal is unknown.

Then there is another variable. The Sun "flickers"; that is, it dims and brightens slightly over a period of about 70 years. When it dims, the sunspots attain lower maxima. When the Sun brightens, the sunspots have higher maxima than "normal." Although this dimming and brightening has been suspected for some time, the first actual measurement of such a "flicker" was made on April 4, 1980, when a satellite measuring solar radiation outside the Earth's atmosphere recorded a 0.2 percent drop in radiation. Changes in solar radiation are not routinely measured.

Coupled with the activity of the Sun, there is the Moon's gravitational force, to which the Earth's waters respond daily and in 28-day cycles of tides. Also, there are 20-year and 60-year tidal cycles, as well as longer ones. Moreover, the solid land also responds to the Moon's gravitational force, but because we move with the ground, we do not feel it. Recently, a 556-year variation in the Moon's orbit around the Earth was analyzed; some meteorologists believe that the occasional confluence of all these Sun-and-Moon cycles may trigger dramatic changes in ocean currents and temperatures. And it is now widely acknowledged that the oceans are a major influence on the climate. There is also a 500-to-600-year cycle in volcanic activity, which appears to be near a peak at the present time.

Let's consider again. Does all this variability in solar activity really have anything to do with the weather or climate? No one knows for certain. But studies are continuing, and Dr. John Eddy of the National Center for Atmospheric Research in Boulder, Colorado, has found an interesting correlation between decades of low sunspot activity and cold periods, such as the "little ice age" of the 17th century, when there was a virtual absence of sunspot activity between 1645 and 1715, and decades of high sunspot activity with warm temperatures on Earth.

Since the sunspot cycle is not perfectly regular and varies considerably, how do scientists determine the extent of sunspot activity that occurred decades or centuries ago? This is a neat piece of scientific detective work that merits a brief explanation. It involves another extraterrestrial phenomenon—cosmic radiation.

Cosmic rays consist of high energy particles that enter the Earth's atmosphere from outer space. These energetic particles split the nuclei of atmospheric gases, giving rise

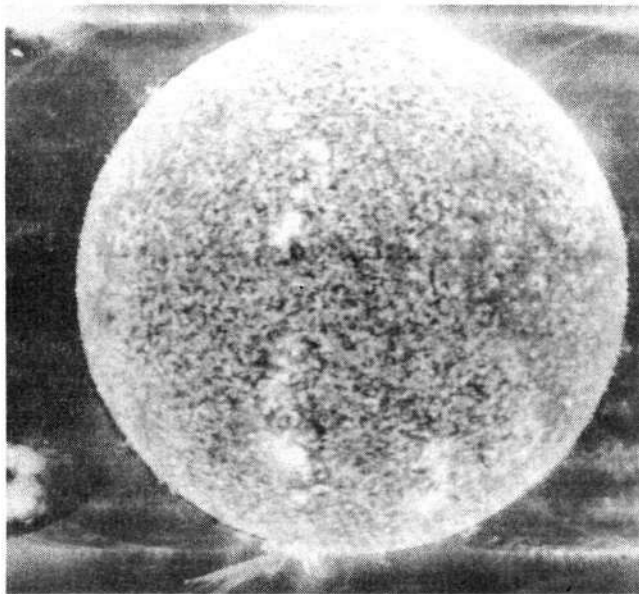
to some of the background radiation to which all living organisms are exposed. Among the fission products are potassium-40 and carbon-14, which get into the food chain and are eaten (by animals) or absorbed (by plants), and that is one of the reasons that the bodies of all living organisms are radioactive. Of these two fission products, it is carbon-14 that is the most interesting for tracing events in the past.

C-14, whose half-life is a relatively short 5,570 years, is being produced continuously in the atmosphere (through interaction with cosmic rays) and is continuously taken up by *living* organisms, but not by dead ones. Therefore, by measuring the amount of C-14 in dead or fossil material, one can infer the date of death. This is called carbon-dating. C-14 is a very good but not perfect clock of history, because the assumption is that the formation of C-14 is not only continuous but also that it occurs at a steady rate. But what Eddy has determined is that the rate of formation varies with the amount of cosmic radiation, which, in turn, varies with the amount of sunspot activity, because high solar activity also creates more solar wind that can compress the Earth's magnetic field. This stronger field is more effective in shielding cosmic rays from the Earth's atmosphere, which means that less C-14 is formed during periods of high sunspot activity. Less C-14 equates with warmer periods on Earth.

Taking advantage of these phenomena, Eddy measured the C-14 radioactivity in tree rings that are up to 5,000 years old. Keep in mind that the years (rings) of low C-14 equate with years of high solar activity and warm temperatures. Dr. Eddy recorded 12 prolonged periods with either unusually cold or unusually mild winters over the past 5,000 years. These correlations between solar activity and weather on Earth seem good; his measurements identified the terrible winter of 1683-84, also recorded in the 1869 novel *Lorna Doone*, when trees in Somerset, England, froze and many exploded from the buildup of internal ice.

If Eddy's work and theory hold up, the mid-20th century was an unusually warm period, and the Earth may be set soon to enter a slow return to cooler temperatures. Besides, in geologically recent times, ice ages recur about every 11,000 to 12,000 years, and it is now 11,000 years since the last one. How do all these complications interact with the greenhouse effect? Again, no one really knows. All we can say with confidence is that it is probably more complicated than many environmentalists seem to believe.

When we consider all of the complex geophysical phenomena that might affect the weather and climate on Earth, from changes in ocean temperatures and currents, volcanic eruptions, solar storms, and cyclic movements of heavenly bodies, it is clear that none of these is under human control or could be influenced by human activity. Is the "greenhouse effect" and its theoretical enhancement by increases in atmospheric CO₂ from human sources more powerful or capable of overshadowing all other planetary influences? Until the supporters of the man-produced-CO₂-caused-global-warming-theory can explain warm and cold episodes in the past, we should remain skeptical. What caused the 80 ppm increase in CO₂ during a 100-year period 300 years ago and the high peak—many times anything measured since—of 130,000 years ago?



NASA

Extraterrestrial phenomena like the activity of the Sun and the Moon's gravitational force trigger changes in weather and climate that are not yet fully understood. Here, a spectroheliogram of a solar eruption, June 10, 1973, taken during the first manned Skylab mission.

Advanced Technology to Lower CO₂

The alteration of the chemical content of the air by *human* production of greenhouse gases, however, is something that man *can* control. And because no one knows what the ultimate consequences of heightened CO₂ might be, it is reasonable to reduce human contribution wherever possible.

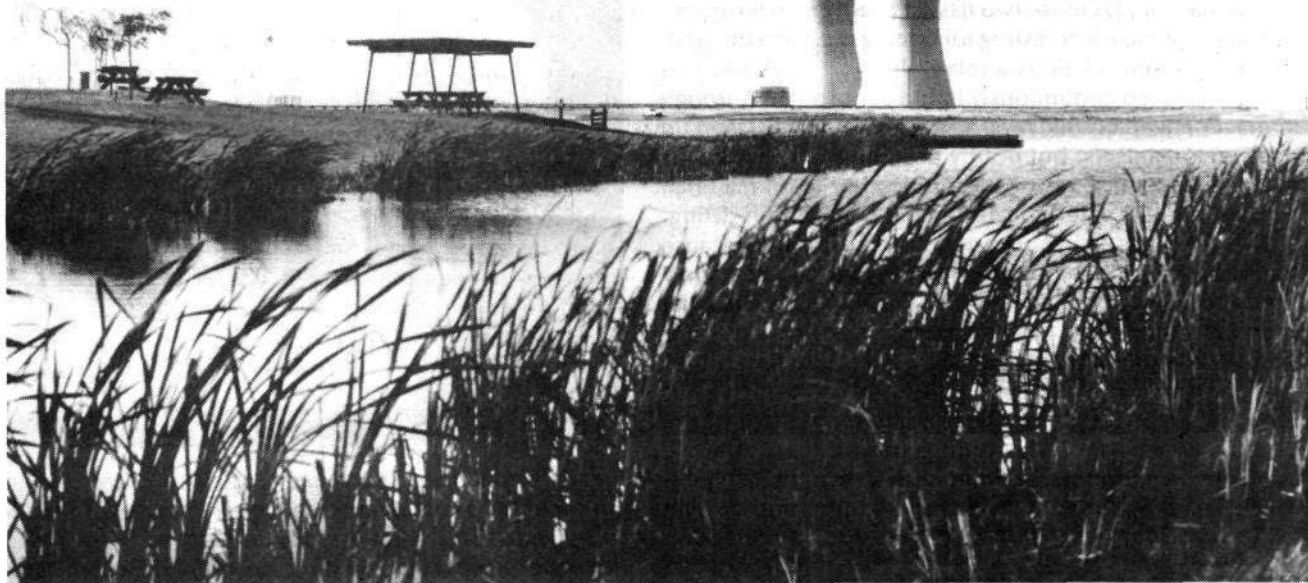
Fortunately, there are ways to accomplish this. For starters, we can phase out the use of fossil fuel for making electricity and turn to the established and proven technology that has no adverse impact on the atmosphere—nuclear power. The energy of the atom now produces 20 percent of the electricity of the United States—more than the total of all electricity used in 1950. The number of nuclear power plants can be increased.

Second, we can shift to an essentially all-electric economy, utilizing electricity for direct heating of buildings and homes and extending the use of electric processes in industry. With enough electricity available, it can be used to desalinate sea water and purify the fresh water sources that have become polluted. It can also be used to split water and obtain hydrogen, which has great potential as a clean fuel for transportation: Its "burning" produces only water vapor.

And we can turn, once again, to electric buses and trains and eventually to electric automobiles.

None of these shifts away from fossil fuels will be easy or fast, but if we have an abundance of electricity from nuclear power plants, it can be done. That would leave fossil fuels for the important synthetics and plastics industries and for the manufacture of medicinals, pesticides, and fertilizers.

There are also two important caveats; though steps to



AEC

If we have an abundance of electricity from nuclear power plants, we can shift away from fossil fuels, leaving them for the synthetics and plastics industries and for the manufacture of medicinals, pesticides, and fertilizers. Here, the Rancho Seco nuclear plant in California.

reduce CO₂ production may be possible for an advanced, highly technical, industrialized society with plenty of electricity, the infrastructure to make use of it, and money to spend, the story is different in the nonindustrialized world. In China, for example, 936 million metric tons of coal were burned in 1987. Who is going to tell China to stop or to change? What alternative do the Chinese have? No matter what we in the Western world do, the amount of CO₂ arising from human use of fossil fuel will not be significantly reduced.

The second caveat is to remember that draconian measures intended to make rapid and large decreases in CO₂ formation won't do much good if they are so costly that they seriously impede the economy and degrade our standard of living without achieving the desired result. Certainly the level of atmospheric CO₂ is increasing, but nothing in all our knowledge of weather and climate guarantees that global warming will inevitably occur. It may, or it may not; the uncertainties are legion. The computer models are too simplistic and include too many estimates and guesses and too little about the role of the hydrosphere, both water vapor and the oceans.

Notwithstanding all this, deliberate, reasoned steps can and should be taken to lower CO₂ emissions; responsible stewardship of the planet demands no less.

The Worst Case Scenario

Finally, let's suppose that a worst case scenario does develop and that global warming does occur. If the warming caused polar ice to melt, only that on land, as in the Antarctic continent (or the glaciers of Greenland), would material-

ly affect global sea level. When ice floats, as in the Arctic ocean, it already displaces approximately the same amount of water that would result if it were to melt. (There would be some slight thermal expansion.) Whether Arctic ice stays solid or melts would no more cause the sea level to rise than ice cubes melting would cause a full glass of ice water to overflow.

Analysis of sea level data since 1900 indicates that the oceans may be rising at a rate of 10 to 25 centimeters per century (about 0.1 inch per year). The data are very sketchy and uncertain. The sea rise, if it is real, is not uniform and other phenomena, such as land subsidence or upthrust, the building and erosion of beaches by weather, and the variation of inshore currents, could all affect the few measurements that are available.

Some scientists postulate that the west Antarctic ice sheet, which is anchored on bedrock below sea level, could melt and add enough water to raise the world sea level by 6 or 7 meters. This would be disastrous for most coastlines, but if it should happen, it would probably take several hundred years, and there is currently neither observational evidence nor scientific measurements to indicate that it is under way. In fact, new measurements show that the glaciers in Antarctica are growing, not melting.

Air temperatures in Antarctica average -40°C. A five-degree rise in air temperature to -35°C is certainly not enough to melt ice. But somewhat warmer sea water (above 1°C) might get under the ice sheet and start it slipping into the sea; then it would float and displace an enormous volume of water, causing the sea level to rise. But this is also a very unlikely "what if?" with no evidence to support it.

What About Those Ozone 'Holes'?

Now, what about ozone in the stratosphere; how significant are the "holes" measured above Antarctica? Are we humans destroying our protective cover? Quite a few people seem to think so.

Let me start with a quotation from an analysis of the ozone problem published in the 1987-88 Annual Report of the Rand Corporation:

The extent of ozone depletion and the severity of the consequences of projected emission levels are extremely uncertain. Projections of future depletion are based on complex simulation models that have not been reconciled with the limited available measurements. . . .

Because of pervasive uncertainty about the likely extent of future ozone depletion, its relationship to the quantity of potential ozone depleters emitted, its effect on the biosphere, and the appropriate valuation of these consequences, it is not currently possible to choose the level of emission-limiting regulations that will maximize welfare by optimally balancing costs of environmental damage against those of emission control. Policymakers must act in the face of this uncertainty.

Is that all perfectly clear? What the writer is trying to say, diplomatically, I think, is that *nobody knows how much ozone depletion has really taken place or what effect, if any, that ozone loss may have on the environment or in living creatures.*

The Rand Corporation writer emphasizes that present knowledge of ozone layer thickness is full of uncertainty and that the conclusions that have been drawn are based on incomplete computer models. There is little reliable, accurate, direct measurement. Nevertheless, he says, "policymakers must act. . . ." Why? Because some doom-predicting scientists say that "irreversible damage may occur?" What is their evidence?

Given the media hoopla and hysteria surrounding the ozone issue, surely it is time to examine the whole question with some sober common sense.

We know that the Earth's ozone layer is turbulent. It undergoes periodic changes in thickness. Natural fluctuations are about 15 percent and it quickly returns to equilibrium. Changes appear to be both seasonal and latitudinal. Seasonal changes above Antarctica are largest when measured at the end of winter. The changes in ozone layer thickness in Antarctica have now been measured in the Arctic, as well. (No one looked until recently.)

The best measurement data indicate that the ozone layer increased in average thickness during the 1960s and decreased during 1979-1986. The decreases were comparable in magnitude to the increases of the 1960s.

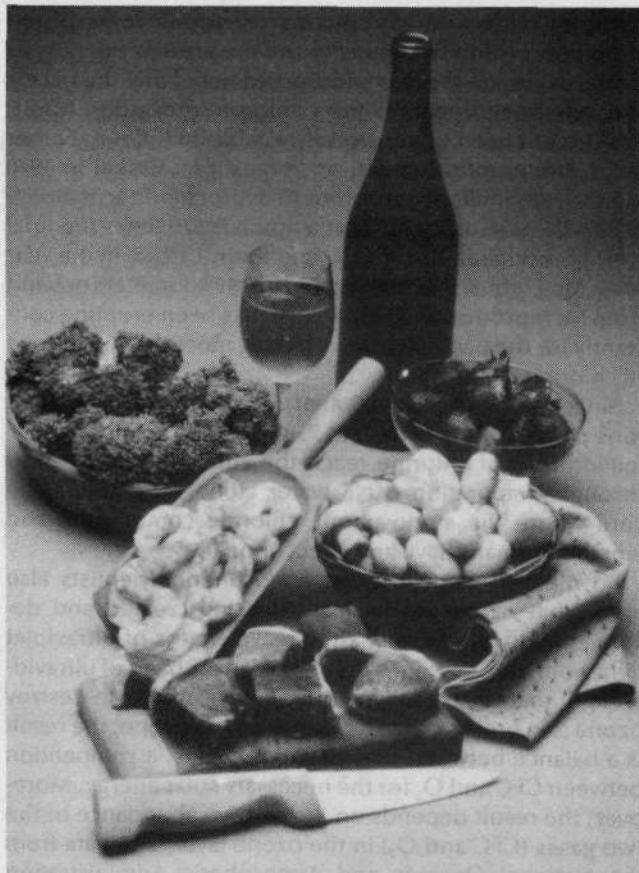
The term ozone "hole" is misleading, since it persists for only a few weeks. The Antarctic ozone "hole" grew during the early 1980s, becoming large in 1985, smaller in 1986, and reaching its greatest size in 1987. In 1988, the "hole" did not appear as expected. It was finally discovered—only 15 percent as large as predicted and displaced over the ocean.

The changes in the amount of ozone appear to be related to complex chloride chemistry and the presence of nitrous oxide. Although there is widespread belief that the necessary chlorination comes from chlorofluorocarbon (CFC), this has not been unequivocally established. On the other hand, the eruption of Mt. St. Augustine (Alaska) in 1976 injected 289 million metric tons of hydrochloric acid directly into the stratosphere. That amount is 570 times the total world production of chlorine and fluorocarbon in the year 1975. Mt. Erebus, which is located just 15 kilometers upwind from McMurdo Sound, Antarctica, has been erupting constantly for the past 100 years, ejecting more than 1,000 tons of chlorine per day.

Since the world production of CFCs peaked at 1.1 million tons per year—equivalent to 750,000 tons of chlorine (300 million tons of chlorine reach the atmosphere each year through evaporation of seawater alone)—we cannot be sure where the stratospheric chloride comes from and whether humans have any effect upon it.

So much is known. Most atmospheric scientists also agree that ozone molecules are being created and destroyed naturally by very short wavelengths of ultraviolet light from the Sun. Since the same narrow band of ultraviolet light that breaks down chlorofluorocarbons to destroy ozone also breaks down oxygen to create ozone, the result is a balance between these two processes, a competition between CFC and O₂ for the necessary solar energy. Moreover, the result depends on the relative abundance of the two gases (CFC and O₂) in the ozone layer, and data from the National Oceanic and Atmospheric Administration (NOAA) show 60,000 ozone molecules created for every 1 destroyed by chlorine from a CFC molecule. It is quite possible that overall depletion of ozone is *not* occurring, and indeed the NOAA data from measurements taken at the surface of the Earth indicate that the total amount of ozone above the United States is actually increasing. In addition, it is known that interaction of solar wind with the Earth's magnetic field, which causes the auroras, can also destroy stratospheric ozone. Solar wind comes from solar flares and these are increasing in the present period of sunspot maxima.

So, is the sky falling? Still being debated among atmospheric scientists is whether the recently measured ozone changes have been occurring all along or whether they are a new phenomenon sparked by human activity—or perhaps a combination of both. To quote a January 1989 summary published in *Science*, "the recent losses may be natural and may result from long-term fluctuations of the general circulation of the atmosphere." Some researchers, pointing out that atmospheric dynamics can cause big changes in ozone, describe a 48-hour period at the beginning of September 1988, when the ozone decreased 10 percent over a 3 million square kilometer area. Robert T. Watson, head of NASA's upper atmospheric research program, said: "In our opinion, all provisional, we do not believe that change can be chemical [that is, caused by CFCs]. It is strong evidence that *meteorological processes alone* can effectively depress areas of ozone over the Antarctic continent." Direct evidence has yet to be produced, and Robert Watson of NASA reported that the optical diffuser plate on



Council on Radiation Applications

If the proponents of banning CFC are so anxious to reduce its use, why aren't they out campaigning for irradiating food as a substitute for refrigeration? Here, a selection of food treated with low doses of radiation to destroy trichinae in the pork cubes, delay spoilage of the shrimp, delay mold growth in the strawberries, and delay maturation of the mushrooms and broccoli—all without changing the flavor or affecting the nutritional quality.

the Nimbus satellite had deteriorated so rapidly in space that its ozone depletion measurements are "useless garbage."

Against this background of uncertainty and the conviction of some respected scientists that natural processes may account for "ozone holes," how can public officials and governmental representatives seriously consider taking drastic action—for example, to ban CFCs—as if that would "cure" the problem, if indeed there is a problem?

Consider that in the United States economy alone, CFCs, mainly freon, are used in 100 million refrigerators, 90 million cars and trucks, 40,000 supermarket display cases, and 100,000 building air conditioners. It is estimated that banning CFCs would mean changing or replacing capital equipment valued at \$135 billion. And all the proposed substitutes have problems; none is in production, most of them are toxic, and many are flammable. Of course, we could always return to using toxic ammonia and sulfur dioxide!

Note that one of the biggest users of freon is refrigeration, and the most important reason for refrigeration is food preservation. If the proponents of banning CFC are

so anxious to reduce its use, why aren't they out campaigning for irradiating food as a substitute for refrigeration? Food irradiation is an available technology used by all our astronauts and in hospitals for patients who require a sterile environment.

We are told that the ozone hole is important because the ozone blanket blocks most of the ultraviolet light in sunshine, which, if it penetrates to the Earth's surface, could cause skin cancer, eye problems, and plant damage. This could be worrisome, except that actual records from a network of recording instruments set up in 1974 to measure ultraviolet light reaching the Earth's surface have shown a continuously decreasing penetration of from 0.5 percent to 1.1 percent per year. If the theories about ozone depletion were correct, ultraviolet radiation should have been increasing, not decreasing.

Furthermore, the form of skin cancer caused by ultraviolet radiation is relatively harmless, though irritating and unsightly, and 99 percent of the cases can be cured if treated in time. On the other hand, malignant melanoma, another unrelated type of skin cancer, is generally fatal. Its appearance is not related to ultraviolet radiation; its cause is unknown. Tragically, it is increasing, by 800 percent since 1935. As for plants, most are protected by several mechanisms that function to repair damage caused by ultraviolet light. The conclusion is hard to avoid: that the claims of skin cancer due to ozone loss are simply a widely repeated scare tactic.

The historian Hans Morgenthau wrote in 1946:

Two moods determine the attitude of our civilization to the social world: confidence in the power of reason, as represented by modern science, to solve the social problems of the age, and despair at the ever renewed failure of scientific reason to solve them.

The intellectual and moral history of mankind is the story of inner insecurity, of the anticipation of impending doom, of metaphysical anxieties.

John Maddox, editor of the prestigious British journal *Nature*, has said that "these days there also seems to be an underlying cataclysmic sense among people. Scientists don't seem to be immune to this."

Well, they ought to be. And we ought to remember that using our technology will go a long way toward averting those cataclysmic events and the "doom-is-almost-here" philosophy that seems to have so much appeal. Scientists owe it to society to show the way to a better life and an improved environment—through quality technology.

Dixy Lee Ray, a marine biologist, headed the U.S. Atomic Energy Commission from 1972 to 1975 and served as governor of Washington from 1977 to 1981. This article is adapted from a chapter in her new book, Trashing the Planet: How Science Can Help Us Deal with Acid Rain, Depletion of the Ozone, and Nuclear Waste (Among Other Things), published by Regnery Gateway (Washington, D.C., 1990). The book was written with Louis R. Guzzo, a TV/radio commentator in Seattle and former managing editor of the Seattle Post Intelligencer.

New Evidence Shows 'Ozone Depletion' Just A Scare

The sky is falling on proponents of the ozone depletion catastrophe theory, as the scientific evidence increasingly makes its way into print.

by Rogelio A. Maduro

The latest scientific evidence on ozone depletion has poked large holes in every argument popularized by those who claim that man-made chlorofluorocarbons are depleting the ozone layer. Here are the facts about four of these alleged catastrophe theories.

(1) There is no long-term ozone depletion.

The evidence indicates that the dire picture of a 3 percent depletion of the ozone layer between 1969 and 1985 by CFCs is a fabrication. The 3 percent scare story was presented at a March 1988 press conference of NASA's Ozone Trends Panel by atmospheric chemist Robert Watson and others. The story was that the Northern Hemisphere was suffering from a general depletion of ozone that paralleled the allegedly increasing thinning of ozone over Antarctica, ominously called the "ozone hole." This "hole" is itself a misinterpretation of the seasonal thinning of ozone over

Antarctica. Although the Ozone Trends Panel was created to review the evidence for ozone depletion, or lack thereof, it is staffed by hard-line proponents of the ozone depletion theory.

In contrast to these claims of depletion, the scientists from around the world involved in gathering daily ozone measurements argue that the Ozone Trends Panel arrived at its results by introducing ad hoc assumptions into its mathematical models to "correct" the actual data. Data from individual meteorological stations that showed no ozone depletion, magically showed depletion after such statistical "reanalysis." This challenge to the accuracy of the Ozone Trends Panel may explain why the Panel still has not released its report, almost three years after the press conference held to announce its findings.

According to leading European atmospheric scientists, data forwarded to the Toronto Weather Data Center from ozone measuring stations in Belgium, England, India, Japan, Norway, Switzerland, and West Germany show *no ozone depletion* over the past decades. These data have not generally appeared in print. But in 1990, Norwegian scientists Søren Larsen and Thormod Henriksen published an analysis of Arctic ozone layer data going back to 1935 (Figure 1). They conclude:

The data from long-term ozone measurements reveal periods of several years with a negative trend [decrease] and other periods with a positive trend [increase]. The combined results up to 1989 give no evidence for a long-term negative trend of the Arctic ozone layer. . . . The data for Oslo and Tromsø show that the ozone layer over Scandinavia has been above normal (or average) during the past three years. Because of the good correlations with the data from other stations this conclusion may be valid for the whole Arctic region.

Larsen and Henriksen then make a critical point: "The figures show the importance of defining the starting point and endpoint when describing trends. The data indicate a positive trend for ozone (in all seasons) in the period 1983-1989 (the past six years). On the other hand, no particular trend can be claimed for the past 10 years." That is, the thickness of the ozone layer undergoes natural fluctuations, and one can show an increase or a decrease, depending on which years are chosen as starting and ending points (Figure 2). Nevertheless, *overall, there is no indication of any ozone depletion.*

As Larsen and Henriksen put it: "These data indicate that anthropogenic gases such as CFCs have, up to the summer of 1989, had a negligible influence on the Arctic ozone layer. The general balance between formation and destruction of ozone has not changed, at least not to an extent that is apparent in the long-term observations."

(2) There is no increase in ultraviolet as a result of ozone depletion.

In a 1989 paper in *Photochemistry and Photobiology*, Larsen, Henriksen, Arne Dahlback, and Knut Stamnes report that there has been no increase in ultraviolet radiation incident at Earth's surface, confirming the 1988 findings of

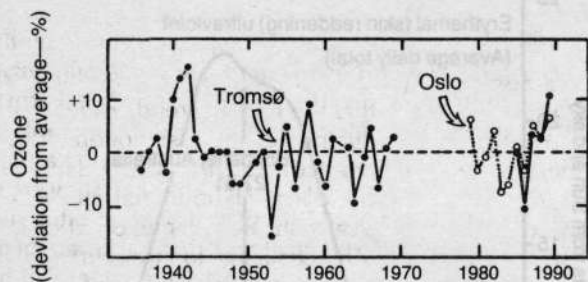


Figure 1

NORWEGIAN SCIENTISTS FIND LITTLE LONG-TERM CHANGE IN ARCTIC OZONE

Søren Larsen and Thormod Henriksen at the University of Oslo's Institute of Physics conclude from observational data that gases like CFCs have had a negligible effect on the Arctic ozone layer. "The general balance between formation and destruction of ozone," they write, "has not changed, at least not to an extent that is apparent in the long-term observations."

Shown here are spring values of ozone for the Norwegian stations at Tromsø at latitude 70° N (filled circles) and Oslo (open circles). The data are the average of measurements in February, March, and April and correspond to the period when ozone depletion occurs in Antarctica (August, September and October). These long-term data show that the natural balance between formation and destruction of ozone has not changed in the Arctic.

Source: Adapted from Søren H. Larsen and Thormod Henriksen, "Persistent Arctic Ozone Layer," *Nature* (Jan. 11, 1990), 124.

Dr. Joseph Scotto of the Biostatistics Branch of the National Cancer Institute. If the scaremongers' assertions about the ozone layer were correct, UV should have increased at least 6 percent over the past 20 years.

Even if there were some increase in exposure to ultraviolet, these authors argue that "depletions of the ozone layer up to about 15 to 20 percent would have a rather small effect on the life on Earth." The four Norwegian scientists very rigorously demonstrate the same point already made by U.S. climate scientist Hugh Ellsaesser: In the middle latitudes (as in the United States, Canada, and Europe) a 1 percent increase in ultraviolet exposure is the equivalent of moving six miles closer to the equator. (The relation is, of course, not linear, but this rough rule of thumb applies within latitude limits.) Thus the scaremongers' worst-case 10 percent increase in ultraviolet over the next 100 years, if it were somehow to happen, is less than the equivalent of moving from Boston to New York (Figures 3 and 4).

So far, no one claims an ozone hole exists over the North Pole, but Dahlbeck, et. al. take the worst-case scenario in which a seasonal depletion identical to that over Antarctica develops over the North Pole:

The so-called ozone hole in Antarctica is a transient springtime depletion of the ozone layer which is con-

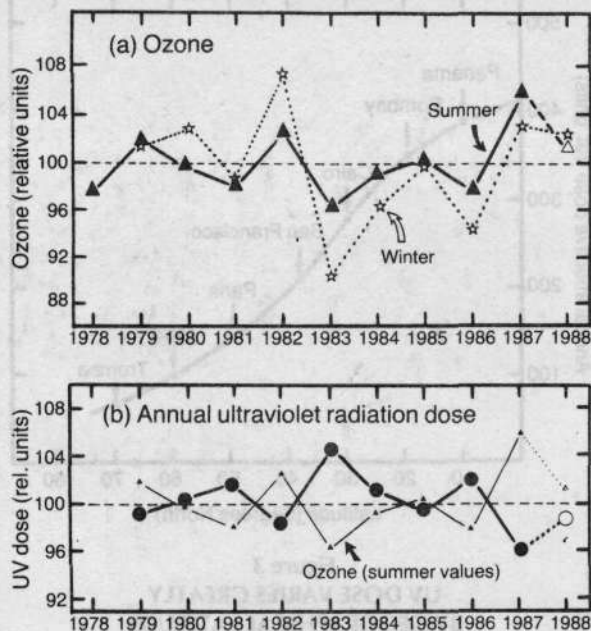


Figure 2

NO OBSERVABLE TREND IN OZONE OR UV IN PAST 12 YEARS

Norwegian measurements demonstrate there is no observable trend, neither increase nor decrease in ozone (a) or ultraviolet radiation (b) values for the past 12 years. If the ozone depletion theory were correct, ozone values should have gone down more than 3 percent, and UV radiation values should have therefore increased by more than 7 percent.

Source: Adapted from Arne Dahlback, Thormod Henriksen, Søren H. Larsen and Knut Stamnes, "Biological UV-Doses and the Effect of an Ozone Layer Depletion," *Photochemistry and Photobiology* 49:621 (1989).

nected to the polar vortex. . . . If we assume a similar depletion over Scandinavia (for example, if we moved the ozone hole) the annual effective UV-dose would increase by approximately 22 percent. . . . One would attain a similar increase in the annual UV-dose by moving approximately 5° to 6° toward lower latitudes; for example from Oslo to Northern Germany.

A Norwegian moving from Oslo to Hamburg, West Germany—hardly a life threatening move—would be exposing himself to a 22 percent increase in ultraviolet radiation.

But what about all the cases of skin cancer in Australia and New Zealand caused by the ozone hole, the ozone-hole proponents ask. Here the scientific evidence is most interesting. Ultraviolet radiation increases nonlinearly 5,000 percent from the North or South Pole to the equator. A move by light-skinned Europeans to Australia and New Zealand means an increased UV exposure of between 250 and 500 percent. From this large increase in exposure, light-skinned people will have an increase in skin cancers. Similarly, the ozone hoaxers never mention that skin cancer is nearly unknown in dark and black-skinned individuals,

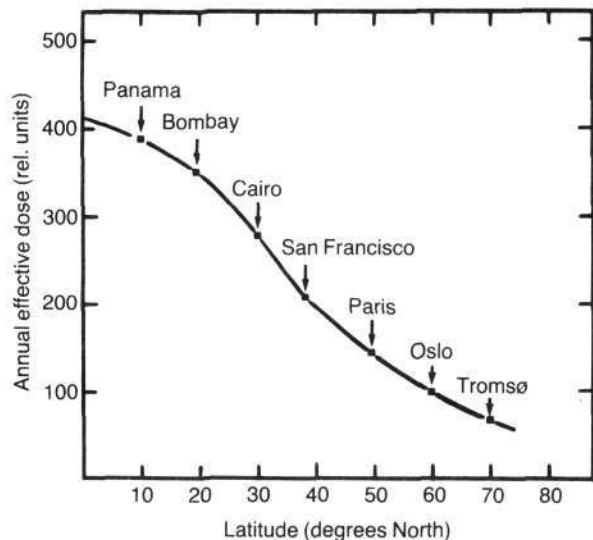


Figure 3
UV DOSE VARIES GREATLY
BY GEOGRAPHICAL LATITUDE

Shown is the annual effective ultraviolet radiation dose for selected cities at different geographical latitudes in the Northern Hemisphere. Under the worst-case scenario of ozone depletion, the increase in the amount of UV reaching the ground is expected to be 10 percent. Moving from Oslo to Panama represents an increase in UV-dose exposure of 300 percent, while a move to balmy San Francisco from Oslo is an increase of 100 percent. In fact, a 10 percent increase in so-called harmful UV, declared to be a disaster by the environmentalists, is the equivalent of moving a mere 60 miles closer to the Equator.

Source: Adapted from Arne Dahlback, Thormod Henriksen, Søren H. Larsen and Knut Stamnes, "Biological UV-Doses and the Effect of An Ozone Layer Depletion," *Photochemistry and Photobiology* 49:621 (1989).

whose skin pigmentation equips them with adequate sun protection for the tropics.

(3) The ozone hole is a natural, seasonal phenomenon, discovered in 1956.

The Antarctic ozone anomaly now known as the ozone hole was discovered in 1956 by the pioneer ozone researcher Gordon Dobson and his students—long before CFCs were in widespread use. Dobson documented that a severe depletion of ozone occurs in Antarctica in early spring.

This anomaly was rediscovered in 1982 by the head of Japan's Polar Research Institute, Prof. Shigeru Chubachi, who at that time also measured a greater depletion than Dobson had documented. In contrast to hysterical views of the Ozone Club, as the ozone hoaxsters are known, Japanese scientists maintain that the ozone hole is simply a natural phenomenon. Hiroshi Kanzawa and Sadeo Kawaguchi, for example, demonstrate that the dynamics of the atmosphere play a critical role in the formation, extent, depth, and later breakup of the Antarctic ozone hole (Fig-

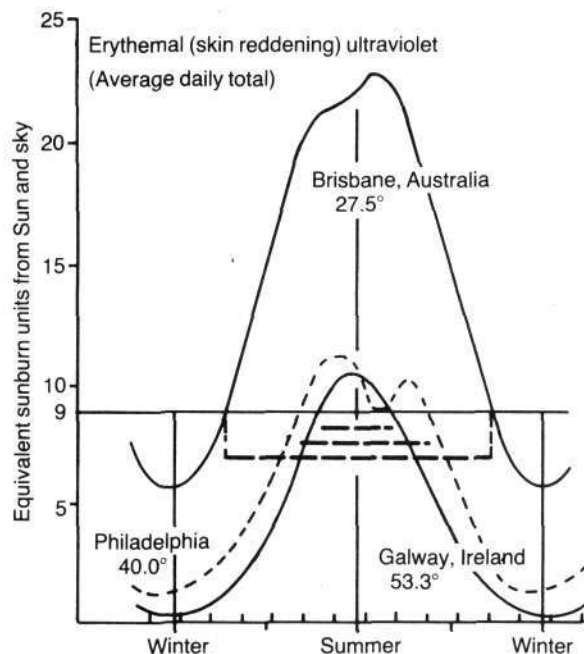


Figure 4
ULTRAVIOLET RADIATION AND SKIN CANCER
VARY WITH LATITUDE, SEASON, AND CLIMATE

Caucasians living in Australia have high rates of skin-cancer because levels of effective ultraviolet radiation in Australia are more than twice those in Philadelphia, or England. The environmentalists hysterically allege that "ozone depletion" is causing a skin cancer epidemic in Australia, but the fact is that white-skinned Europeans have settled a continent where the intensity of ultraviolet radiation is 200 to 300 percent greater than in their original lands. By comparison, the predicted 10 percent increase in UV due to ozone depletion is rather insignificant. Australian aborigines, meanwhile, show no cases of skin cancer because their dark skins, appropriate for the tropics, effectively filter the UV.

Source: Adapted from J.D. Everall, "Distribution and General Factors Causing Chronic Actinic Dermatitis," *Research In Photobiology*, Amleto Castellani, ed. (New York: Plenum, 1977).

ures 5 and 6).

Two years after the Japanese work by Chubachi on the southern anomaly, in 1985, Joseph Farman of the British Antarctic Survey reported the exact same phenomenon. Farman and his colleagues at Cambridge University falsely claimed credit for the discovery of the ozone hole, ignoring the work in the 1950s by Dobson as well as the more recent Japanese work.

Other recent work documents the role of solar system dynamics in the formation and breakup of the ozone hole. A group of Italian scientists led by G. Moreno of the Institute of Atmospheric Physics in Rome reports, "While the current view accounts for the ozone depletion entirely in terms of chemical and dynamical processes occurring in

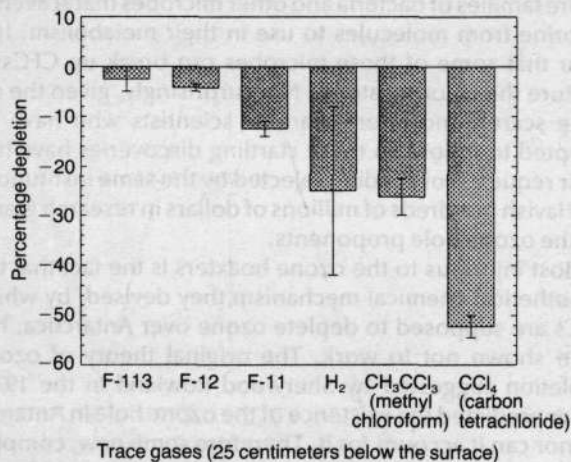


Figure 5

SOILS DESTROY SIGNIFICANT AMOUNTS OF CFCs

Significant depletion of CFCs—especially methyl chloroform and carbon tetrachloride—occurs a short distance below the soil surface, as this graph shows. As yet, the processes destroying the CFCs are unknown. For instance, the concentration of carbon tetrachloride just 25 centimeters below the surface of the soil is only 50 percent of that of the ambient air concentration. It is possible that certain types of soil have microorganisms that scavenge chlorine from CFCs to use metabolically. Several scientists interested in pursuing this discovery have had their requests for funding rejected.

Source: Adapted from M.A.K. Khalil and R.A. Rasmussen, "The Potential of Soils As a Sink of Chlorofluorocarbons and other Man-Made Chlorocarbons," *Geophysical Research Letters* 16:679 (July 1989).

the atmosphere, we show that the present experimental evidences rely favorably on the contribution of geomagnetic phenomena such as aurorae, induced by solar related disturbances." The Earth's magnetic fields channel the most energetic particles arriving from the Sun and outer space to two spots on Earth, the North and South Poles. Thus the complex atmospheric phenomena that occur at the poles are very different from anything else in Earth's atmosphere, and very much related to solar and geomagnetic fluctuations.

(4) CFCs sink to the ground and go up in smoke; they don't get to the stratosphere.

One of the supposedly most solid claims of the ozone hole proponents is that CFCs in our atmosphere can be broken up only by ultraviolet radiation, and only at the level of the stratosphere. Two of the world's most recognized atmospheric chemists, Aslam Khalil and Reinhold Rasmussen, refute this in their documentation that processes occurring in soils in Australia and rice paddies in China destroy CFCs and other chlorocarbons, destroying as much as perhaps 20 percent of the CFCs released into the air (Figure 7).

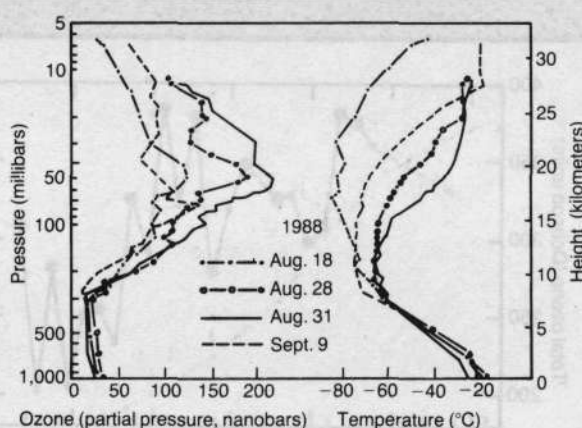


Figure 6

OZONE ABUNDANCE IS DIRECTLY RELATED TO TEMPERATURE

The so-called ozone hole appears when the stratosphere is cold, and disappears when it warms up. The abundance of ozone is directly related to the temperature of the stratosphere, as can be seen in these vertical profiles of ozone (in partial pressure) and temperature measured at Antarctica's Syowa Station in 1988. On the days when the stratosphere's temperature was relatively warm—Aug. 28 and 21—ozone was very abundant. During the cold days that preceded and followed the warm spell—Aug. 18 and Sept. 9—the ozone layer thinned out.

Pioneer ozone researcher Gordon Dobson noticed this phenomenon in the 1950s. He described the ozone hole (or thinning) as largely a dynamic phenomenon with great dependence on stratospheric temperatures and planetary wave patterns.

Source: Adapted from Hiroshi Kanzawa and Sadao Kawaguchi, "Large Stratospheric Sudden Warming in Antarctic Late Winter and Shallow Ozone Hole in 1988," *Geophysical Research Letters* 17:77 (Jan. 1990).

More recently, Dean Hegg and others from the University of Washington in Seattle have studied emissions of trace gases during the burning of biomass. To their surprise, the scientists discovered that large quantities of CFCs were being emitted in the smoke plume of biomass fires. Since trees don't produce CFCs, the authors ask, where are these CFCs in smoke coming from? Hegg, et. al., state: "The high emissions of NO_x [nitrogen oxides] and F12 [freon 12, a CFC] are due in whole or in part to the resuspension of previously deposited pollutants. Since this can be the only source of F12 in the smoke from fires, deposition [in the soil] may be a significant sink for F12."

There is another possibility under consideration: CFCs are not very soluble in water, one of the reasons they are allegedly invulnerable. However, plant tissue is very rich in lipoproteins, in which CFCs have a solubility 300 to 400 times greater than in water. It is therefore very likely that large quantities of CFCs have been absorbed into plant tissues and are being released when the plants burn.

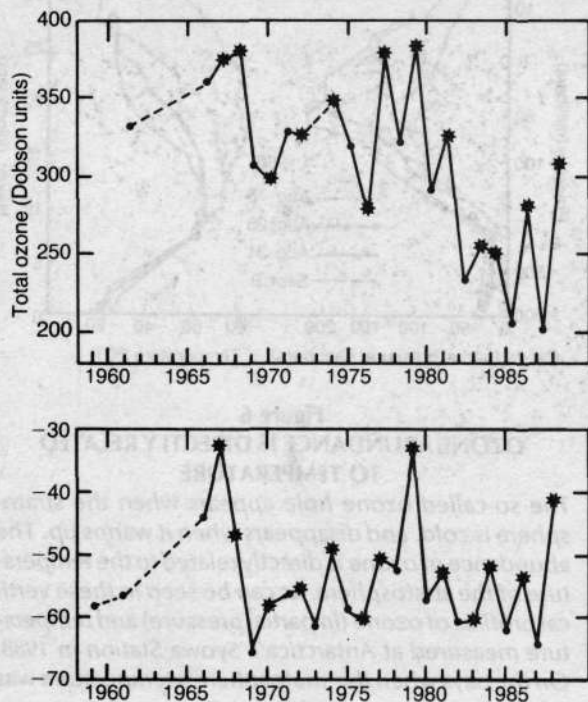


Figure 7

TRACKING THE OZONE ANOMALY IN ANTARCTICA

The ozone anomaly at the South Pole can be explained by natural, dynamical causes, without resorting to exotic chemistry concerning man-made CFCs. These data from Japan's Syowa station in Antarctica show that planetary wave activity is strong enough to penetrate the Antarctic vortex and, together with warm stratospheric temperatures, bring about high concentrations of ozone. Yearly variations in the monthly mean values of total ozone (top) and October monthly mean values of temperature (bottom) are plotted for 1960-1985. (Broken lines indicate missing years.)

The asterisks and the solid circles denote the easterly wind phase and the westerly wind phase, respectively, of the equatorial quasi-biennial oscillation (QBO), a phenomenon in which upper atmospheric planetary waves change direction every two years. During the westerly phase of the QBO, planetary wave activity is weak, which means the Antarctic vortex is much stronger. Together with colder temperatures in the stratosphere, this brings about a significant depletion of the ozone layer.

Note that ozone concentrations in 1988 were higher than those in 1975, and almost as high as those in 1960.

Source: Adapted from Hiroshi Kanzawa and Sadao Kawaguchi, "Large Stratospheric Sudden Warming in Antarctic Late Winter and Shallow Ozone Hole in 1988," *Geophysical Research Letters* 17:77 (Jan. 1990).

CFCs are also being destroyed in the soils. There are entire families of bacteria and other microbes that scavenge chlorine from molecules to use in their metabolism. It is clear that some of these microbes can break up CFCs to capture the chlorine atoms. Not surprisingly, given the climate scare atmosphere, various scientists who have attempted to follow up these startling discoveries have had their requests for funding rejected by the same institutions that lavish hundreds of millions of dollars in research grants on the ozone hole proponents.

Most injurious to the ozone hoaxers is the fact that the hypothetical chemical mechanism they devised, by which CFCs are supposed to deplete ozone over Antarctica, has been shown not to work. The original theory of ozone depletion suggested by Sherwood Rowland in the 1970s never predicted the existence of the ozone hole in Antarctica, nor can it account for it. Therefore some new, complex chemistry has been concocted after the fact by Rowland's student, Mario Molina, to explain the hole's existence.

The plausibility of this new chemistry, the so-called dimer or heterogeneous chemistry, has recently been demolished by Igor J. Eberstein of NASA's Goddard Space Flight Center. It was claimed—as an essential part of the chemical sequence to explain ozone destruction—that chlorine peroxide (Cl_2O_2) breaks up into ClOO and Cl. Free chlorine, Cl, is highly reactive and will readily break up ozone, O_3 . Eberstein, however, demonstrates that it takes much less energy to cause chlorine peroxide to photodissociate into a simple chlorine oxide molecule plus oxygen ($\text{Cl}_2\text{O} + \text{O}$), a pathway ignored by chemists eager to reach a predetermined conclusion.

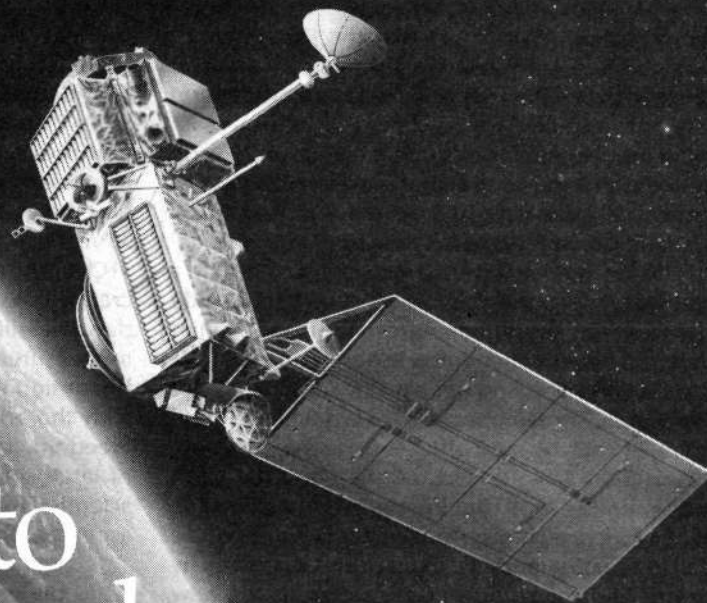
These few examples of the work being done by climate and atmosphere scientists indicate that if the sky is falling, it is falling only on the proponents of the ozone hoax.

Rogelio Maduro, an associate editor of *21st Century*, is completing a book on ozone, *The Holes in the Ozone Scare*, to be published in January 1991.

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The Science Needed to Understand Climate



Fairchild Space Company

From the bottom of the oceans to the top of the atmosphere, the 1990s Mission to Planet Earth will probe and measure many variables simultaneously, providing the information necessary to make decisions about weather and climate based on facts, not fictions.

by Marsha Freeman

How many times have you read in the technical or popular press that mankind's activities have changed the amount of carbon dioxide in the atmosphere or created the "hole" in the ozone layer and that these changes will destroy "global habitability"? Actually, no trends toward such catastrophic effects have been documented. Yet, international policies with definite and damaging consequences—like the global banning of chlorofluorocarbons by the year 2000—are being implemented on the basis of these undocumented allegations.

Over the next decade, a series of international space science missions will be developed and launched to provide the information that will make possible a better understanding of weather and climate. Some will be single-instrument satellites to focus on particular aspects of weather and climate; others will be large platforms with families of different instruments to take many simultaneous measurements. Until a more fundamental understanding of these phenomena is in hand, scare stories and far-reach-

Artist's drawing of the TOPEX/Poseidon spacecraft, a joint U.S.-French project being built by the Fairchild Space Company. Designed for a three- to five-year global study of the world's oceans, it is to be launched on a European Ariane rocket in 1992.

ing policy decisions should be put on hold.

Weather and climate are extremely complex phenomena. They result from the interaction of not only the temperature, chemical composition, and motion of the atmosphere, but also of the hydrosphere (oceans and other bodies of water), lithosphere (the solid Earth), cryosphere (ice and frozen regions), and biosphere (living organisms).

Climatic trends are dependent upon longer-wave phenomena, including changes in the Earth's rotation on its axis, solar cycles, and gradual changes in the oceans, cryosphere, and biota of this planet. Contributing to the long waves of climate change are activity in the Earth's interior, like the eruption of volcanoes; changes in the cryosphere, like the Little Ice Age (1645 to 1715) caused by an unusually low level of solar-magnetic activity; and changes in the biosphere, like the burning of the tropical rain forests or the development of agriculture.

Global warming, supposedly caused by increased atmospheric carbon dioxide from man's "dirty" habit of burning fossil fuels, has been shown *not* to exist. In March 1990, Roy W. Spencer of NASA's Marshall Space Flight Center and John Christy of the University of Alabama at Huntsville reported in *Science* magazine that data collected by the Tiros-N weather satellite from 1979 to 1988 showed no evidence of warming. Summarizing their findings for the

press, Christy stated, "We found that the Earth's atmosphere goes through fairly large year-to-year changes in temperature and over a 10-year period we saw no long-term warming or cooling trend."

The satellite read temperatures in swaths 100 miles wide and throughout the 6-mile depth of the troposphere. Most of the historical data that have been used for climate analyses, Spencer and Christy say, have come from ground measurements and do not include the oceans, which play a decisive role not only in the absorption of carbon dioxide but also in moderating the temperature of the planet. As the daily *Washington Times* commented in describing Spencer and Christy's work, "The findings quickly became part of the growing skepticism over the need for an immediate end to the burning of coal, oil, and other fossil fuels."

Some researchers have posed the idea that the Earth might not be warming at all, but instead might be heading into a period of increased glaciation, since ice ages occur on an 11,000 to 12,000-year cycle apparently determined by peculiarities of Earth's rotation and its orbit. It has now been 11,000 years since the last ice age.

Another argument against the warming hypothesis comes from recent studies indicating that increases in atmospheric pollution may contribute to cooling. In December 1990, three atmosphere scientists reported evidence showing that pollution in clouds can actually *cool* the Earth's climate, based on simultaneous observations made from the NOAA-10 satellite and the University of Washington's C-131A research aircraft off the coast of California. According to one of the scientists, Michael D. King of NASA's Laboratory for Atmospheres, "Changes in cloud reflectivity, resulting from the burning of fossil fuels, are expected to have a cooling effect on global climate. Our study reports new evidence that the cooling effect will be larger than previously predicted." This is so because pollution serves as a source of particles, called condensation nuclei, around which form cloud droplets.

"Increases in pollution are expected to lead to increased numbers of these nuclei, which compete for liquid water in the cloud. With more nuclei, the cloud contains more droplets, which are smaller in size," King said:

Our paper shows that these changes are indeed taking place in the portions of maritime clouds that have been polluted by underlying ships. . . . [W]e discovered that the polluted clouds contained more liquid water than the surrounding clouds. These observations indicate that clouds with smaller droplets suppress the loss of water by precipitation, thereby allowing water to remain in the clouds for longer periods, which in turn increases cloud life span and prolongs their cooling effect on the Earth.

Unlike the quackademic theories of Carl Sagan and others who think that the Earth is no different from Venus, or perhaps wonder whether nuclear war leading to nuclear winter might ameliorate global warming, actual experimental results do not support the doomsday theories that man is going to kill himself by living, eating, breathing, and reproducing on this Earth.

When the first TIROS meteorological satellite was launched into Earth orbit in April 1960, space technology provided the first global view of the weather of our planet. Since those first images from the Television and Infra-Red Observation Satellite, wind patterns, cloud cover, storm formation, and other characteristics of the atmosphere have been seen on television nearly every day for the past 30 years.

Over the decade of the 1990s, more than a dozen spacecraft will be launched using new remote sensing technology that will improve the scope of coverage, the accuracy of measurement, and the array of characteristics that can be continuously monitored from space. In the next century, with the added capabilities available with Space Station Freedom, it will be possible to launch and maintain a series of large space platforms that for the first time will allow scientists to make *simultaneous* measurements of different aspects of the Earth's weather and climate.

Understanding the Earth: The Humboldt Example

A major advance in the study of climate will require returning to an approach for solving complex scientific problems not considered by many of today's scientists. In 1799, Alexander von Humboldt set sail from Germany to the Americas to begin a detailed study of many of the aspects of nature that he understood to determine the total environment of Earth. It was the first scientific Mission to Planet Earth ever undertaken.

The fruit of his detailed, intensive study of the Earth's geology and geography, weather and climate, flora and fauna, and human culture and development was his book *Cosmos*, published in 1844. Humboldt recognized that there is no particular aspect of this living planet that can be usefully studied in isolation. "On being first examined, all phenomena appear to be isolated," he wrote,

and it is only by the result of a multiplicity of observations, combined by reason, that we are able to trace the mutual relations between them. If, however, in the present age, which is so strongly characterized by a brilliant course of scientific discoveries, we perceive a want of connection in the phenomena of certain sciences, we may anticipate the revelation of new facts, whose importance will probably be commensurate with the attention directed to those branches of study. Expectations of this nature may be entertained with regard to meteorology, several parts of optics, and to radiating heat, and electromagnetism. . . .

Humboldt also insisted that fantastic theories about the way the world worked could only be superseded by systematic, rigorous study. He wrote in the preface to *Cosmos*:

The principal impulse by which I was directed was the earnest endeavor to comprehend the phenomena of physical objects in their general connection, and to represent nature as one great whole, moved and animated by internal forces. My intercourse with highly gifted men early led me to discover that, without an earnest striving to attain to a knowledge of special

branches of study, all attempts to give a grand and general view of the universe would be nothing more than a vain illusion.

These special departments in the great domain of natural science are, moreover, capable of being reciprocally fructified by means of the appropriate forces by which they are endowed. Descriptive botany, no longer confined to the narrow circle of the determination of genera and species, leads the observer who traverses distant lands and lofty mountains to the study of the geographical distribution of plants over the earth's surface, according to distance from the equator and vertical elevation above the sea. It is further necessary to investigate the laws which regulate the differences of temperature and climate, and the meteorological processes of the atmosphere, before we can hope to explain involved causes of vegetable distribution; and it is thus that the observer who earnestly pursues the path of knowledge is led from one class of phenomena to another, by means of the mutual dependence and connection existing between them.

In Humboldt's time, as in our own, there was no lack of half-baked theories and popular science scare stories in the public culture. Though the particulars may seem amusing today, they are actually frighteningly similar to what is in our daily newspapers. Humboldt wrote:

The superficial half-knowledge, so characteristic of the present day, which leads to the introduction of vaguely comprehended scientific views into general conversation, also gives rise, under various forms, to the expression of alarm at the supposed danger of a collision between celestial bodies, or of disturbances in the climatic relations of our globe. These phantoms of the imagination are so much the more injurious as they derive their source from dogmatic pretensions to true science.

The history of the atmosphere, and of the annual variations of its temperature, extends already sufficiently far back to show the recurrence of slight disturbances in the mean temperature of any given place, and thus afford sufficient guarantee against the exaggerated apprehension of a general and progressive deterioration of the climates of Europe. . . . The astronomical causes of a refrigeration of our globe, and of the diminution of moisture at its surface, and the nature and frequency of certain epidemics—phenomena which are often discussed in the present day according to the benighted views of the Middle Ages—ought to be considered as beyond the range of our experience in physics and chemistry.

A comprehensive and rigorous study of weather and climate presents special problems. These phenomena are topological and dynamic in nature. They develop on scales from the microscopic to the global, and change in seconds as well as over eons. A comprehensive study of just the atmosphere must include measurements taken in thousands of geographic locations, at varying heights above the

Table 1
ELEMENTS OF MISSION TO PLANET EARTH

Quantity	Element
1	Space Station
1-2	Special-purpose satellite missions
5	Geosynchronous orbiters
2-6	Polar orbiters
18-24	GPS constellation
2-3	Tracking and data relay satellites
1,000	Floating buoys, "pop-ups"
100	Moored buoys
100	Ocean bottom stations
100-1,000	Smart ground stations
1,000-10,000	Simple ground installations
	Aircraft
	Balloons
	Rockets
	Ships, research
	Ships, opportunity

Source: "Space Science in the Twenty-First Century: Imperatives for the Decades 1995 to 2015," National Research Council, 1988

To adequately monitor changes in the Earth's weather and climate, thousands of simultaneous measurements must be taken. The full-scale Mission to Planet Earth program is to have an array of thousands of elements in space, in the air, on land, and on sea.

Earth as well as on the surface of the land, the oceans, and the cryosphere, using instruments that can observe everything from chemical composition, temperature, velocity, electric charge, and pressure.

Other factors, from changes in the sunspot cycle to subtle changes in Earth's magnetic field, must be measured and correlated to weather data to define the longer waves of climate change.

Mission to Planet Earth

In the early 1980s, numerous American and international scientific organizations proposed various experimental projects to upgrade the study of weather and climate from space. At the August 1982 United Nations Conference on Exploration and Peaceful Uses of Outer Space, NASA submitted a proposal for a study of "Global Habitability." Understanding that any causal study of weather and climate must be global in nature, as the phenomena themselves are, the space agency suggested that other nations join the American effort to improve and coordinate the massive amounts of data-collecting already being done by satellites and that are expected from future experiments.

In 1983, the International Council of Scientific Unions proposed an International Geosphere-Biosphere Program, which was approved by its members in September 1986. It is to be a 1990s follow-up to the 1957 International Geophysical Year, under which auspices the Soviet Sputnik and the U.S. Explorer 1 were launched, allowing the Earth to be studied from space for the first time.

Concern about the state of space science in the United States led the Space Science Board of the National Academy

Table 2
INSTRUMENTS AND MEASUREMENTS FOR MISSION TO PLANET EARTH

Measurement	Measurement Systems					
	Polar Orbiter	Geosynchronous	Other Satellites	Aircraft Balloons	Ocean Stations	Ground Stations
Magnetic field		—	G	G		
Gravity field (geoid)	G	G,A	G	C	G	G
Stratospheric chemistry	G	—	—	T	G,A	G,A
Aerosols	C,P	M	—	T	P	P
Winds	M,P	—	A	T	T	T
Severe storms	A,P	R,M	D	T	T	T
Clouds	R,M	—	—	—	T	T
Precipitation	M,P	R,M	M,D	T	T	T
Particulate matter	R,M,P	M	—	C	T,S	T
Tropospheric chemistry	M,P	—	—	—	T	T
Ocean currents	C,P	M,A	A,D	O	C	C
Ocean chlorophyll	M,A	M	—	—	A	—
Ocean salinity	M	M	—	—	O	—
Lake levels	M	—	A	—	O	O
Sediments	—	M	D	—	—	—
Sea state	M	R	D	—	O	—
Sea ice	R	R,A,M	A	—	O	—
Glaciers	R,A,M	—	A	—	O	A
Snow	R,M,A	R,M	—	—	—	A
Topography	R,M	—	A	O	—	A
Surface temperature	A	M	—	—	—	T
Albedo	M	M	—	—	O	T
Surface geochemistry	M	M	—	—	—	—
Geological features	M	R,M	—	—	—	—
Cultural features	R,M	R,M	—	—	—	—
Vegetation	R,M	M	—	—	—	T,C
Soil moisture	M	M	—	—	—	—
Soil erosion	M	M	—	—	—	—
Surface strain	A	—	A,D	S	—	A
Seismic wave velocities	—	D	—	—	S	—
Tectonic deformation	—	—	D,L	—	S	S

Characteristics of the Earth as diverse as its changing magnetic field and the growth and recession of glaciers are subjects of the global climate study. Here are some of the necessary measurements, and the kinds of systems required to obtain them.

Key for instrument categories

- A Altimetry ranging
- C Chemical composition instruments
- D Data links
- G Gravimeter-magnetometer
- L Precise geodetic locations
- M Multispectral imaging
- P Vertical profile remote sensing
- O Oceanography instruments
- R Radar imaging
- S Seismographs, acoustic detectors
- T Meteorological instruments

Source: "Space Science in the Twenty-First Century: Imperatives for the Decades 1995 to 2015," National Research Council, 1988

of Sciences to do a series of studies in 1987 titled *Space Science in the Twenty-First Century*. One volume, *Mission to Planet Earth*, is a comprehensive outline of the questions in weather and climate that space science missions, combined with *in situ* measurements, should attempt to answer.

In August 1987, former astronaut Sally Ride released her report on the future of the U.S. space program, requested by NASA Administrator James Fletcher. Ride's report, titled *Leadership and America's Future in Space*, recommended four programs including the Mission to Planet Earth: "We currently lack the ability to foresee changes in the Earth System, and their subsequent effects on the planet's physical, economic, and social climate. . . . [T]his initiative would revolutionize our ability to characterize our home planet, and would be the first step toward developing predictive models of the global environment," the report said.

Mission to Planet Earth is conceived of as a \$15 to \$30 billion project over a 15-year period. Although it is an international program, its implementation will probably depend on whether the U.S. contribution to the project, managed by NASA, receives the necessary funding. It will provide

new data in every scientific discipline concerned with weather and climate (see tables). As a measure of the vast array of data involved, Lennard Fisk, NASA associate administrator for space science, noted that the missions could generate up to 2,000 times the information stored by the Internal Revenue Service!

Mission to Planet Earth is made up of an integrated set of satellite and surface observations from a variety of platforms and instruments including polar and geosynchronous Earth orbital spacecraft, special purpose orbiters, space-based data relay satellites, ocean drifting instruments, pop-up buoys, tethered buoys, ocean bottom instruments, optical fiber links to islands and buoys, automated ground stations, simple ground stations such as reflectors, rain gauges, and tide gauges. Modules containing measuring instruments can also be developed for ships and aircraft, linked to the global network.

The plan envisions 1,000 ocean systems, 1,000 automated land stations, thousands of simple surface stations, and a variable number of ships, planes, and balloons in addition to the space assets. The tables summarize the elements of Mission to Planet Earth and the range of weather and cli-

mate characteristics to be measured.

A crucial part of the mission, the Earth Observation System (EOS), is a series of very large Earth-orbiting platforms, each of which will carry an array of instruments to simultaneously measure various characteristics of the Earth, the atmosphere, the oceans, solar activity, and the other factors affecting the weather and climate.

Earth Observation System (EOS)

Four large platforms carrying remote-sensing instruments for the cyclical collection of data over the globe comprise the Earth Observation System. They will operate at an altitude of 705 km in Sun-synchronous polar orbit, in which the platform remains approximately fixed with respect to local time directly beneath it, for example at 10:30 AM. The solar angle is therefore about the same for all observations. Two of the polar platforms will be built by the United States, one by the European Space Agency, and one by Japan. Combined, they will carry more than 50 scientific instruments.

EOS will obtain a sequence of 14-day "snapshots," or synoptic measurements, of the entire Earth, showing simultaneous changes in various characteristics. NASA has selected 551 scientists from 13 countries to develop and use the instruments on the two U.S. EOS platforms. Teams of scientists will conduct interdisciplinary studies of particular features of interest, such as the Amazon rain forest.

The four platforms are planned for launch in the late 1990s for 15 years' operation. They will supplement and greatly enhance the data now being collected by satellite remote-sensing systems operated by the United States, Soviet Union, France, India, Japan, and the European Space Agency (see Figure 1).

EOS will provide the first coordinated simultaneous measurements of the interactions of the atmosphere, oceans, solid earth, and hydrological and biogeological cycles. Rather than coordinating the data from different small and specialized satellites that are in different places at different times, the large EOS platforms will sweep sets of instruments over the same parts of the Earth at the same time, taking different measurements.

The Eyes of EOS

The first EOS platform will have about 19 instruments (Figure 3) for objectives including the global quantification of Earth's hydrological cycle, continued monitoring of the radiation budget and surface temperature, a comprehensive study of clouds, characterization of biological activity and ecosystems, improved study of atmospheric circulation, and study of surface mineralogy.

One of the candidates for inclusion in the core payload of the first platform, EOS-A, is a series of instruments to take images in visible light and infrared. This combination of instruments, known as the Moderate-resolution Imaging Spectrometer (MODIS), will function as the platform's wide-angle lens, taking broad sweeps to show large-scale phenomena. An imaging spectrometer obtains separate images of the same field of view at several different wavelengths.

- The MODIS-T (tilt) instrument will focus on the mea-

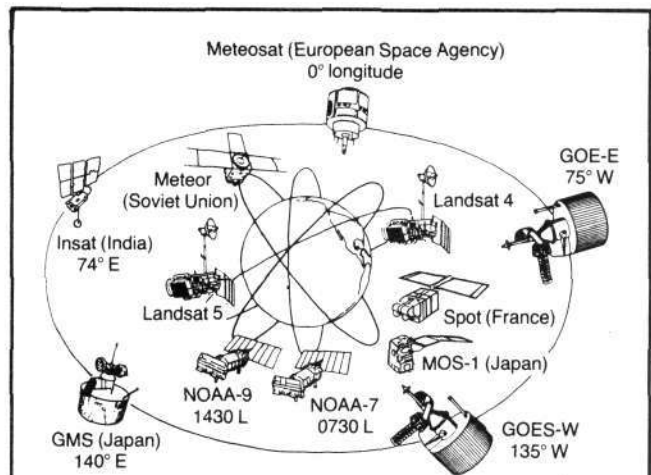


Figure 1

OPERATIONAL EARTH OBSERVATION SATELLITES

A sampling of the weather and environmental satellites in operation in 1987, showing the longitude of the geostationary satellites and the paths of the low-altitude polar-orbiting satellites. In 1987 the global civil environmental satellite system included satellites from five nations and the European Space Agency. Dozens more will be launched during the 1990s.

Source: "Space-Based Remote Sensing of the Earth: A Report to Congress," NOAA and NASA, 1987.

surement of biological and physical properties on a 1-km scale, with emphasis on ocean productivity. It is a scanning instrument with a 50-degree tilt capability to avoid sun glint, and will image a swath 1,500 km wide. MODIS-T data will help quantify vegetation and wetlands, monitor cloud properties, and examine sediment transport in bodies of water.

- The companion MODIS-N (nadir) instrument will provide data on land and ocean surface temperatures, aerosol concentrations, snow cover, and ocean currents. It will generate global vegetation maps as have been produced with the Landsat satellites, and scientists plan to use the data to quantify fast-changing phenomena that have climatic effects, such as deforestation.

MODIS-N will be used for measurements at the nadir, or directly below the spacecraft, for processes that do not require pointing. Its wide swath, about 2,300 km, is especially applicable to observing large-scale characteristics of the oceans.

- The Geoscience Laser Ranging System (GLRS), the first space-based laser ranging system, will bounce coherent energy off ground-based reflectors. It will measure the height of glaciers and polar ice sheets to within 1 meter, to determine whether they are growing or receding. GLRS will also measure crustal movements on Earth as small as a few centimeters, and hence may be used to predict earthquakes.

The GLRS, now being developed at NASA's Goddard Space Flight Center, will use a Nd:YAG laser—the laser

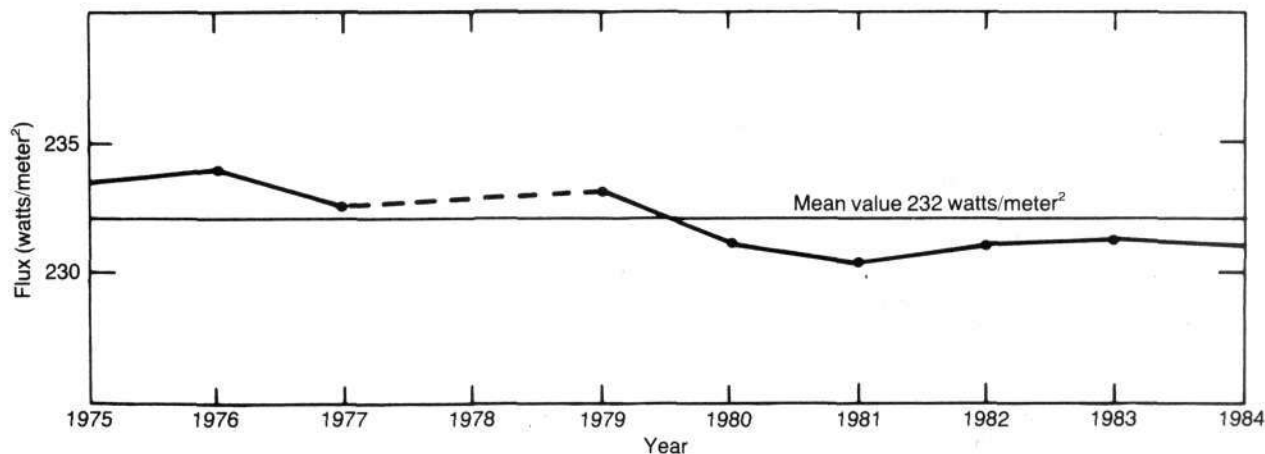


Figure 2
GLOBAL ANNUAL OUTGOING LONGWAVE RADIATION

NOAA's polar orbiting satellites have provided this decade of data on Earth's energy emission. Climate changes can be discerned only by collecting and comparing data over decades, because annual fluctuations are so great. In this case, if the absorbed solar radiation exceeds the outgoing longwave radiation, warming would be expected; if less than the outgoing longwave radiation, cooling would be expected. On average the absorbed solar energy is expected to balance the loss of energy to space, resulting in a net energy loss of zero. Over a decade, that precise balance was never measured, although the measurements averaged zero. The dashed line represents missing data. The average value of all years is 232 watts/meter² of Earth's surface, with a standard deviation of 1.3 watts/meter².

Source: "Space-based Remote Sensing of the Earth: A Report to Congress," NOAA and NASA, 1987

medium is a rod of yttrium-aluminum-garnet doped with neodymium. It will produce laser light at three frequencies—at infrared and ultraviolet wavelengths—and is being designed to have a repetition rate of 40 pulses per second. The laser beam will illuminate a spot on the ground 70 meters in diameter at nadir. The telescope aboard the spacecraft for detecting the reflected light will have an aperture of 18 cm and a ranging/tracking precision of 0.01 milliradians. The laser instrument will also be used to measure aerosol distributions and the precise heights of clouds.

- The High-resolution Imaging Spectrometer, or HIRIS, is the zoom lens of the EOS-A platform for phenomena in the intermediate range "between the human and the global scales." HIRIS will provide high spectral and spatial resolution of the Earth, with 30-meter resolution in 24 km swaths across 192 spectral bands. (The Landsat satellite has only 6 bands.) It will permit detailed examination and monitoring of sensitive ecosystem interfaces where rates of change are highest and hence most readily detected. These include regions of mountains below the timberline, savanna-woodland borders, wetland-upland edges, and the estuarine-oceanic zone.

The highly programmable HIRIS instrument will look for subtle stress in tree leaves caused by pollution and lack of moisture. Because its view angle will range from plus 52 degrees to minus 30 degrees from nadir, it will be able to sample any area of interest on Earth's surface a minimum of once every two days.

- CERES—the Clouds and Earth's Radiant Energy System instrument—will combine two broadband scanning radiometers to gauge radiation input and output and provide

global measurements of atmospheric radiation. It is a follow-on to the highly successful Earth Radiation Budget Experiment carried on the ERBS satellite launched from the Space Shuttle in October 1984.

The Earth reflects back into space some of the radiative energy it receives from the Sun. It also emits its own radiation. The Earth absorbs more incident radiation in the tropics than at the poles, and undergoes large-scale changes in its radiation budget—the balance of energy received to energy reemitted—through evaporation and precipitation. These factors affect both weather and climate. CERES will provide global radiation measurements from the top of the Earth's atmosphere to the surface of the planet.

- The Laser Atmospheric Wind Sounder (LAWS) will use a light detection and ranging (lidar) instrument. The Doppler lidar system will be aimed to bounce light waves, generated by a laser, off atmospheric particles for direct tropospheric wind measurements. Analysis of the reflected light will help reveal the direction and speed of winds, and provide information on the particulate matter or aerosols suspended in the atmosphere.

LAWS will provide real-time global wind profiles for the lowest weather-producing layer of the atmosphere. It will provide data on the transport of water vapor to help determine the factors that control the hydrologic cycle. The tropospheric distribution of global gases and aerosols will be tracked, and the crucial coupling between the oceans and atmosphere will be examined.

Most global wind velocity data are now obtained from balloons launched over land by nations in the northern hemisphere. Much of the emphasis of LAWS, therefore,

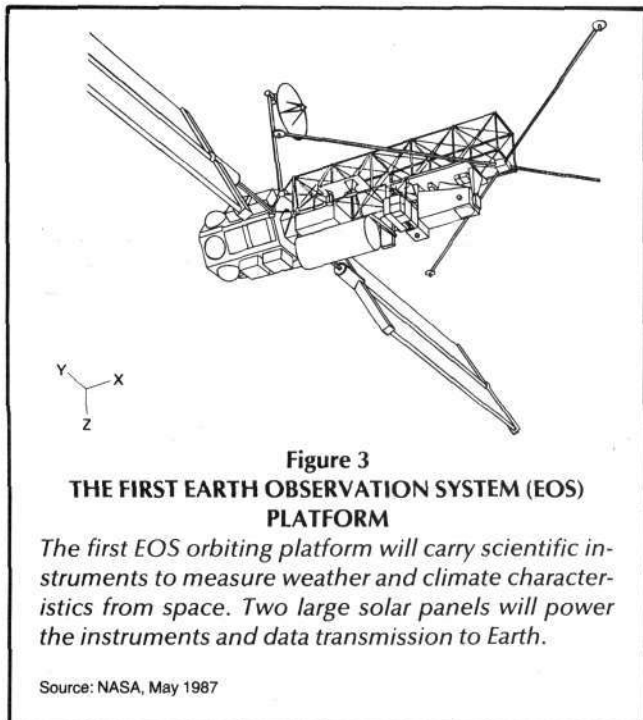


Figure 3
THE FIRST EARTH OBSERVATION SYSTEM (EOS) PLATFORM

The first EOS orbiting platform will carry scientific instruments to measure weather and climate characteristics from space. Two large solar panels will power the instruments and data transmission to Earth.

Source: NASA, May 1987

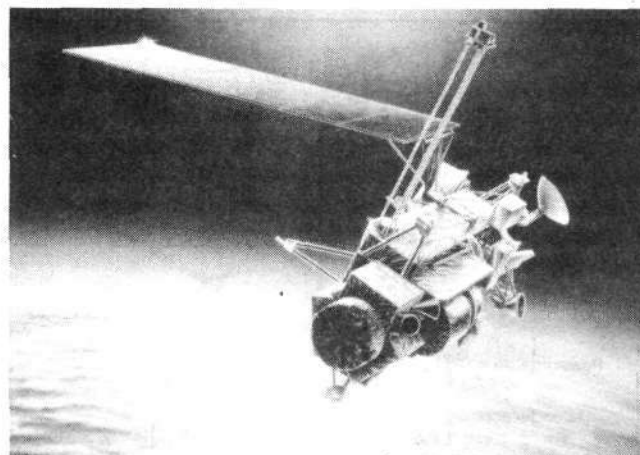
will be in tropical and subtropical regions, where little data are now collected. It will survey winds over the entire Earth at least once a day, from ground level to 4,000 feet.

The precursor experiment was GLOBE, the Global Backscatter Experiment. That instrument flew aboard a DC-8 aircraft from the NASA Ames Laboratory in California, used for airborne research over the Pacific Ocean in 1989, collecting baseline data for LAWS. The experiments measured the numbers of particles as small as 1/100th the diameter of a human hair (1 micron) as well as their optical, physical, and chemical properties. Lidar instruments remotely sensed particles at 1,000 to 40,000 feet in altitude. Operating at different wavelengths, the lidar instruments measured the energy reflected back (backscattered) by the aerosols.

Earth Probes

Media attacks on the large-scale EOS program have included the lie that nothing will be done to study Earth's climate for the next few years while the large platforms are being prepared. Over the 1990s, while the first EOS multi-instrument platform is readied for launch at the end of 1997, dozens of single-mission, self-contained satellites will be launched as follow-ups to previous scientific probes, to extend the existing data base on Earth's weather and climate. These spacecraft follow a long line of successful Earth observation missions, which have provided the basic data now available on weather and climate. Two of the most important regions to be studied by these small missions are the oceans and the upper atmosphere.

The lowest layer of the upper atmosphere, the stratosphere, is the 30- to 40-km thick region energetically dominated by the presence of the ozone layer. Stratospheric aerosols play a role in the Earth's energy budget and thereby influence climate. According to the National Academy of Sciences report on *Space Science in the 21st Century*,



General Electric Company, Space Systems Division
Built by the General Electric Company, UARS is about twice the size of Landsat.

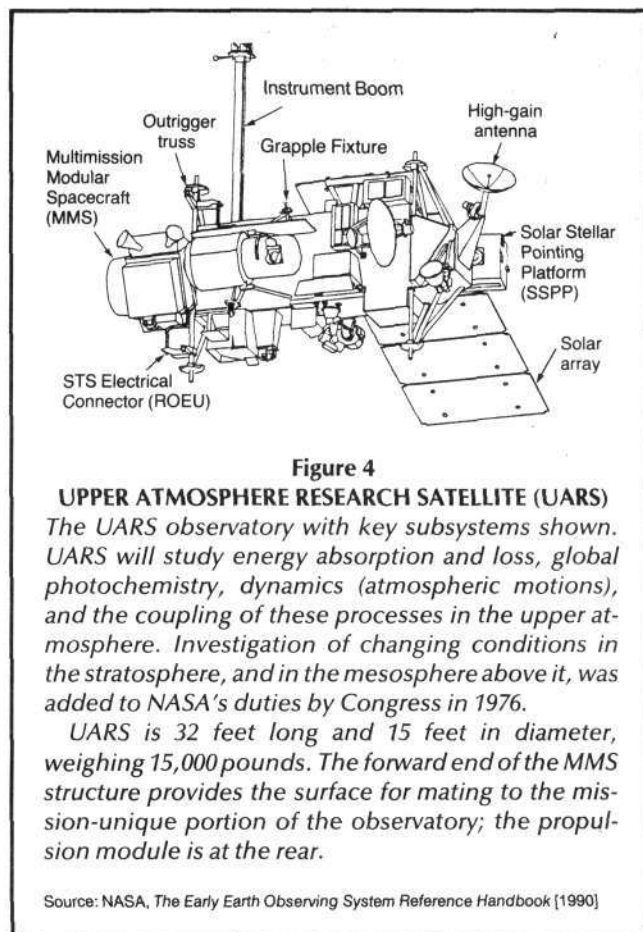
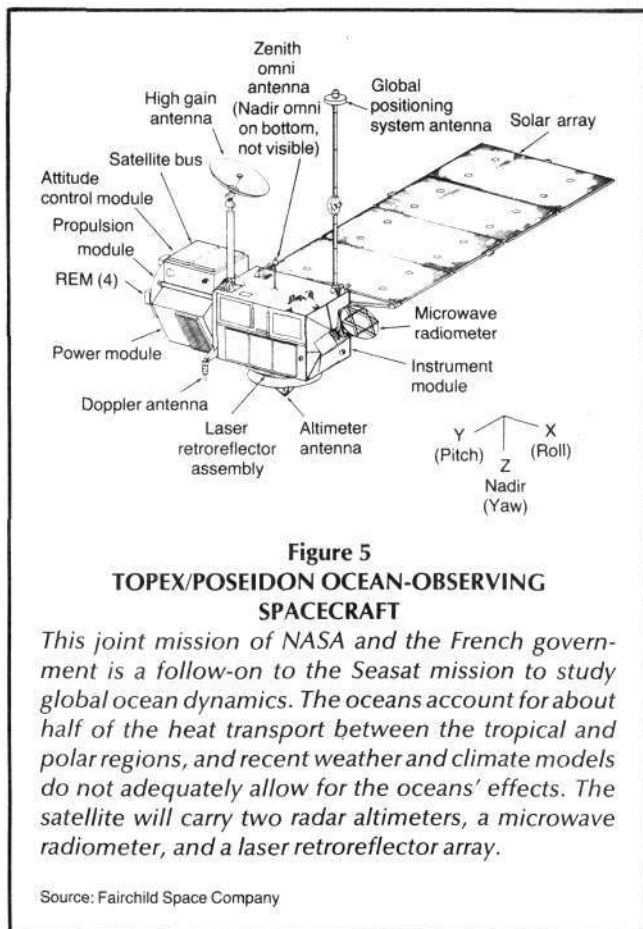


Figure 4
UPPER ATMOSPHERE RESEARCH SATELLITE (UARS)
The UARS observatory with key subsystems shown. UARS will study energy absorption and loss, global photochemistry, dynamics (atmospheric motions), and the coupling of these processes in the upper atmosphere. Investigation of changing conditions in the stratosphere, and in the mesosphere above it, was added to NASA's duties by Congress in 1976.

UARS is 32 feet long and 15 feet in diameter, weighing 15,000 pounds. The forward end of the MMS structure provides the surface for mating to the mission-unique portion of the observatory; the propulsion module is at the rear.

Source: NASA, *The Early Earth Observing System Reference Handbook* [1990]

many of the aerosols appear to be derived from sulfur gases that are in part transported continually to the stratosphere, and in part injected episodically by volcanoes. "Because of low temperatures and the presence of water vapor, once the gases arrive in the stratosphere they condense into small droplets of sulfuric acid and persist for up to several years," the report says. Through radiant solar energy absorbed by ozone and aerosols, these constituents increase the temperature in the troposphere below and modulate



the energetics and dynamics in the lower atmosphere.

The Upper Atmosphere Research Satellite (UARS), scheduled for launch in the fall of 1991 from the Space Shuttle, will carry nine complementary instruments to measure the upper atmosphere's internal structure and the external influences acting upon it (Figure 4). UARS will also carry an instrument to extend the long-term measurement of changes in the solar constant, the amount of energy emitted by the Sun.

Specifically, UARS will study energy input and loss in the upper atmosphere, its global photochemistry, its dynamics, and the coupling between these processes as well as between the upper and lower layers of the atmosphere. Four instruments will measure temperature profiles and concentrations of ozone, methane, water vapor, and other key trace species, including chlorofluorocarbons.

Two instruments will map the upper-atmosphere wind fields, which shape the global distribution of chemical species, through Doppler-shift measurements. Three instruments will determine energy inputs from the Sun and the Earth's magnetosphere, which influence both chemistry and dynamics.

"Both world weather and long-term climate changes are strongly linked to ocean behavior," according to the National Academy report. Though existing weather satellites provide some routine ocean surface observation, crucial data are lacking on surface winds, ocean currents, biological productivity, and the gravity field of the Earth.

The U.S. and French Ocean Topography Experiment, or TOPEX/Poseidon, is currently planned for a June 1992 launch on the French Ariane rocket (Figure 5). The oceans account for about 50 percent of the heat transport between the tropics and the polar regions, with the atmosphere accounting for the other half. According to weather and climate experts at NASA, many of the recent models that predict significant global warming do not adequately account for the oceanic effects on climate. These effects will be more precisely measured through TOPEX/Poseidon and the follow-on ocean monitoring from EOS instruments.

Radar altimeters aboard the spacecraft will measure the distance from the satellite to the ocean surface by bouncing short pulses of energy off of the surface. The time required for the pulses to return to the satellite's antenna indicates its distance. The satellite's distance from the Earth's center will also be obtained, and the comparison of the two distances will show the hills and valleys of the ocean surface topography.

Ocean topography maps currents, eddies, and other features of ocean circulation. Scientists believe that if ocean topography can be discerned, the details of ocean circulation can be understood. TOPEX-Poseidon will make possible the first models of changes in global ocean circulation while providing crucial data on the role in weather and climate played by the oceans, which cover 70 percent of the Earth's surface.

Earth probes to observe nearly the full range of global climate and weather factors will be launched over this present decade. The data they produce will aid in the development of specific tasks for the more sophisticated EOS and other Mission to Planet Earth instruments that will lead weather and climate research at the opening of the 21st century.

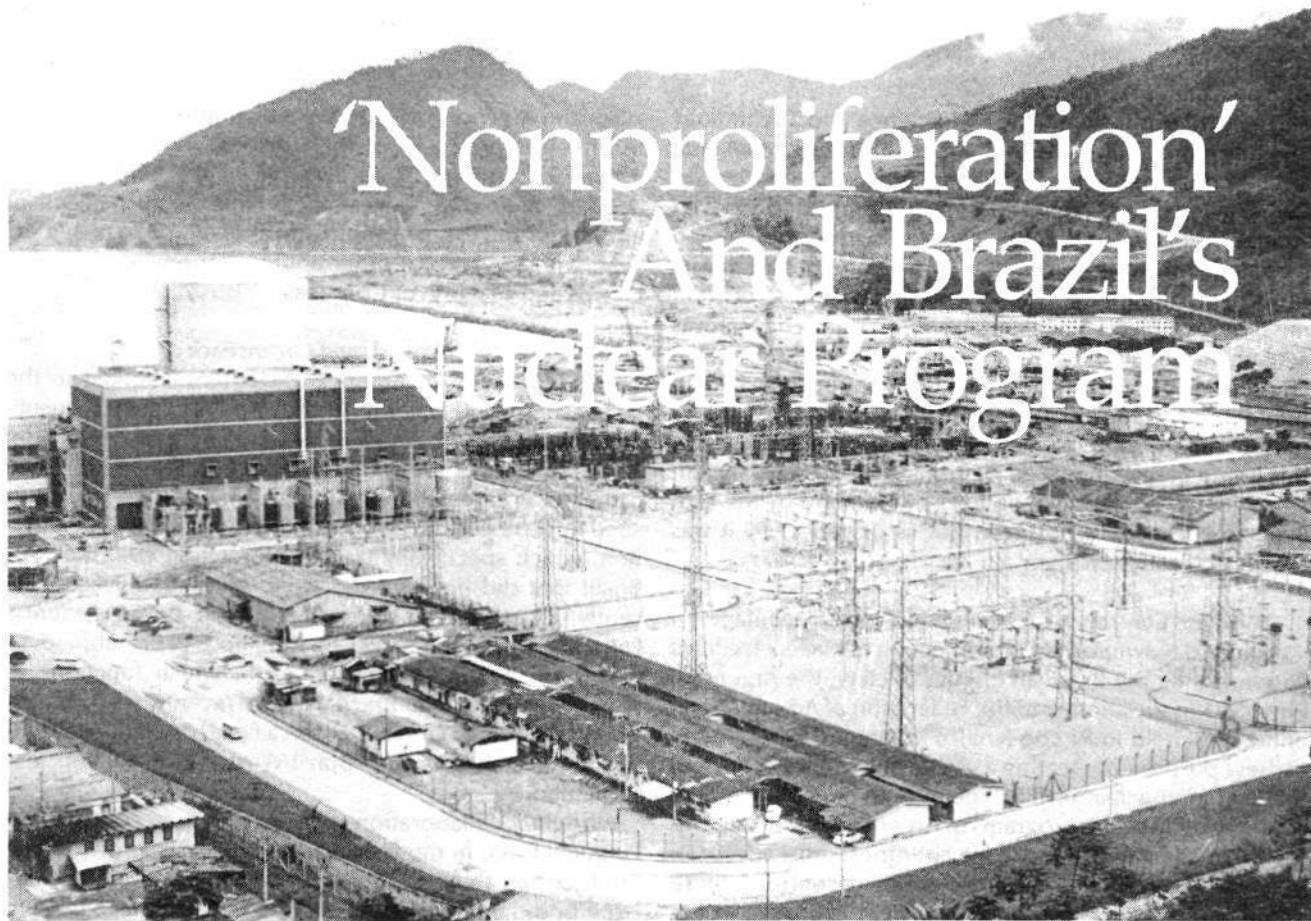
Over the next two decades, the many improvements in our knowledge of weather and climate dynamics from both small, specialized satellites and the families of instruments on large EOS platforms will allow for informed policy decisions to be made, if any are necessary, regarding man's activities and the climate.

What will most likely be rediscovered is that man's historically positive intervention into the life of this planet—increasing its biological productivity, energy throughput, energy intensity, and, most important, increasing its potential for population growth—is what can perhaps improve the weather and climate.

Marsha Freeman, an associate editor of 21st Century, writes frequently on space topics.

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Dennis Small

For 45 years "nonproliferation" has been the argument used to stop nuclear energy in Brazil—and put a brake on the growth of industry, population, and prosperity.

by Lorenzo Carrasco and Mario Sergio Paranhos

When William Webster, director of the U.S. Central Intelligence Agency, told the Boston-based World Affairs Council in April 1990 that it was no longer "communist subversion" that "poses serious dangers to United States interests," but rather technological development—especially nuclear—of "certain" Third World countries, it was not news to Brazil. For nearly 45 years Brazil's nuclear development program has been under attack from the Pugwash faction in the West, those policymakers who view industrial development and growth in the developing sector as dangerous. The difference was that now this antidevelopment policy was being voiced so openly.

Around the same time, the Carnegie Foundation issued a provocative report, "Nuclear Exports: The Challenge of Their Control," accusing Argentina, Brazil, India, Iraq, and Pakistan of dealing in "contraband" nuclear parts for war purposes. Similarly, Jozef Goldblat, the director of the Institute for Peace Research in Oslo, Norway, called on the governments of the world's wealthy nations to carry out "economic and political pressures" against the same countries to pressure them on the nuclear question. How this "pressure" translates to action was seen in the U.S. State Department blocking of the sale of advanced computer processing equipment that would transform the IBM 3090-

200 computer of the Brazilian Air Force's aircraft company, Embraer, into a supercomputer. The State Department argued that this advanced equipment would assist Brazil in the construction of nuclear weapons.

In May 1990, U.S. Secretary of State James Baker sent a high-level mission to Brazil to try to get Brazil to sign the Nuclear Nonproliferation Treaty. Headed by U.S. Ambassador-at-Large Richard T. Kennedy, the mission was rejected by the Brazilian government after it alleged that Brazil's constitution was only for "internal consumption," and therefore served as no guarantee for the world powers that Brazil would not use its nuclear program for war ends. Despite the government's rejection of Ambassador Kennedy's insults, the antiproliferation faction has many Brazilian allies. For example, the so-called green congressman, Fabio Feldman, has been working on a constitutional amendment to force the executive branch's Secretariat of Strategic Affairs to relinquish control over Brazil's National Nuclear Energy Commission (CNEN). Instead the CNEN would be

Brazil's Angra dos Reis nuclear complex in the state of Rio in 1982. The completed plant is the Angra 1 turnkey reactor built by Westinghouse. Under construction here is Angra 2, a project of the 1975 West German-Brazilian nuclear agreement.

placed under the jurisdiction of Science and Technology Secretary José Goldemberg, an internationally known radical environmentalist who has admitted that his nomination was proposed by E. Velikhov, vice president of the Soviet Academy of Sciences, to President Collor de Mello.

Feldman has also presented the Brazilian Senate with a proposal to create a special congressional oversight commission for Brazilian nuclear activities. This proposal was actually formulated by Luis Pinguelli Rosa of the Brazilian Physics Society, home of a gaggle of antinuclear "bomb hunters." One such physicist, in fact, Anselmo Paschoa, is now one of the directors of the CNEN. The collaboration of this group of self-described "leftist and progressive" scientists with the neocolonial policies put forward by the U.S. State Department is not new, but as of early 1990 it was reactivated with new vigor.

'Civilian' Control: A Euphemism for Nuclear Sabotage

A three-day symposium on inspection of nuclear facilities sponsored by the Brazilian Physics Society, the Argentine Physicists Association, and the Federation of American Scientists was held in Rio de Janeiro in January 1990, for the express purpose of creating a global network of nonscientific and antinuclear civilian agencies to oversee the now autonomous nuclear programs of Argentina and Brazil. Under the pretext of placing these countries' most advanced nuclear research centers under "civilian control," these groups are seeking to sabotage nuclear cooperation between Argentina and Brazil. The specific targets are the joint nuclear fuel reprocessing programs, the development of advanced small-scale reactors, and the future construction of a fast breeder reactor—cooperative projects of obvious strategic significance for the region.

In Argentina, the installations targeted for "supervision" include the uranium enrichment center at Pilcaniyeu in Rio Negro province and the reprocessing plant at the Ezeiza Research Center in Buenos Aires. In Brazil, the special targets are the centrifuge uranium enrichment plant at the Marina Aramar center and the reprocessing laboratory at the Nuclear Energy Research Institute, both located in the state of São Paulo.

Brazilian physicists Luis Pinguelli Rosa and Odair Gonçalves proposed to the symposium the creation of "an advisory body" that would pressure Brazilian congressmen into exercising a "supervisory" role—through them—over uranium reprocessing and enrichment installations, according to the daily *Jornal do Brasil*, Jan. 24. "We want to inspect Navy installations in order to assure that the fuel produced there does not surpass 20 percent enrichment, the required level for moving a nuclear submarine," declared Pinguelli.

The interest in blocking cooperation between the two countries was formalized in a manifesto signed by the Argentine and Brazilian physicists' associations *against* ratification of a bilateral agreement for peaceful nuclear cooperation, which had been signed by the countries' former presidents, Raúl Alfonsín and José Sarney.

William A. Higginbotham and David Albright, physicists from the Federation of American Scientists (an antinuclear organization that has worked closely with E. Velikhov and Moscow), intervened at the symposium to advise their Bra-

zilian and Argentine counterparts on how best to "oversee" the nuclear programs in their respective countries. The Americans offered, as an example of the kind of action needed, their own success in forcing the suspension of plutonium and tritium production at several U.S. plants last year, with the help of other antinuclear environmentalist groups and a faction of Congress.

Pugwash and Greenpeace

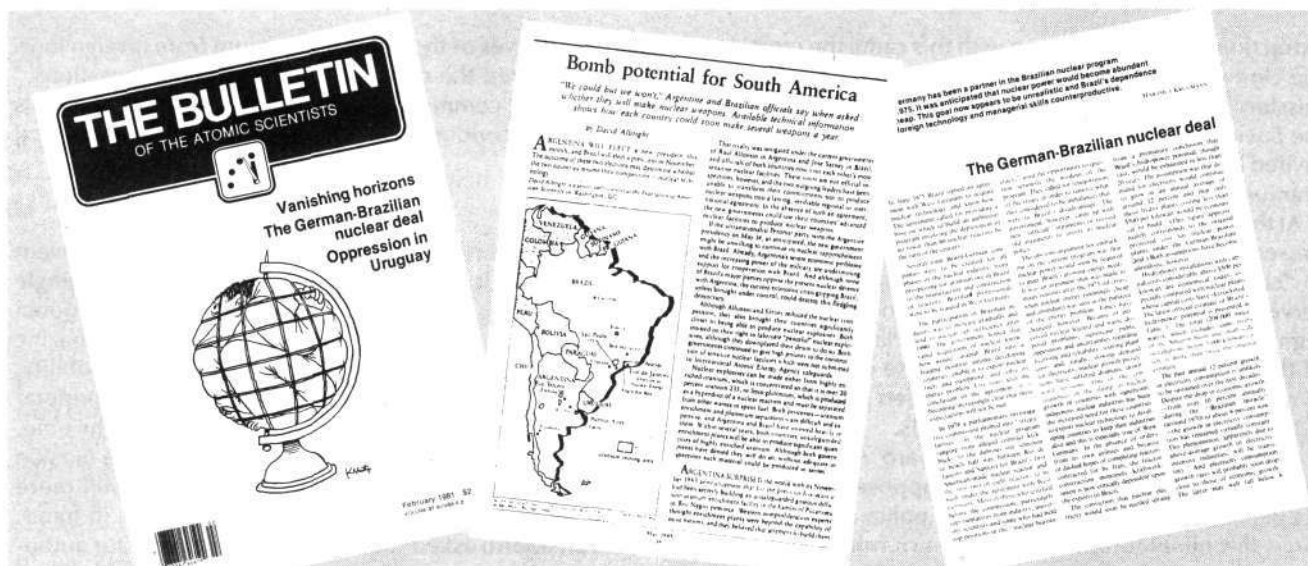
The Federation of American Scientists is linked to the Pugwash Conference, founded in 1954 in order to consolidate superpower control over nuclear energy development via supranational "verification" agencies. David Albright's career as an "atomic bomb hunter," in particular, was pursued in close collaboration with the Greenpeace organization, which specifically targeted for action countries like Brazil that did not sign the Nonproliferation Treaty. Recently, Greenpeace's representative in Brazil, Federico Fullgraf, received \$80,000 in donations from abroad to found an organization called Earth, which functions as Greenpeace's front in Brazil. Fullgraf recently worked with the West German Green Party on a failed operation intended to destabilize the Brazil-West Germany nuclear agreement.

Albright's collaboration with his Brazilian counterpart, Pinguelli Rosa, in the fight against nuclear energy became public when they coauthored an article in the May 1989 issue of the *Bulletin of the Atomic Scientists*. The two authors focused their attack against the nuclear successes of the two target countries, complaining that both Brazil and Argentina refused to ratify the nuclear arms nonproliferation treaties, as well as the Tlatelolco Treaty for the denuclearization of Latin America. The Nonproliferation Treaty, in particular, was rejected by both governments as a threat to national sovereignty, as discriminatory against developing-sector access to advanced technologies, and as an instrument to maintain superpower hegemony over nuclear energy.

The antiproliferation physicists have acknowledged that nuclear development cooperation between Argentina and Brazil would mitigate any possible rivalry between them, since "officials of both countries visit each other's most sensitive nuclear facilities." Nonetheless, they insist that such collaboration is "dangerous" because both countries "could soon develop the capacity to produce nuclear explosive material free of international restriction." Once this happens, Albright wrote in his May 1989 *Bulletin* article, "Bomb Potential for South America," that "technological momentum and political pressure may lead them [Brazil and Argentina] to decide to produce highly enriched uranium and eventually nuclear weapons."

Another article in the same issue, written by Luis Pinguelli Rosa and two other Brazilian physicists, "Brazil's Nuclear Shakeup: Military Still in Control," lamented that the reorganization of Brazil's nuclear sector "did reduce opposition in the academic community to the government's program . . . [and] recaptured some of the nationalism that colored Brazil's nuclear program of the 1950s."

Ignoring the fact that the new Brazilian constitution explicitly restricts nuclear activity to solely peaceful purposes,



Brazil's nuclear energy program came under attack from the antinuclear "nonproliferation" faction from the very beginning. Here, a February 1981 article in *The Bulletin of the Atomic Scientists* calling Brazil's plan to provide nuclear power "unrealistic" and "counterproductive." A May 1989 article in *The Bulletin* notes that many nuclear officials in Brazil and Argentina do "not believe that nuclear weapons would serve any rational purpose" but makes the case for "international restrictions" anyway.

the three Brazilian physicists wrote, "To ensure peaceful coexistence in Latin America, we scientists stress the importance of a clear, public, official rejection of nuclear weapons in Brazil and elsewhere." The authors make it very clear that their concern is not with weapons, but with prohibiting Brazil from developing an extensive nuclear electricity capacity, with all the development benefits that would entail: "Brazil should concentrate its efforts on the design, construction, and operation of small reactors suited to producing radioisotopes with medical, industrial, and scientific significance."

An additional aim of the "oversight" policy at the January symposium in Rio is to create unwarranted friction between Brazil and Argentina which, the antinuclear networks calculate, would end up destroying any nuclear cooperation programs between the two nations. This provocative strategy was cut short by the president of the Atomic Energy Commission of Argentina, Manuel Mandino. Mandino told the Brazilian daily *Gazeta Mercantil* Jan. 10: "Whom should Argentina fear having the bomb? Only Brazil? And whom should Brazil fear having the bomb? Only Argentina? We, Argentina and Brazil, have joined hands and are now working together. This constitutes a clear and precise regional peace."

The concerns of the antiproliferationists who met in Rio de Janeiro have nothing to do with the kinds of antinuclear fears voiced by uninformed lay people. These are scientists who hate science and technology because of its development potential. For example, in the cited *Bulletin* article, Pinguelli and his Brazilian colleagues bitterly protest that

the CCPN's [Superior Council for Nuclear Policy] policy still seems to be dictated by the erroneous belief that nuclear power is needed in the near future. The

hard fact is that the concept of well-being based on limitless industrial growth and the expenditure of natural resources is being sharply challenged worldwide. Brazil itself is far from the so-called economic miracle of the 1970-1974 period, when the economy was expanding at yearly rates of over 10 percent—accompanied by a steep increase in foreign debt and unrestricted expenditure of nonrenewable resources. . . . This is no time for an expensive, unnecessary nuclear power program.

With such statements, Pinguelli and company not only reveal their own anti-industrial prejudices, but contradict evidence that the advanced-sector nations themselves are returning to an emphasis on nuclear energy development. Pinguelli et al. conclude:

Current projections, in fact, show that nuclear power will not be needed before 2010-2020. During the next 30 years, Brazil should rethink its nuclear program, optimizing the use of locally available personnel, materials, and industrial capability, with the most serious regard for safety and environmental preservation.

A History of Brazil's Nuclear Energy Fight

The efforts to sabotage nuclear development in Brazil and Argentina are certainly not new. They began at the very beginning of nuclear energy research and became increasingly frantic after World War II with the Anglo-American nuclear policy that shackled the nationalist governments of Argentina's Juan Perón and Brazil's Getulio Vargas.

In August 1946, the U.S. Congress approved the McMahon Act, which limited nuclear cooperation between the United States and other countries to exploration and

extraction of uranium. Along with this came the creation of the United Nations Atomic Energy Commission. The commission's first meeting was attended by the United States, the Soviet Union, Britain, France, and four other countries invited as "observers" because they had the world's largest uranium reserves—Brazil, Belgium, Canada, and India.

At that meeting, American representative Bernard Baruch presented a proposal for creating a supranational agency to "control ownership of world uranium and thorium reserves," which Brazil took as an affront to its national sovereignty. Behind the infamous "Baruch Plan" was the thesis of the "injustices of nature": that those countries lacking in nuclear technology should have been graced with considerable reserves of strategic minerals.

Brazilian representative Adm. Alvaro Alberto was the only one present at that meeting to oppose the injustice of the Baruch Plan, describing the U.S. policy as an attempt to force the mineral-rich nations to surrender their natural wealth. In 1951, Alberto proposed legislation to protect

natural reserves of thorium and uranium from foreign looting. He offered the concept of "specific compensations," meaning that commercial transaction in strategic minerals could not be conducted in dollars but only in technological exchanges.

Secret Diplomacy

Admiral Alberto's resistance did not suffice to prevent the U.S. assault on Brazil's reserves. In 1952, in a single transaction, the U.S. imported the entire thorium quota guaranteed by a two-year agreement. Brazil's monazitic sands were even traded for rotten wheat. U.S. inflexibility, aggravated by the MacMahon Act, made any real cooperation with Brazil unfeasible. The American envoy at the time, Gordon Dean, nonetheless made a big deal of the illusion of bilateral cooperation, in hope of securing a still more liberal Brazilian mineral export policy. With this in mind, Admiral Alberto asked the Brazilian government for authorization to begin negotiations with other countries and he

Brazil in the 1990s: 'Yes, to Nuclear Energy'

by Guilherme Camargo

Guilherme Camargo, president of the Brazilian Nuclear Energy Association, keynoted the association's third general congress held in Rio de Janeiro July 23-27, which addressed the challenge Brazil's nuclear energy sector faces in the 1990s. The audience of 300 included members of Brazil's nuclear leadership, government and business representatives, and many engineers. Here are excerpts from his speech.

The world today is going through accentuated social, political, economic, and cultural transformations. On the political-economic plane, we observe an unprecedented crisis, marked by the decline of the traditional economic systems. On the one side, there is liberal capitalism inspired by Adam Smith, a system incapable of promoting the common good and social justice, and, on the other side, the Marxist-inspired statist economy, based on collectivism that inhibits creativity and individual freedom.

The decline of these economic systems has sparked profound political and social conflicts, some of them marked by explosions of violence like those that recently took place in China, Romania, Azerbaijan, and Panama, while others are carried out surprisingly spontaneously and naturally, such as the political changes in Czechoslovakia and East Germany. . . .

The world power balance is shifting. The East-West conflict ends and North-South polarization increases, or better said, the conflict between rich and poor nations—where the former try to maintain their hegemony over the rest.

In this new geopolitical scenario, new instruments for affirmation of international power are being created.

The first of those relevant to our analysis is access to state-of-the-art technologies and the most recent scientific breakthroughs. Superconductors and nuclear technology are becoming important allies in this dispute.

There is full recognition today that without access to these new technologies, no nation would be able to move up the steps in the direction of the First World.

Another important piece in this world chess game is the environmental question. The ecological question—extending far beyond the limits of just and natural concern with protecting and improving the human species—is taking on the attributes of a new ideology and even a religion.

In our opinion, we are dealing with a political-cultural phenomenon born in the womb of the counterculture, stemming from ideological disillusionment and the discrediting of science, which began in the early 1960s. Whether intentional or not, the fact is that the world ecological movement has been backed with billions of dollars in investments from the industrialized countries for publicity campaigns and in multinational environmentalist organizations, becoming a powerful instrument for maintaining the international *status quo*.

A New World Order

Poverty is the factor that most contributes to the degradation of the environment. . . . The path taken by the developed nations was high levels of industrialization, intense technological development, high per capita energy consumption, and solid national infrastructures. Environmental protection is related to economic and social development. When, on the pretext of economic concerns, we are pressured not to exploit our mineral

went to Europe to make contacts with France and Allied-occupied Germany.

At this point, Admiral Alberto's trip took on aspects of a secret mission. To accomplish his purpose—transferring prototypes of uranium centrifuges to Brazil—he had to rely on secret diplomacy, bypassing the Brazilian Foreign Ministry as well as other decision-making agencies like the National Security Council, the military joint chiefs of staff, and the Department of Mineral Production. The Brazilian ambassador to Bonn at the time recommended that Alberto await the restoration of full sovereignty to West Germany, when the export of centrifuges would then become possible.

The recommendation was officially accepted by Alberto's National Council for Scientific and Technological Development, but the admiral requested and received special presidential authorization to get the Foreign Ministry to back a secret shipment of the machines. Less than 24 hours after the authorization was granted, however, the Military Secu-

rity Board of the Allies seized the centrifuges in Göttingen and Hamburg, West Germany.

The seizure was orchestrated by the U.S. Atomic Energy Commission. Alberto contacted Lewis Strauss, the president of that commission, but Strauss offered no hope of getting the confiscated machines released by the Allies. Instead, Strauss offered American aid, within the restricted framework permitted by U.S. nuclear policy. Alberto repeated once again his government's desires: enrichment plants, a factory to produce uranium fluoride, and research reactors.

Admiral Alberto was forced to return to Brazil with empty hands. His resignation followed in March 1955, making possible, in August 1955, the signing with the United States of a Program of Cooperation for the Inspection of Uranium Resources in Brazil. One year later, in 1956, a commission of the Brazilian Congress gained access to secret U.S. diplomatic documents that revealed the U.S. pressures to force Alberto's resignation. The commission recommended a re-

“Despite all of the international and domestic pressures and intrigues . . . nuclear energy could become a powerful instrument of redemption for the Brazilian people, who detest poverty and social underdevelopment—a tool to install in the country an economic system based on social justice and defense of the inalienable rights and dignity of the individual.”

—Guilherme Camargo

reserves, not to build roads or nuclear and hydroelectric plants; when we are pressured to remain as a big agrarian country, full of untouched virgin forests, we are giving in to the slogan: “Do as I say, not as I do.”

All these changes can still mean the beginning of a new world order characterized by the resumption of development. We do not think such optimism is unfounded.

The profound and overwhelming changes in Eastern Europe, notably German reunification, certainly will lead to a development surge on that continent, shown by massive investments in infrastructure and in training skilled personnel. In order to reestablish the socioeconomic levels of the Eastern European countries, we can expect [thousands of] kilometers of modern railroads to be built, complete canal transport integration of Europe to be sought, and large investments in electricity generation and distribution systems to be necessary.

This will be the natural environment for a resurgence

of worldwide nuclear activities.

Without question, [in Brazil] we face today a moment of decision regarding nuclear energy.

On the political level, we must reaffirm the essentially peaceful vocation of the Brazilian nation, seen in its respect for the sovereignty of nations, its search for regional integration, its rejection of any ambition for expansionism or hegemony, and its endorsement of negotiated solutions to international conflicts. . . .

Will we affirm ourselves as an informed, developed and sovereign nation, or will we descend into the depths of economic disorder, speculation, misery, and social inequality?

Will we continue to be an agrarian country, dominated by industries of extraction and basic transformation? Or will we be a technologically industrialized nation, in which the electronics, chemical, computer and highly sophisticated capital goods industries can flourish? . . .

If it wishes, Brazil can be a nuclearly developed nation by the year 2000. A clear decision by the government is required to attain this goal. To do so, we should accelerate our technological and scientific programs. We should seek international cooperation, primarily with our South American neighbors, like Argentina and Peru. A Latin American common market for [marketing] of nuclear and technological products is possible today.

We believe that our country can overcome its temporary crisis; we are confident in the recovery of the economy and the resumption of development, in a program that could be the Latin American counterpart of Eastern Europe's recovery—a program that encourages investment in the physical economy, the building of railroads, highways, hospitals, mechanization of agriculture, rural integration and accelerated building of new hydroelectric and nuclear as well as conventional thermal plants.

In this then, we can remove the question mark and affirm with confidence, “Brazil in the 1990s: Yes to nuclear energy in the service of society!”

vision of international agreements that were prejudicial to the country. The government followed up by naming an interministerial commission whose directors, approved by the National Security Council, ruled that "the fundamental point of nuclear policy should be to produce, inside the country, nuclear fuel under total government ownership and control." To carry out this nuclear policy, the National Nuclear Energy Commission, now distinct from the National Council for Scientific and Technological Development, was put in charge.

The Nonproliferation Treaty

Pressures against nuclear development continued, despite the launching of the Atoms for Peace program by U.S. President Dwight D. Eisenhower before the United Nations General Assembly in December 1953. The International Atomic Energy Agency (IAEA) was created in this period with two basic objectives: first, to promote atomic energy for the development of humanity and second, to establish a system of safeguards to assure that technical assistance and technology transfer cannot be diverted for armaments.

Whatever good intentions these nuclear programs had, Atoms for Peace and the IAEA abandoned the goal of promoting nuclear energy in the developing sector and concentrated their efforts on making the safeguard system—at first presented as voluntary—increasingly stringent. Two decades later this safeguard system became the Nonproliferation Treaty.

The final form of the Nonproliferation Treaty in 1978 was worked out by the United States and the Soviet Union. In effect, the treaty divided the world into two kinds of countries: the "haves," those with nuclear arsenals that would be permitted to continue to perfect their atomic technologies, and the "have-nots," those who by 1967 had not managed to produce atomic bombs. The have-nots were obliged to commit themselves to neither producing nor acquiring nuclear weapons. In the eyes of many of the have-not countries, the treaty thus became a violation of the principle of equality among sovereign states and an instrument for legitimizing nuclear hegemony by the superpowers.

As a complement to the treaty, the "have" countries established the so-called Club of London in 1975, to supervise and block any technology transfer to countries that did not submit to the system of internationally managed nuclear development. It is the Club of London that is now sabotaging the development of launch vehicles essential to the Brazilian space program.

At that point, promising initiatives in Brazil were lost. For example, the Thorium Group, a team of researchers from the Institute of Radioactivity Research in Belo Horizonte, had developed a project for a thorium-fed reactor between 1955 and 1960. The work was ready to go when the group was dissolved.

The Brazil-German Nuclear Pact

In 1973 and 1974, the National Nuclear Energy Commission and its subsidiary, the Brazilian Company of Nuclear Technology, developed a strategy that included creating a Brazilian heavy industry to produce reactors, as well as the

industries that would handle all phases of the nuclear fuel cycle. The purpose of the program was to provide a growing nuclear electricity capacity for the country. The Angra reactor of Westinghouse, a "turnkey" program (one who the vendor presents a completed plant to the purchaser fell outside of these guidelines. At that point, Brazil began negotiations with West Germany in the utmost secrecy, as to avoid the treatment accorded Admiral Alberto.

U.S. pressures on Brazil and other "have nots" continued, however, through the U.S. Senate and even through Jimmy Carter's presidential campaign. In 1978, the United States decreed the Nonproliferation Act, imposing such unilateral measures as suspension of nuclear exports to countries that refused to accept the treaty. These measures were applied *retroactively* in order to suspend nuclear fuel supply contracts to Brazil that had been previously signed for Angra I. Brazil had already broken off negotiations with the United States months before it signed its 1975 pact with West Germany, once it became illegal for U.S. companies to provide so-called sensitive technologies to nonnuclear nations.

In early 1977, the Carter government threatened to impose a "repressive program in stages" if West Germany and Brazil refused to accept U.S. conditions on their bilateral nuclear agreement. Those proposed conditions, some mutually exclusive, included:

- (1) U.S. participation in the agreement and in the process of technology transfer for uranium enrichment and reprocessing;
- (2) Construction in a "neutral" Latin American country of a reprocessing plant subject to international control;
- (3) Subjection of any reprocessing plant built in Brazil to controls complementary to the system of the IAEA; and
- (4) Formation of an international cartel of nuclear technology producers and sellers.

Carter threatened several reprisals if these conditions were not accepted by West Germany and Brazil. The United States would impose heavy tariff barriers against German and Brazilian products on the U.S. internal market; block the export of products upon which Brazil and Germany depend; block Brazilian access to financial markets; embargo the supply of enriched and natural uranium that had already been contracted with West Germany; and withdraw U.S. "protective troops" stationed on German soil.

Brazilian and German diplomacy resisted these initiatives. U.S. pressures, however, and initiated the Brazil-German agreement to build a nuclear energy capacity in Brazil under the agency Nucleobras. Continuing diplomatic wrangling with the Carter administration ultimately led Brazil to break its military agreements with the United States. At that point the attacks against the German-Brazilian agreement took a different tack: bringing about its financial collapse. This path was facilitated by the Baader-Meinhof terrorist gang, the murder of West German banker Jürgen Ponto, one of the sponsors of the German-Brazilian pact.

The other "gang" that facilitated financial collapse was the International Monetary Fund. From Brazil's first negotiations with the IMF in 1982, that blackmail institution demanded as its first conditionality that Brazil limit the scope of the German-Brazil nuclear pact. This meant that plants



Government of Brazil

Admiral Alberto (above right) examining Brazil's strategic minerals with President Getulio Vargas in 1951. Physicist Costa Ribeiro (center) holds a Geiger counter. At right is a New York Times cartoon from 1946 depicting Alberto as one of the major figures in the UN Atomic Energy Commission.



and 5, initially included in the agreement but without specific locations, were totally frozen, limiting the program to construction of Angra 2 and Angra 3.

'Parallel' Programs

It was under this pressure, specifically in response to the threats of the Carter government to prevent transfer of nuclear technology, that the governments of Argentina and Brazil decided to launch autonomous technological efforts in these areas—necessarily under strict secrecy.

The November 1983 announcement by the Argentine Atomic Energy Commission that the uranium enrichment process had been completed at Pilcaniyeu, and a similar 1987 announcement by the Brazilians, took Anglo-American intelligence completely by surprise. David Albright admits this in the *Bulletin* article cited above:

Western nonproliferation experts thought enrichment plants were beyond the capability of most nations, and they believed that attempts to build them could have been discovered by Western or Soviet intelligence agencies. *Nucleonics Week* quoted a Reagan administration source as saying that the announcement "represents a startling and dismaying failure of intelligence gathering."

When Brazil announced that it had achieved the complete nuclear fuel cycle, an official of the U.S. State Department's nonproliferation office declared: "Our reaction will be the same as when Argentina announced it had achieved the nuclear fuel cycle; we said then and we repeat now that

those countries should place all their nuclear installations and material within reach of the International Atomic Energy Agency's inspections. When they don't, they raise suspicions that they are using nuclear technology for other than peaceful purposes."

This, of course, is the same argument used today by the Brazilian Physical Society and the Brazilian Society for the Advancement of Science. This is also the argument of the "universalist" group at Itamaraty, Brazil's Foreign Ministry, which recently demanded—through the daily *O Estado do São Paulo*—that Brazil sign the Nonproliferation Treaty. Thus, whether witting or not, the efforts of the antinuclear group headed by Professor Pinguelli Rosa to lift the veil of secrecy around Brazil's most advanced nuclear projects is nothing less than a continuation of the superpower efforts to sabotage all future progress in Third World nuclear development.

The antidevelopment faction has an even broader, more "flexible" purpose in mind. In its view, Brazil not only must sign the Nonproliferation Treaty, but also must disperse with its research in such high-technology areas as the VLS (Satellite-Launch Vehicle) and microchip and supercomputer technology. Another U.S. aim is to have Brazil adopt a more "open" posture toward the General Agreement on Tariffs and Trade (GATT), which would complete this strategy of aborting Brazil's technological and industrial development.

Lorenzo Carrasco heads the Rio bureau of the news weekly Executive Intelligence Review. Mario Sergio Paranhos is an engineer working in Brazil's nuclear industry and a member of the Brazilian Nuclear Society.

Morphology of the Electron, Photon, and Neutron



The Plasmoid Construction of the Superstring

Winston Bostick

Theoreticians desperately searching for superstrings can relax: Experimental recognition and delineation of superstrings' role in nature has been with us for three decades.

by Winston H. Bostick

EDITOR'S NOTE

We are pleased to present this two-part special feature by plasma physicist Winston Bostick. Bostick begins with the plasma structures produced in laboratory fusion experiments and from these highly organized force-free structures he conceives the physical characteristics of electrons, photons, and neutrons. Although fundamentally an experimentalist, Bostick has contributed to the development of a unified field theory through insights garnered from the plasma hydroelectrodynamics produced in the plasma focus device.

This article, written in March 1989, is adapted from the essay Bostick submitted to the annual essay contest of the

Gravity Research Foundation. The author notes that although this 1989 work was accorded no recognition by the Foundation, he considers it superior to his 1961 contribution, which won First Prize. It is not his judgment that has suffered in the intervening years, Bostick asserts.

Bostick is George Meade Bond Professor of Physics Emeritus at Stevens Institute of Technology in Hoboken, New

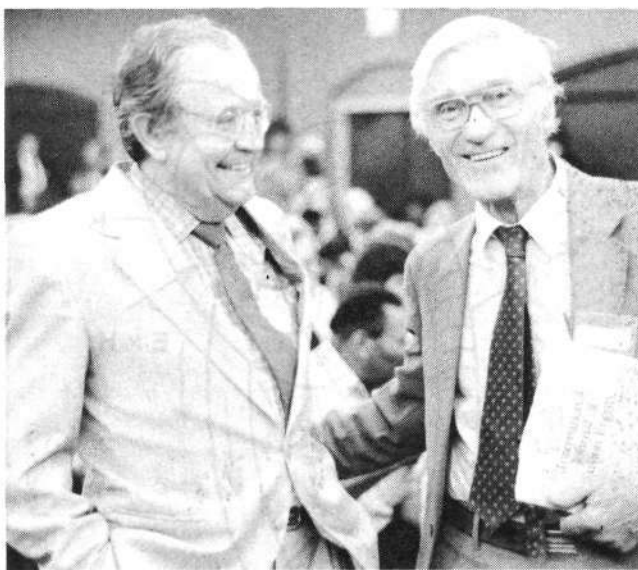
A head-on view of a self-organized plasma in a plasma focus device where the current flow can be seen traveling in filaments. The Stevens Institute fusion group saw and photographed these structures starting in the mid-1960s.

Jersey. One of the pioneers of the plasma focus fusion device, Bostick helped set up plasma focus research groups throughout the world and his Stevens group has been a leader in exploring the experimental frontiers of the fusion device. Some of his experimental work with the plasma focus machine was reported in the Sept.-Oct. 1988 issue of *21st Century* ("The Plasma Focus Fusion Device: Universal Machine of the Future"), p. 37. Bostick is also a consultant to the Los Alamos and Lawrence Livermore national laboratories, and was coeditor of the Proceedings of the First International Conference on Energy Storage, Compression, and Switching (1974) and of the Proceedings of the second conference in 1978.

* * *

Laboratory experiments in 1954 to 1956 with magnetized plasmas produced spontaneously arising, integrity-possessing structures called plasmoids (Bostick 1956, 1957, 1957a, 1958, 1958a). Recognition ensued that these plasmoids were force-free, minimum-free-energy structures, like spherical droplets, carrying their electric currents in slender, force-free, tensile-strength-possessing vortex "strings"—the Beltrami geometry (Beltrami 1889; Bostick 1986; Peratt 1986).

There followed a project (ansatz) to conceptualize the electron morphologically as a stringlike submicroscopic force-free "plasmoid" constructed of self-gravitating **E** and **H** vectors (Bostick 1958b, 1978, 1985, 1986). This ansatz has yielded a high-fidelity, stringlike, equilibrium fermion



Stuart Lewis

Winston Bostick (right) and fusion scientist Friedwardt Winterberg at a 1985 conference in honor of space scientist Krafft Ehrlicke, sponsored by the Fusion Energy Foundation.

model described here. Its cornerstone is an extremely slender, electrically charged electromagnetic string, equilibrated (net mass = 0) by its own self-gravity, whose electromagnetic energy is 2.5×10^{18} GeV. We respectfully nominate this string as a candidate for being the elusive, much

Giving Physical Meaning to Quantum Mechanics

The conventionally recognized interpretation of quantum phenomena for the last 60 years is that promoted by Niels Bohr and Max Born, which treats elementary particles or *onta* as mathematical points of a certain amount of lump mass, electric charge, spin, and magnetic moment. The theoretical and experimental discovery of the de Broglie-Einstein waves requires that the probability of finding the particle within a linear distance dz (for example when the free particle is moving with a velocity in the z direction) is given by $\Psi^*\Psi dz$, where Ψ and Ψ^* are the solutions of the Schroedinger wave equation discussed in Figure 4.

Although the product $\Psi^*\Psi$ is a real number, the individual wave functions Ψ and Ψ^* are complex quantities that factor into both real and imaginary components. In this 60-year-old interpretation, Ψ and Ψ^* have absolutely no direct physical meaning. It is only their product $\Psi^*\Psi dz$ that has physical meaning.

In the new interpretation presented here, the wave functions Ψ and Ψ^* represent helical deformation waves on real strings. The mass of the particle (or *on*) is related to the electromagnetic energy of the **E** and **H** vectors that surround the stringlike torus, the spin is carried by the Poynting vector associated with those vectors, and the magnetic moment is related to the velocity and configuration of the charge on the stringlike torus.

The beautiful approach to complex numbers of Karl Gauss, presented in English translation in *21st Century* ("The Metaphysics of Complex Numbers," Spring 1990, p. 60), is thus used in all its full-blown geometrical glory to demonstrate why it is perfectly natural for us to expect fermions (electrons and quarks, for example) to exhibit intrinsic wavelike behavior, spin, magnetic moment, and a mass that is *entirely electromagnetic in origin*. Indeed, all of these characteristics are a consequence of the minimum-free-energy, force-free nature of fermions.

In the Bohr-Born interpretation, mass is a mysterious lump of unknown essence, charge is unstabilized, spin, magnetic moment, and wavelike characteristics have no explainable physical-geometrical origin or rational reason for existence. In the new interpretation, charge is stabilized by self-gravitation, spin- $1/2$ can be explained to a college sophomore, and all four of the famous disparate forces of the Grand Unification Theories are explained geometrically as manifestations of electromagnetic effects. The difference between rest mass and total mass is explained geometrically with a clarity never before realized. The new interpretation represents a triumph of the geometrical approach over the strictly algebraic, lump-mass constant approach of the past 60 years.

—Winston Bostick

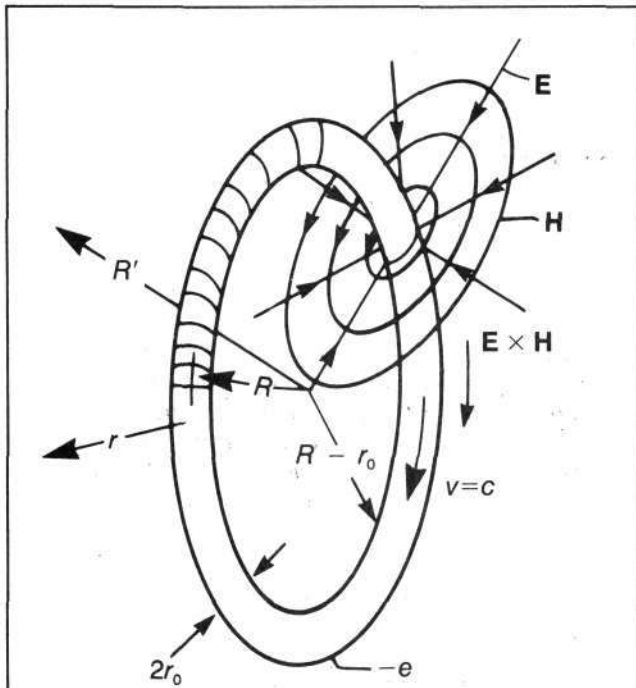


Figure 1
THE ELECTROMAGNETIC FLYWHEEL MODEL

This electromagnetic flywheel is a model for the storage of energy in one like the electron. The toroidal "sausage casing" consists of a massless superconductor (thin toroidal shell) with a linear spring constant k . The casing is uniformly charged with a massless charge $-e$ that circulates with a velocity $v = c$ in the toroidal direction. The concept of the charge and its circulation is invoked to generate the electric field \mathbf{E} and magnetic field \mathbf{H} in the region $r_0 < r \leq R$. The energy and angular momentum are stored in these vectors and (largely) in this space.

sought-after "superstring" (Gross 1990).

At the moment, "all the smart money is being bet on" superstrings and the theoreticians are "desperately searching for superstrings" (Ginsparg and Glashow 1986; Bostick 1988); Arthur Holly Compton's 1918-1919 attempt at a stringlike, ringlike electron has been all but forgotten (Compton 1918, 1919, 1919a). Compton's stringlike model (Figure 1), with a radius of 1.85×10^{-10} cm, gave calculated fluorescence, shortwave X-ray scattering cross sections that were in better agreement with experimental values than were the mathematical-point or finite-radius sphere models.

The author, a former thesis student of Compton (circa 1941) at the University of Chicago, became fascinated as an experimentalist in plasma physics in 1954 with the laboratory-produced, integrity-possessing structures called plasmoids and their ubiquitous cosmological counterparts (Bostick 1956, 1957, 1957a, 1958, 1958a, 1986; Peratt 1986, 1986a, 1986b): Starting with essays in 1958 and 1961 and continuing to the present, this former student, unaware of Compton's 1918-1919 work, has pursued and developed

the conceptualization of the electron and other fermions as stringlike, force-free, minimum-free-energy structures consisting of self-gravitating electromagnetic fields. Here all energy (mass) and momentum are strictly of electromagnetic origin and there are no self-energy infinities, no lump mass, and no embarrassing obligations requiring renormalization (Bostick 1958b).

The pedagogical, primitive form of the filamentary electron is shown in Figure 1, where the charge $-e$, distributed on the surface of the torus, circulates with velocity $v = c$. The current is $e/2\pi R$, $|\mathbf{E}| = \mathbf{H} = e/\pi r R$, and the electromagnetic field energy is

$$E_f \cong 2\pi R \int_{r_0}^R \frac{|\mathbf{E}|^2 + |\mathbf{H}|^2}{8\pi} 2\pi r dr$$

$$= \frac{e^2}{\pi R} \ln \left(\frac{R}{r_0} \right) \cong \frac{1}{2} m_{0e} c^2,$$

where m_{0e} is the electron rest mass and $R = \hbar/m_{0e}c$ is chosen to give the appropriate magnetic moment for the electron. The spin carried by the Poynting vector is

$$s \cong 2\pi R \cdot R \int_{r_0}^R \frac{|\mathbf{E}| \times |\mathbf{H}|}{4\pi c} (2\pi r dr) = \frac{e^2}{\pi c} \ln \left(\frac{R}{r_0} \right)$$

$$\cong m_{0e} \frac{Rc}{2} = \frac{\hbar}{2}.$$

An additional $\cong \frac{1}{2} m_{0e} c^2$ contribution to the electron's rest energy comes from the elastic potential energy stored in the stretching of the perfectly elastic flywheel of Figures 1 and 2. This latter $\frac{1}{2} m_{0e} c^2$ does not contribute to the Poynting vector in the space outside the torus of radius r_0 , and therefore does not contribute to the spin. Ergo "spin = $\frac{1}{2}$ "! An additional small component to the total rest mass comes from the monopole electrical energy at distances $\geq 2\pi R$ from the geometrical center of the torus. Hence the $(1 + \alpha/2\pi \dots)$ factorial correction to the gyromagnetic ratio of the electron ($\alpha = 1/137$)!

We have now to assay the nature of that elastic, circumferential, tensile force in whose stretch we invest approximately half of the rest-mass energy of the electron: We choose to create the smooth thin coating of charge $-e$ on the torus surface by a dynamic fine structure consisting of a very slender string or fiber of radius r_{0g} shown in Figure 2, which is helically wound around the torus of small radius r_0 . The pitch of this helix is θ' . The effective flow at $v = c$ of the surface charge on the torus in the circumferential direction is accomplished by a combination of the charge flowing within the helix at c and the rotation of the helix at the appropriate speed. The resulting helix provides an elastic circumferential spring for the elastic flywheel. Within this spring we hope, by having r_{0g} small enough, to store enough concentrated electromagnetic energy ${}_{ss}E_f$ to provide a gravitational (negative) binding energy ${}_{ss}E_g = -{}_{ss}E_f$, so that the exploding ${}_{ss}E_f$ will be equilibrated by the equal and opposite ${}_{ss}E_g$.

Now the length of the fiber to be gravitationally equilibrated is

$$\frac{2\pi R}{\cos \theta'}, \quad |{}_{ss}\mathbf{E}| = |{}_{ss}\mathbf{H}| = \frac{e \cos \theta'}{r_g \pi R}, \quad {}_{ss}E_f = \frac{e^2 \cos \theta'}{\pi R} \ln \frac{r_0}{r_{0g}}.$$

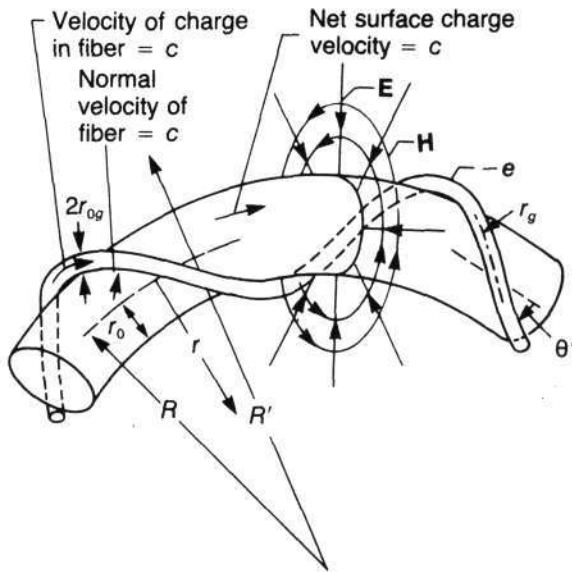


Figure 2
THE L'CHAIM ELECTRON

This is the simplest pedagogical form of the l'chaim or chayah electron. The slender, gravitationally equilibrated fiber, helical in configuration as shown, circulates the charge $-e$ in such a way as to produce a thin toroidal shell of charge $-e$ with surface velocity c in the $2\pi R$ circumferential direction.

The electric field $\mathbf{E} = e/\pi R$ and magnetic field $\mathbf{H} = e/(\pi R' \cdot v/c) = e/\pi R'$. The circulation velocity v of the charge $-e$ on the toroidal shell must be c if the explosive electrical stress in the direction r is to be compensated exactly by the contractive stress due to \mathbf{H} . The current is $e/2\pi R$, where $R = \hbar/m_{0e}c$. The torus behaves like a perfectly elastic, relativistic, electromagnetic flywheel, where the potential energy stored in the elastic, spring-shaped, gravitationally equilibrated fiber is, by the virial theorem, exactly equal to the electromagnetic field energy,

$$E_f \cong 2\pi R \int_{r_0}^R \frac{|\mathbf{E}|^2 + |\mathbf{H}|^2}{8\pi} 2\pi r dr$$

$$= \frac{e^2}{\pi R} \ln \left(\frac{R}{r_0} \right) \cong \frac{1}{2} m_{0e} c^2,$$

where m_{0e} is the rest mass of the electron. The spin is approximately

$$2\pi R \cdot R \int_{r_0}^R \frac{|\mathbf{E}| \times |\mathbf{H}|}{4\pi c} (2\pi r dr) = \frac{e^2}{\pi c} \ln \left(\frac{R}{r_0} \right) \cong m_{0e} \frac{Rc}{2} = \frac{\hbar}{2},$$

and is said to be only 1/2 because this spin carried by the Poynting vector represents only half the mass m_{0e} , the other half being the equilibrating, elastic potential energy of the stretched gravitational fiber spring. If the monopole electrostatic energy of the electron at values of $R' > 2\pi R$ is taken into account, the gyromagnetic ratio for the torus is

$$g \cong \frac{2e}{2m_{0e}} \left(1 + \frac{\alpha}{2\pi} \dots \right),$$

where

$$R = \frac{\hbar}{m_{0e}c} = \frac{\lambda_c}{2\pi}, \quad \alpha = \frac{e^2}{\hbar c},$$

the current in the torus is $i = e/2\pi R$ and the magnetic moment of the torus is $\mu = \pi R^2 i$. The monopole energy in the region $R' \geq 2\pi R$ contributes to the mass m_{0e} , but not to the spin, because \mathbf{H} and hence $\mathbf{E} \times \mathbf{H}$ is essentially zero in this region.

Note that

$$\ln \frac{R}{r_0} = \frac{\pi \left(\frac{e^2}{\hbar c} \right)^{-1}}{2} = \frac{137\pi}{2},$$

hence $E_f \cong \frac{1}{2} m_{0e} c^2 = e^2/R \cdot 137\pi/2$ and $m_{0e} c^2 \cong e^2/R \cdot 137\pi$, which is, in this approximate, primitive model, the energy associated with the "strong force" E_{st} , the entire energy of the fermion. However, the interaction energy E_{em} associated with the electromagnetic interaction between two charges of value e brought within $R = \hbar/m_{0e}c$ of one another is e^2/R , which is of order 1/137 times the "strong force" interaction energy E_{st} .

The energy density

$${}_{ss}^d E_f = \frac{1}{8\pi} ({}_{ss} E^2 + {}_{ss} H^2) = \frac{1}{4\pi} \frac{e^2 \cos^2 \theta'}{\pi^2 R^2 r_g^2},$$

giving a mass density of

$$\rho = \frac{1}{4\pi c^2} \frac{e^2 \cos^2 \theta'}{\pi^2 R^2 r_g^2}.$$

By Gauss's theorem, the gravitational field f_g is given by

$$2\pi r_g f_g = 4\pi G \int_{r_0}^{r_g} 2\pi r \rho dr$$

and thus

$$f_g = \frac{e^2 G \cos^2 \theta'}{\pi^2 c^2 R^2 r_g} \ln \frac{r_g}{r_0}.$$

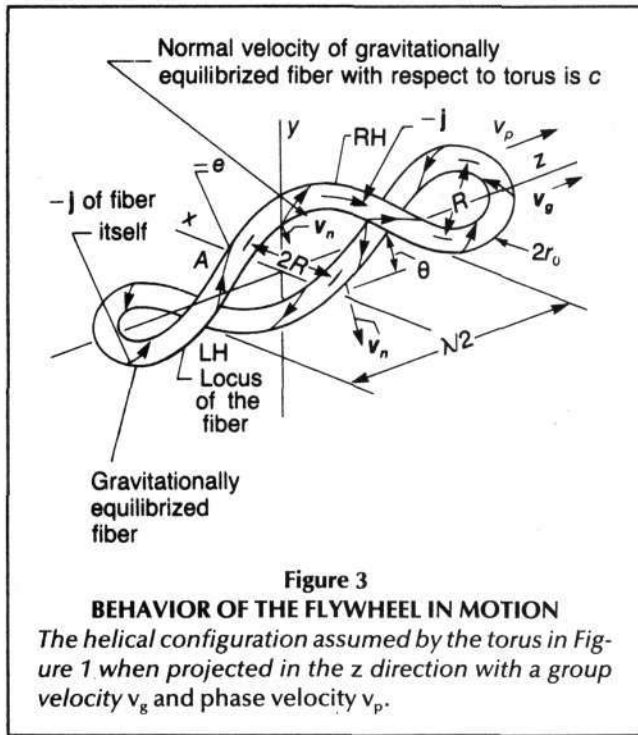
$$G = 6.6732(31) \times 10^{-8} \text{ dyne cm}^2/\text{g}^2.$$

The energy density associated with this gravitational field is

$${}_{ss}^d E_g = \frac{-f_g^2}{8\pi G} = -\frac{G}{8\pi} \left(\frac{e^4 \cos^4 \theta'}{\pi^4 c^4 R^4 r_g^2} \right) \ln^2 \frac{r_g}{r_0}.$$

The total negative gravitational self-binding energy of this mass distribution is

$$\begin{aligned} {}_{ss} E_g &= -\frac{2\pi R}{\cos^2 \theta'} \int_{r_0}^{r_g} \frac{2\pi G e^4 \ln^2 \frac{r_g}{r_0}}{8\pi \cdot \pi^4 c^4 R^4 r_g} dr_g \cos^4 \theta' \\ &= -\frac{G e^4 \cos^3 \theta'}{6\pi^3 c^4 R^3} \ln^3 \frac{r_0}{r_0}. \end{aligned}$$



Equating ${}_{ss}E_f = |{}_{ss}E_g|$ to produce gravitational equilibration of the fiber, we have

$$\frac{e^2 \cos \theta'}{\pi R} \ln \frac{r_0}{r_{0g}} = \frac{Ge^4 \cos^3 \theta'}{6\pi^3 c^4 R^3} \ln^3 \frac{r_0}{r_{0g}},$$

which gives

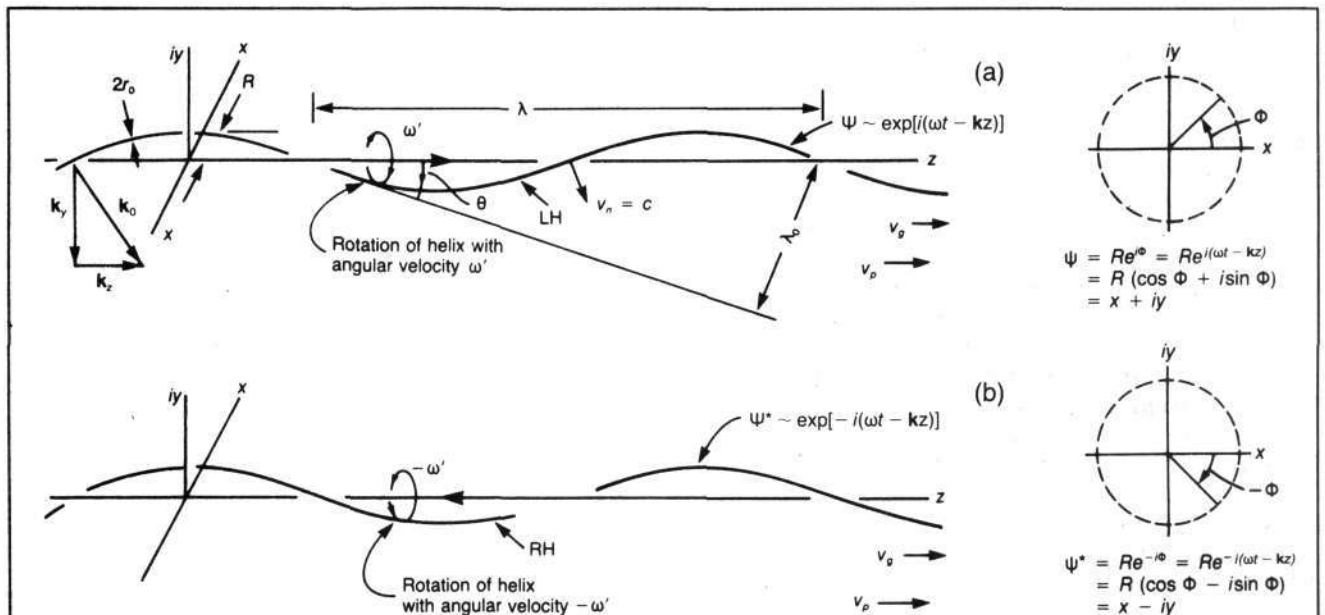
$$\ln \frac{r_0}{r_{0g}} = \frac{6^{1/2} \pi c^2 R}{eG^{1/2} \cos \theta'}.$$

Now ${}_{ss}E_f = |{}_{ss}E_g|$ can be evaluated to be

$${}_{ss}E_f = \frac{e^2 \cos \theta'}{\pi R} \cdot \frac{6^{1/2} \pi c^2 R}{eG^{1/2} \cos \theta'} = \frac{6^{1/2} e c^2}{G^{1/2}}$$

$= 4.1 \times 10^{15} \text{ ergs} = 2.5 \times 10^{18} \text{ GeV} = 5.0 \times 10^{21} \text{ electron masses.}$

We can thus justifiably nominate our gravitationally equilibrating fiber, whose ${}_{ss}E_f = |{}_{ss}E_g| = 2.5 \times 10^{18} \text{ GeV}$, as a candidate for the role of the superstring that the theoreticians have so desperately been seeking, because its mass energy, derived from principles of equilibrium and stability, is of the same order of magnitude as the Planck mass 10^{19} GeV which the theoreticians find for their superstrings. Indeed we have already honored our candidate with the subscript *ss* for "superstring" on the quantities ${}_{ss}E_f$ and ${}_{ss}E_g$. If we should construct, on the same principles, a "super-



$$1/\lambda_0^2 = 1/\lambda_{\text{Compton}}^2 + 1/\lambda_{\text{de Broglie}}^2 \quad \text{or} \quad \omega^2 = \omega_{\text{Compton}}^2 + k_z^2 c^2,$$

which is of the same form as for the photon in a wave guide. Ψ and Ψ^* are, of course, joined by loops at the front and rear of the electron wave packet as shown in Figure 3. Both Ψ and Ψ^* are necessary in order to produce a l'chaim electron. Note that the rotational frequency, $\pm\omega'$, is not to be confused with the observed frequency ω .

sphere" shell of radius r instead of a helical superstring of radius r_{og} , then

$${}_{\text{sph}}E_f = \frac{1}{2} \frac{e^2}{r} = |{}_{\text{sph}}E_g| = \left| -\frac{1}{2} \frac{GM^2}{r} \right|,$$

$M = e/\sqrt{G} = 1.86 \times 10^{-6}$ gm, $Mc^2 = ec^2/\sqrt{G} = 1.67 \times 10^{15}$ ergs $= 1.05 \times 10^{18}$ GeV, and $r = 1.38 \times 10^{-34}$ cm. In view of the values obtained for ${}_{\text{ss}}E_f$ and ${}_{\text{ss}}E_g$, would not 10^{18} GeV be a better benchmark than 10^{19} GeV for characterizing the magnitude of superstrings?

The primitive pedagogical electron model of Figures 1 and 2 not only shows what role superstrings have in the universe, but also shows how a charged entity like an electron can exist and prevail: Behold therefore the *l'chaim* electron and other fermions, after the Hebrew toast to life! Without the superstrings there would be no matter, no chemistry, no universe! It is quite possible that the gravitationally equilibrated fiber, our superstring candidate, has itself a finer structure in the form of a hyperfine helical spring (a new realm of Riemannian manifold), and that it is this hierarchy of Riemannian manifolds that gives rise to the theoreticians' conceptualized 26-dimensional space. We suggest that our gravitationally equilibrated fiber represents the physical "compactification" of all of those dimensions, of all that hierarchy of Riemannian manifolds.

Although at this potentially ecstatic moment when we suspect that the Holy Grail of the true Grand Unification Theory has revealed itself, we must not pause for celebration; we press on to search for more succulent dividends this revelation might produce. The torus of Figures 1 and 2 can support the helical deformation waves shown in Figures 3, 4, and 5 to produce the de Broglie-Einstein waves with the appropriate dispersion relationship. The striking similarity of a photon's rest mass in a wave guide (Figure 6) to the electron's rest mass (Figure 4), shows that rest mass and total mass can be understood with a new and incandescent clarity, since all mass is electromagnetic in character—no lump mass exists!

The stringlike structure of the electron is a model for the structure of most other simple fermions—the μ - and τ -mesons and quarks. The strong, short-range nuclear force can be understood schematically in terms of an electromagnetic interaction between two tightly telescoped fermions, each with the morphology of Figure 1. The electromagnetic interaction energy can then be equal to the rest energy of one of the fermion components, which equality is what is meant by the expression "strong force." The *l'chaim* electron should also fit well with the concept of the electro-weak force because, as Figure 5 shows, the spin and magnetic moments line up with group velocity only when the electron reaches relativistic speeds, which is experimentally shown to be true for beta decay.

Since the stringlike *l'chaim* model for fermions is achieving at least some modest success, a stringlike model of a photon is advanced in Figure 7. With such a graphically depicted photon it is possible to characterize a gravitational reaction as completely electromagnetic in character. The messengers of the reaction are gravitons. Each graviton is composed of two matched, oppositely directed, oppositely rotating, tightly telescoped photons coupled to the sponta-

neous, oscillating, electrical dipole polarization of the two neutral bodies undergoing the attractive induced electrical polarization, as shown in Figures 8 and 9. Donald Conant has used this conceptualization with the fine structure constant $\alpha (= e^2/\hbar c = 1/137)$ to derive algebraically the gravitational constant G to within one part in 1,000 (Conant 1978). However, the graphical description of the *l'chaim* photons and the gravitons that they constitute is really required if the argument is to be successful pedagogically.

All four of the forces that have to be unified in any Grand Unification Theory have been quantitatively accounted for

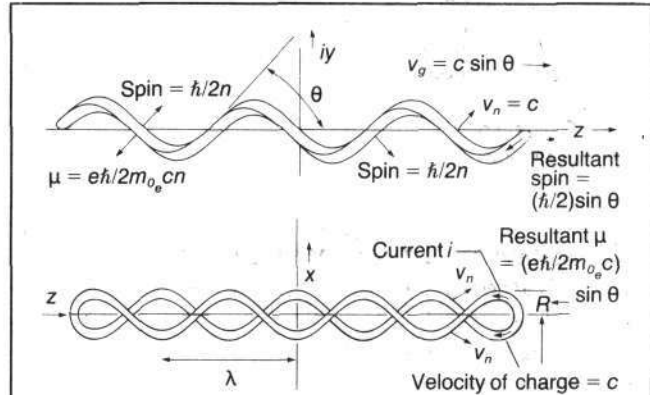


Figure 5
DISTRIBUTED NATURE OF FLYWHEEL SPIN AND MAGNETIC MOMENT

This elaboration of the flywheel in Figure 3 shows the distributed nature of the spin and magnetic moment μ , where n is the number of half wavelengths ($\lambda/2$).

The normal velocity v_n of the filament of radius r_0 is $v_n = c$. The group velocity is $v_g = c \sin \theta$, while the phase velocity is $v_p = c/\sin \theta$.

$$\begin{aligned} \lambda &= \int d\lambda = \frac{R}{\tan \theta} \int_0^{2\pi} d\theta \\ &= \frac{2\pi R}{\tan \theta} = 2\pi R \frac{\cos \theta}{\sin \theta} \\ &= 2\pi R \frac{\sqrt{1 - \sin^2 \theta}}{\sin \theta} = \frac{h}{m_0 c} \frac{\sqrt{1 - (v_g^2/c^2)}}{v_g/c} \\ &= \frac{h}{m_0 v_g \sqrt{1 - (v_g^2/c^2)}} = \frac{h}{\gamma m_0 v_g} = \frac{h}{m_e v_g'} \end{aligned}$$

where

$$m_e = m_0 / \sqrt{1 - \beta^2} = \gamma m_0,$$

$$\beta = v_g/c, \text{ and } \gamma = (1 - \beta^2)^{-1/2}.$$

Thus also $v\lambda = c = c^2/v_g = c^2 m_e \lambda/h$, or $h\nu = m_e c^2$, which is the Planck relationship. Also, $\gamma = 1/\cos \theta = \sec \theta$. The spin of each loop ($\lambda/2$) is $\hbar/2n$. The totality of spins of all n loops ($\lambda/2$) added algebraically (not vectorially) is $\hbar/2$. The sum of the components in the z direction of the spins of all n loops is $\hbar/2 \cdot \sin \theta$, which is indeed experimentally the case in beta decay.

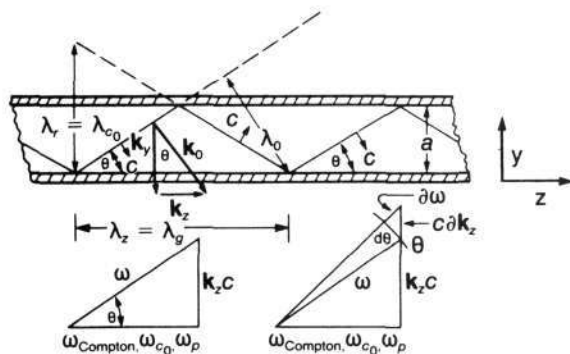


Figure 6
THE ELECTRON COMPARED WITH A PHOTON
IN A WAVEGUIDE

While the photon is considered to be an "uncharged particle of zero rest mass" and the electron a "charged particle of finite rest mass," their dispersion relationships suggest a strong similarity when the photon is confined to a waveguide, as shown.

The electromagnetic wave made up of photons with free-space wavelength λ_0 is propagating in the TE_{01} mode between two parallel plates (a waveguide) at $y = 0$ and $y = a$: $\lambda_z = \lambda_g = \lambda_0/\sin \theta$; $v_p = c/\sin \theta$; and $c = \lambda_0 v$. The cutoff wavelength $\lambda_{c_0} = 2a$. Wave fronts are shown propagating at a normal velocity c .

Compare the resolution of the propagation of k_0 into its components k_y and k_z with that of Figure 4 for the free l'chaim electron. The resolution of k_0 into its components gives a dispersion relationship $\omega^2 = \omega_{c_0}^2 + k_z^2 c^2$, where ω_{c_0} is the cutoff angular frequency associated with the cutoff wavelength $\lambda_{c_0} = 2a$, and $k_z = 2\pi/\lambda_g$ where λ_g is the guide wavelength. A similar dispersion relationship holds for an electromagnetic wave propagating through a plasma of plasma frequency,

$$\omega_p = \left(\frac{4\pi n e^2}{m_e} \right)^{1/2},$$

namely,

$$\omega^2 = \omega_p^2 + k_z^2 c^2.$$

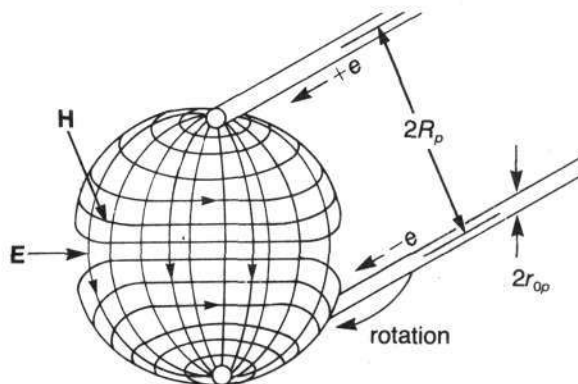


Figure 7
THE L'CHAIM MODEL OF THE PHOTON.

The l'chaim model of a photon propagating toward the observer. A pair of induced virtual charged filaments bearing charges $+e$ and $-e$ are propagating at a velocity c as they orbit around their common center line with a peripheral velocity $\omega_p R_p = c$, where $\omega = 2\pi v$, $\lambda v = c$, $\lambda = 2\pi R_p$, and $v = c/2\pi R_p$.

If the length of the configuration (wave packet) is $n\lambda$, the electric field $|E|$ at a distance r_p from each of the filaments is $E = e/\pi r_p R_p n$, and the magnetic field $|H| = |E|$. Since there are two filaments, the photon's electromagnetic energy is

$$\begin{aligned} E_p &= \frac{2R_p h}{8\pi} \int_{r_{0p}}^{R_p} \frac{2e^2}{\pi^2 r^2 R_p^2 h^2} \cdot 2\pi r dr = \frac{2e^2}{\pi n R_p} \ln \frac{R_p}{r_{0p}} \\ &= \frac{4e^2}{n\lambda} \ln \frac{\lambda}{2\pi r_{0p}} = \frac{4e^2 v}{hc} \ln \frac{R_p}{r_{0p}} = \frac{4\hbar v a}{n} \ln \frac{R_p}{r_{0p}} \\ &= \frac{2\hbar v a}{\pi n} \ln \frac{R_p}{r_{0p}} = \frac{2\hbar v}{\pi n 137} \ln \frac{R_p}{r_{0p}}. \end{aligned}$$

To consummate the Planck relationship of $E = hv$, it is necessary that $\pi^{-1} \ln R_p/r_{0p} = 137h/2$. The spin of this right-hand rotating photon is $hv/c^2 \cdot R_p c = \hbar$, which is what it should be. The momentum of the photon is the integrated effect of the Poynting vector.

on a simple, nonmysterious, electromagnetic basis. Perhaps it is unnecessary to attempt the expensive task of trying to reconstruct that fanciful process known as the Big Bang by building a Super Collider.

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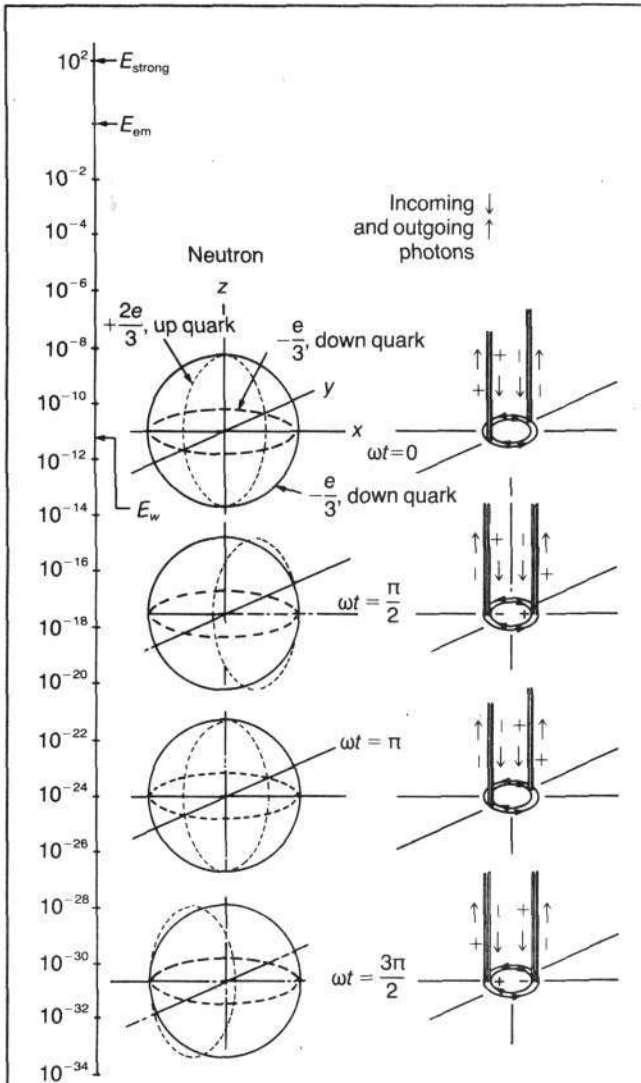


Figure 8
MODEL OF THE NEUTRON

In this schematic diagram of a neutron composed of one $+2e/3$ up quark and two $-e/3$ down quarks, the neutron undergoes linear polarization in the x direction to form an oscillating electric dipole coupled to the two circularly polarized, mutually telescoped photons, one coming into the neutron, and the other going out from the neutron, as indicated. Arrows on the circles indicate the sense of the circular polarization. The plus and minus charges on the x axis for $\omega t = \pi/2$ and $\omega t = 3\pi/2$ indicate the states of linear polarization of the neutron at that time.

The upper ends of these photons are coupled to another polarizing, neutral body in the same way to produce a gravitational interaction between the two bodies. The coupling of one photon to one dipole requires the formation of five additional charge bonds compared with the isolated charge bond of just the dipole itself. Each photon has a spin of $\pm h$. Taken together, the two photons constitute a graviton.

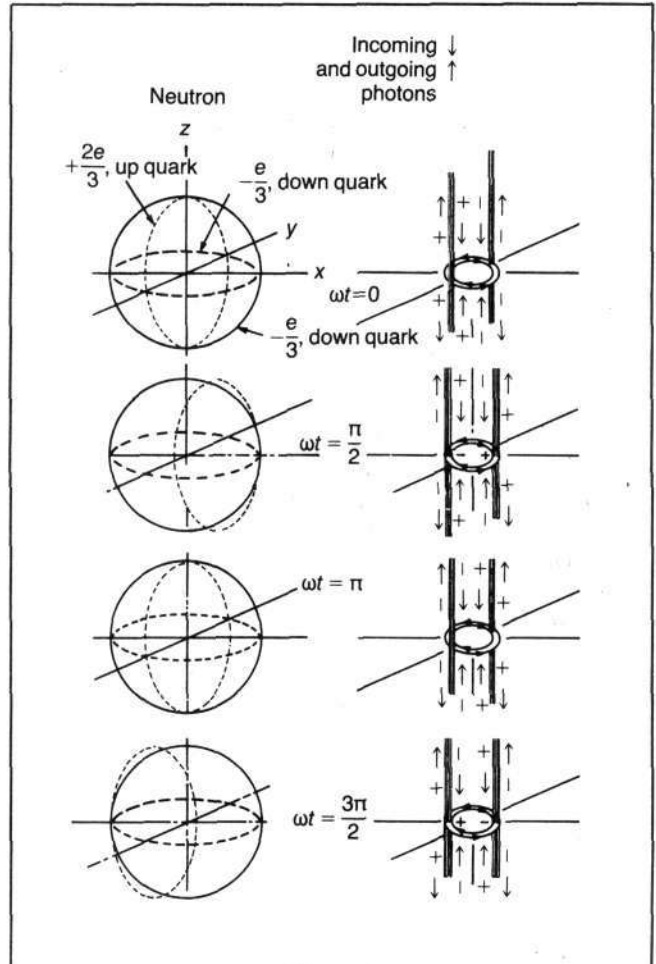


Figure 9
GRAVITONS PASS THROUGH THE NEUTRON

Here a neutron intervenes between two bodies in gravitational interaction—one above, the other below the neutron. The gravitons involved in the interaction effectively pass through the neutron, which is polarized into an oscillating linear dipole, almost as if it were not there. The neutron does not shield or cut off the gravitational interaction. The process is analogous to visible light passing through a dielectric such as glass.

* David J. Gross, 1990. "String Theory: Current Status and Future Prospects," in: P.J. Ellis and Y.C. Tang, eds., *Trends in Theoretical Physics Vol. I* (Redwood City, Ca.: Addison Wesley), 193.

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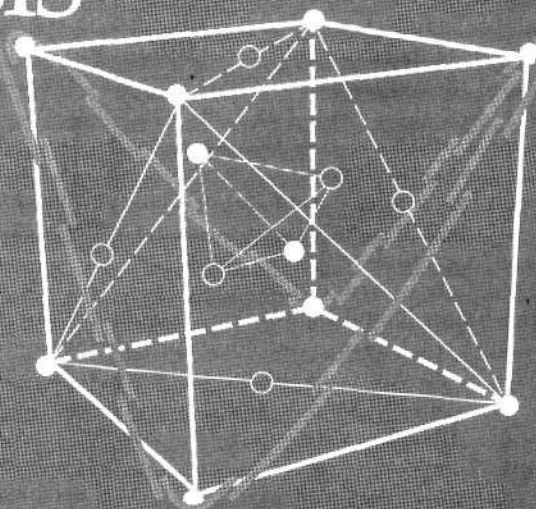
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Note

* This work is helpful to readers lacking prior knowledge of string theory. Gross writes: "String theory says that if we look at a quark with a good microscope, that can see distances of 10^{-33} centimeters, we will not see smaller constituents, but rather the quarks will look to us like closed strings. . . . A point particle has no structure, but a string can do many things and each vibration of a string (like the harmonics of a violin string) corresponds to a separate elementary particle. . . ."

How Superstrings Form the Basis Of Nuclear Matter

by Winston H. Bostick



The concept of the l'chaim fermion, a plasmoid superstring, is used to construct the proton, the neutron, and the partner-switching deuteron daisy chains that hold baryons together and account for the structure of the periodic table.

This is an inevitable and intellectually mandatory sequel to the author's "Plasmoid Construction of the Superstring" also appearing in this issue.

In the current parlance of "superspace" and "supergravity" the famous Planck length $(\hbar G/c^3)^{1/2} = 1.6 \times 10^{-33}$ cm and corresponding energy or mass $(\hbar c^5/G)^{1/2} = 1.22 \times 10^{19}$ GeV refer to the quantum fluctuations of the vacuum (or free space) where the dimensions are so small and the corresponding masses of photons or particles whose wavelengths can fit into those dimensions are so large that space becomes a blinding foam and spray where the turbulent and chaotic formation and destruction of extremely small black holes makes any further description of the situation impossible. The frequencies and energy densities are so vastly out of our earthly experience that our nervous systems are completely unaware of this turbulent environment, even as we are constantly being penetrated by cosmic rays without feeling pain. The ordinary creatures of the Earth are as blind and deaf as moles underground, completely insulated from the din of a turbulent battle raging between two armies above them. Matter (mass) and its corresponding gravitational properties represent mild perturbations in the otherwise uniform character of this foam, this blizzard of turbulent energy jumping in and out of tiny black holes. The theoreticians who paint pictures of this foam are desperately searching for experimental evidence of a "superstring," (Ginsparg and Glashow 1986; Bostick 1988) an eel-like inhabitant of this foam, whose energy is about 10^{19} GeV.

This author claims that his 1961 prize-winning essay for the Gravity Research Foundation, "Hydromagnetic Model

of an Elementary Particle" (Bostick 1961, 1978, 1985, 1986), is the map that can lead the theoreticians to their Holy Grail—the Grand Unification Theory (GUT)—and their Golden Fleece or Blizzard of Gauze (superstrings).

One must recognize that the Planck mass (or energy) of $(\hbar c^5/G)^{1/2} = 1.22 \times 10^{19}$ GeV and the energy of the hypothesized superstrings the theoreticians associate with the Planck energy surpasses by 18 orders of magnitude the energies 0.001 to 1 GeV associated with elementary particles like the electron or proton. Even the largest cosmic ray showers reach an energy level of only 10^{11} GeV. Note that the author's gravitationally equilibrated string has an electromagnetic field of energy of ${}_{ss}E_f = 6^{1/2}ec^2/G^{1/2} = 2.54 \times 10^{18}$ GeV, which does not explicitly contain Planck's constant h , but contains the electronic charge e . The energy ${}_{ss}E_f = 6^{1/2}ec^2/G^{1/2}$ of the gravitationally equilibrated, helical string of the electron attains a value that is only a factor of 5 (less than one order of magnitude) less than the Planck energy. Thus, in terms of energy, the gravitational equilibration of the fermions' basic string of charge $\pm e$ should be considered in the same class with the Planck mass and the theoreticians' superstring; the electron (and other fermions) is essentially a stringlike dark gray "hole" if not a black hole. In order for the electron to exist it must be a minimum-free-energy, force-free configuration which is equilibrated gravitationally (a black hole). This author suggests that existentiality is such a strong basis for argument that Nature was obliged to select the charge of $e = 4.774 \times 10^{-10}$ esu in order for the electron to exist, and the fine structure constant $\alpha = e^2/\hbar c$ accordingly came out to be 1/137, and the corresponding

electromagnetic energy $_{ss}E_i = 6^{1/2}ec^2/G^{1/2}$ of the gravitationally equilibrating string turned out to be very close to the Planck energy (mass).

We can now pictorialize our argument by utilizing that word "foam," which the theoreticians have so dramatically employed to characterize the chaotic state of quantum fluctuations of the vacuum at the Planck length: In the breaking of a great ocean wave in a storm at sea, the turbulence is indescribably complicated, but the whitened spray, foam, and mist are made up of billions of droplets and bubbles, each one of which is a perfect, force-free, minimum-free-energy, equilibrated sphere, even as our *l'chaim* electron (and other fermions) are equilibrated, force-free, minimum-free-energy, stringlike entities. In the wild turbulence of a blizzard, each snowflake is a well-organized, beautiful, minimum-free-energy entity.

The inspiration for this concept of the *l'chaim* electron has come not from the giants of quantum theory, but from experimental plasma physics, wherein Nature has generated beautiful plasmoids even as it can generate countless droplets and bubbles of foam and spray in a breaking ocean wave and countless snowflakes in a blizzard.

If the reader is willing to concede that our stringlike model of the fermion has now been sufficiently established, we will pursue the concept of the strong force between nucleons, which this model illuminates, and its role in the construction of the nucleus and in fusion itself. It can easily be shown that if two stringlike fermions telescope on each other or lie close to one another for enough of their length, the electromagnetic interaction energy between them can be comparable to the rest energy of either fermion, and this is what is meant by the concept of the short-range strong force—one of the four famous forces in GUTs.

Since it appears that quarks (Fritzsch 1983, Bernstein 1989) in nuclear physics (like sex in our drama and literature) are "here to stay," at least for a while, we will deal with stringlike quarks to construct our proton and neutron of Figures 1, 2, 3, and 4.

We construct the proton out of *l'chaim* quarks, specifically two up quarks each of charge $q_u = +2e/3$, and one down antiquark of charge $q_d = -e/3$, which will give us a proton of charge $q_p = +e$, where e is the magnitude of the electronic charge.

We commence with the proposed primitive geometry of the elastic flywheel as shown in Figure 1. The three quarks are shown in Figure 1(a) as being toruses, each of the same mass $2m = m_T$ and same radius R being "assembled" along the center line, and in Figure 1(b) they are "assembled." The various parameters are indicated in Table 1, and everything works out fairly well, if the mass of the proton $m_p = 2m = m_T = 2E_i/c^2$, where m_T stands for the total mass, which is two times as great as the electromagnetic mass, E_i/c^2 . Half of m_T is due to the energy stored in the "elastic flywheel." Since the masses of the individual quarks are not known, because they are never observed in the state where they are separated from their companions, we assume for simplicity that the mass of each quark before it is bound to the others is $m_T = 2m = 2E_i/c^2 = m_p$, where m_p is the net mass of the proton. E_i is the electromagnetic field energy of each individual quark. It will be assumed that the binding energy

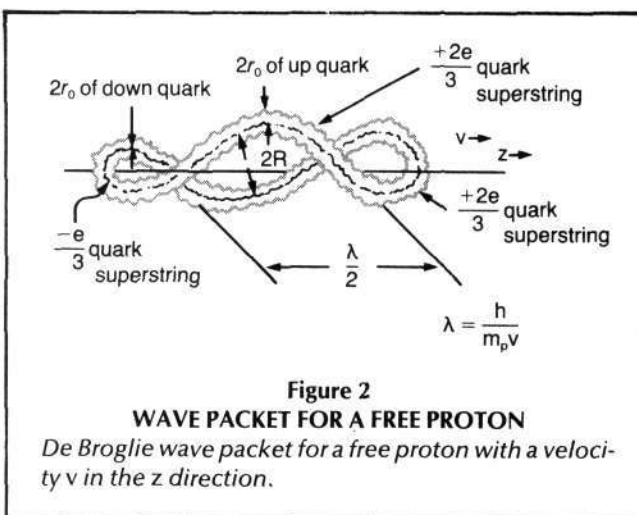
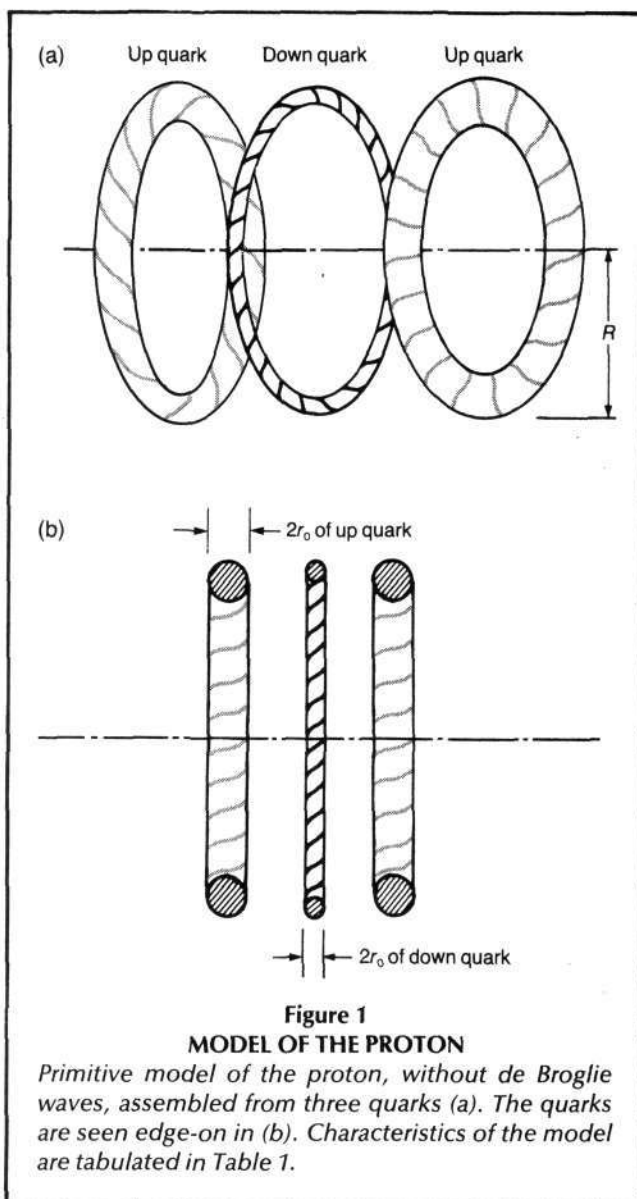


Table 1
CHARACTERISTICS OF THE PROTON MODEL

Characteristic	Up quark	Down quark	Up quark	Net for proton
$q = \text{charge}$	$+\frac{2e}{3}$	$-\frac{e}{3}$	$+\frac{2e}{3}$	e
$E_i = \frac{q^2}{\pi R} \ln \frac{R}{r_0}$	$\frac{.45e^2}{\pi R} \ln \frac{R}{r_0}$	$.11e^2 \ln \frac{R}{r_0}$	$\frac{.45e^2}{\pi R} \ln \frac{R}{r_0}$	$\sim \frac{e^2}{\pi R} \ln \frac{R}{r_0}$
E_i	$\frac{m}{c^2}$	$\frac{m}{c^2}$	$\frac{m}{c^2}$	
$m_T = \text{total mass}$	$2m$	$2m$	$2m$	
$\text{Spin} = \frac{q^2}{\pi c} \ln \frac{R}{r_0}$	$.45e^2 \ln \frac{R}{r_0}$	$-.11e^2 \ln \frac{R}{r_0}$	$.45e^2 \ln \frac{R}{r_0}$	
	\leftarrow $\frac{1}{2}$	\rightarrow $-\frac{1}{2}$	\leftarrow $\frac{1}{2}$	
Value of $\ln \frac{R}{r_0}$ necessary to make spin correct (r_0 is the variable)	$2.2 \left(\frac{\pi}{2}\right) 137$	$9.1 \left(\frac{\pi}{2}\right) 137$	$2.2 \left(\frac{\pi}{2}\right) 137$	
Value of $\ln \frac{R}{r_0}$ necessary to make each quark mass $m_T = \frac{2E_i}{c^2} = 2m$	same	same	same	
$\mu = \text{magnetic moment} = \frac{qR}{2} = \frac{qh}{2m_T c}$	$\frac{2}{3} \frac{eh}{2m_T c}$	$\frac{1}{3} \frac{eh}{2m_T c}$	$\frac{2}{3} \frac{eh}{2m_T c}$	$\frac{5}{3} \frac{eh}{2m_T c}$
Current direction	\leftarrow \curvearrowright	\leftarrow \curvearrowright	\leftarrow \curvearrowright	
If binding energy is	$\frac{2m_T}{3c^2}$	$\frac{2m_T}{3c^2}$	$\frac{2m_T}{3c^2}$	Total binding energy = $\frac{2m_T}{c^2} = \frac{4m}{c^2}$ Net mass = $m_T = 2m$ $m_T = m_p = \text{proton mass}$

Table 2
CHARACTERISTICS OF THE NEUTRON MODEL

Characteristic	Down quark	Up quark	Down quark	Net for neutron
$q = \text{charge}$	$-\frac{e}{3}$	$+\frac{2e}{3}$	$-\frac{e}{3}$	0
Spin	\rightarrow $\frac{1}{2}$	\leftarrow $-\frac{1}{2}$	\rightarrow $\frac{1}{2}$	\leftarrow $\frac{1}{2}$
$E_i = \frac{m}{c^2} = \frac{m_T}{2c^2}$	$9.1 \left(\frac{\pi}{2}\right) 137$	$2.2 \left(\frac{\pi}{2}\right) 137$	$9.1 \left(\frac{\pi}{2}\right) 137$	$\sum E_i = \frac{3 \times 2m}{c^2} = \frac{3m_T}{c^2}$
Increase $\ln \frac{R}{r_0}$ by factor	9.1	2.2	9.1	
$\mu = \text{magnetic moment}$	$-\frac{1}{3} \frac{eh}{2m_T c}$ \leftarrow	$\frac{2}{3} \frac{eh}{2m_T c}$ \leftarrow	$-\frac{1}{3} \frac{eh}{2m_T c}$ \leftarrow	$\frac{4}{3} \frac{eh}{2m_T c}$, which is too low. If R is increased by $\frac{1.9}{1.33} = 1.4$, then $\mu = -1.9$ nuclear magnetons $m_T \cong m_p \cong m_n = \text{neutron mass}$

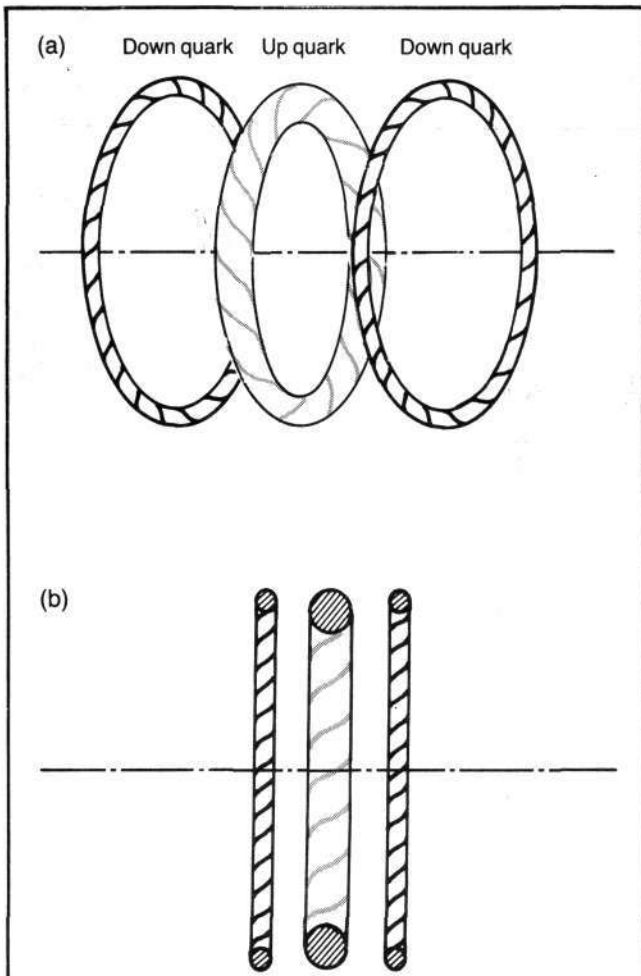


Figure 3

MODEL OF THE NEUTRON

Primitive model of the neutron, without de Broglie waves, assembled from three quarks. Characteristics of the model are tabulated in Table 2.

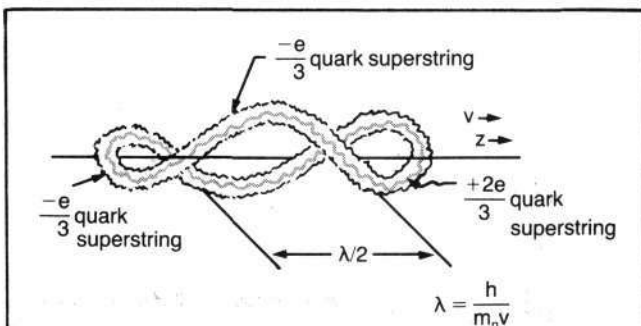


Figure 4

WAVE PACKET FOR A FREE NEUTRON

De Broglie wave packet for a free neutron with a velocity v in the z direction.

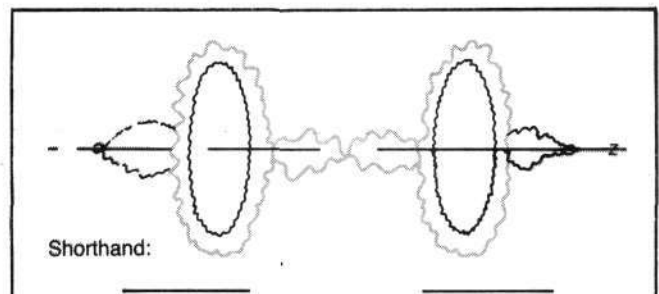


Figure 5

STANDING WAVE PACKET FOR NEUTRON IN A POTENTIAL WELL

Standing wave packet for a neutron in a potential well. Shorthand notation of quark positions shown below.

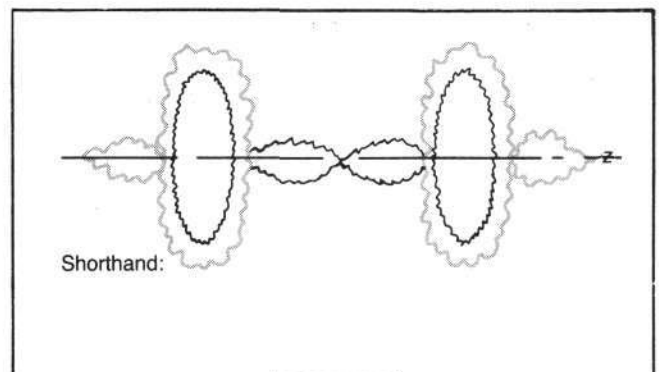


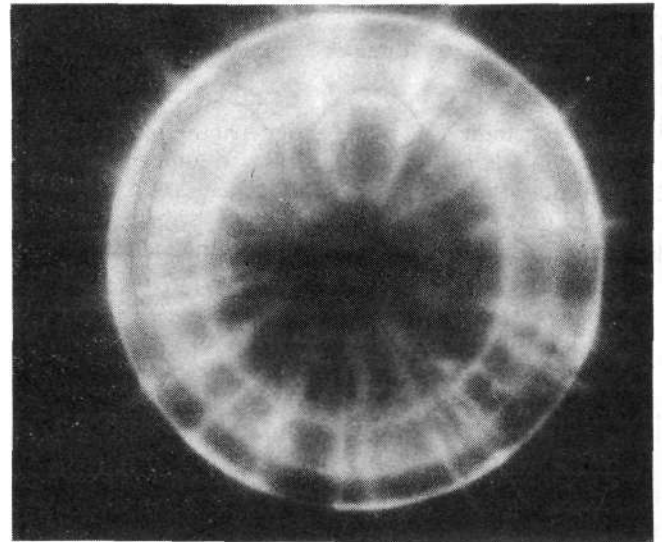
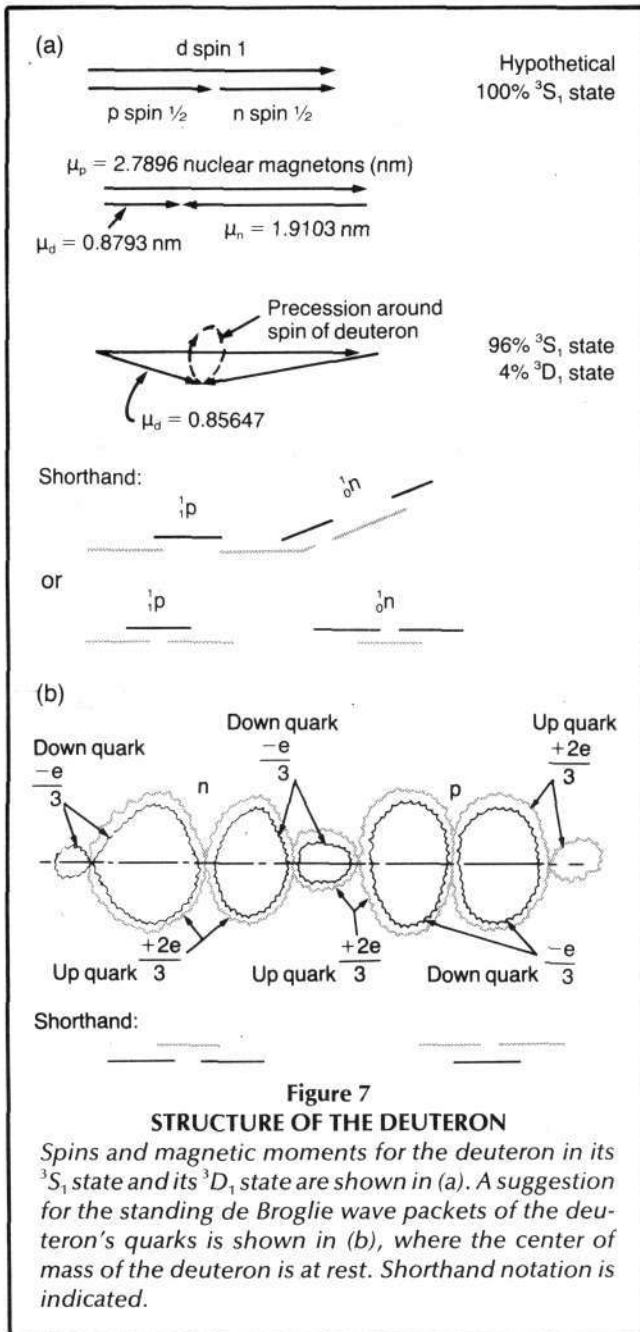
Figure 6

STANDING WAVE PACKET FOR PROTON IN A POTENTIAL WELL

Standing wave packet for a proton in a potential well. Shorthand notation for quark positions shown below.

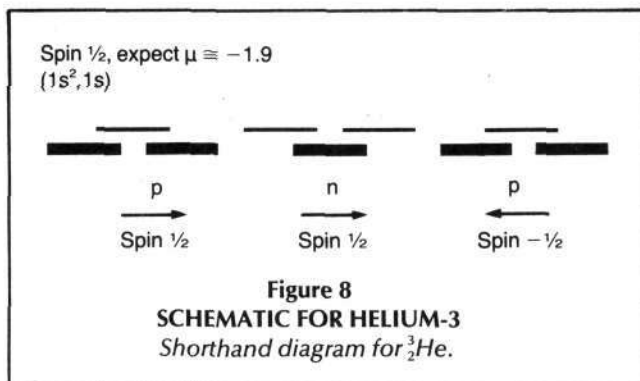
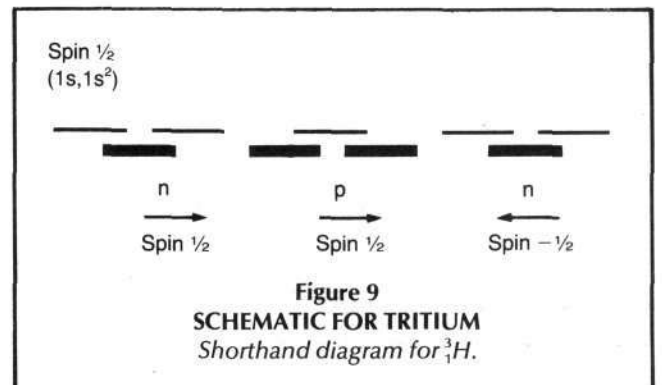
of each quark, one to another, can be if necessary a large fraction of its mass when it is unbound.

From the previous essay we recognize that the toroidal, *l'chaim*, stringlike electron must exhibit the Ψ and Ψ^* wave functions in its configurational deformations (Figures 5, 6, and 7). It is perfectly natural that the *l'chaim* proton will do likewise, where instead of a single superstring (gravitationally equilibrated charged electromagnetic fiber) whose electromagnetic energy $_{ss}E_f = 2.54 \times 10^{18}$ GeV as with the electron, there are three superstrings, one for each quark, the two + up quarks being bound together by the intervening - down quark and their mutually parallel electrical currents with their net mass $m_p = 6m$ - binding energy $= 2m = 2E_f/c^2$ and $R = \hbar/2mc$. For a free proton with a velocity v in the z direction, the de Broglie waves of Ψ and Ψ^* are schematically illustrated in Figure 2. The author suggests that none of these quarks is stable or observable by itself, because none of them possesses by itself the magical charge value of $q = e$, the electronic charge that confers gravitational equilibration. It is postulated that only because of their mutual close association, which produces a net charge of $+e$, can their composite superstrings become



Winston Bostick

Plasma filaments photographed in the plasma focus device at Stevens Institute. These force-free structures carrying current inspired the author's model for *onta* and their magneto-electrodynamics. In this photo, the inner electrode is located at the circle at the center of the sheath. The outer electrode is located at the circumscribing circle. The current is carried in plasma vortex filaments, which look like pairs of radial lines in the photo.



eligible for gravitational equilibration.

The next *on* (baryon, hadron) to be constructed on the *I'chaim* principles is the neutron, which is shown schematically in Figure 3. The neutron magnetic moment of $\mu_n = -1.9$ nuclear magnetons can be achieved only if R for each of the three quarks is increased by a factor of 1.4 over what it would be if $R = \hbar/m_p c$. Figure 4 shows the configuration of a free neutron moving through space with a velocity of v in the z direction with respect to the observer.

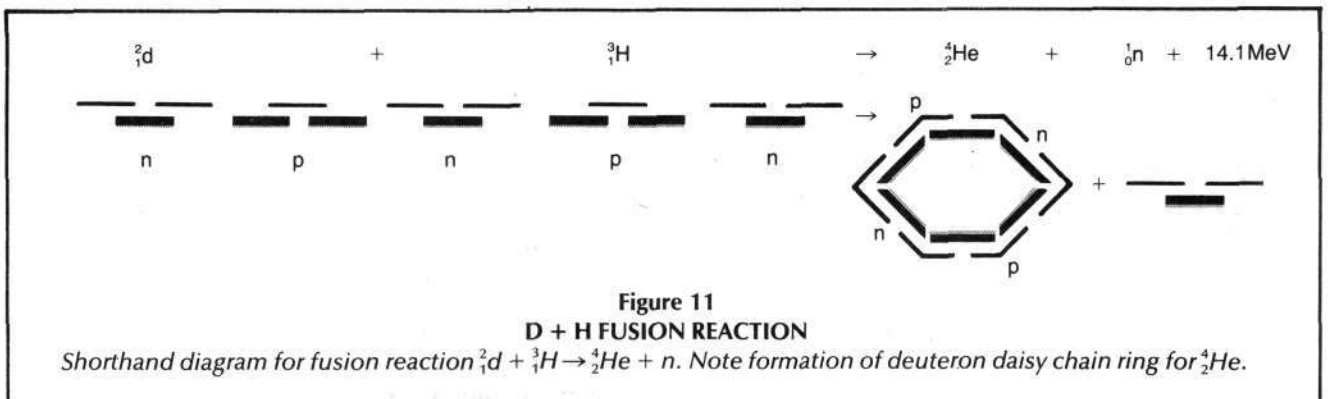
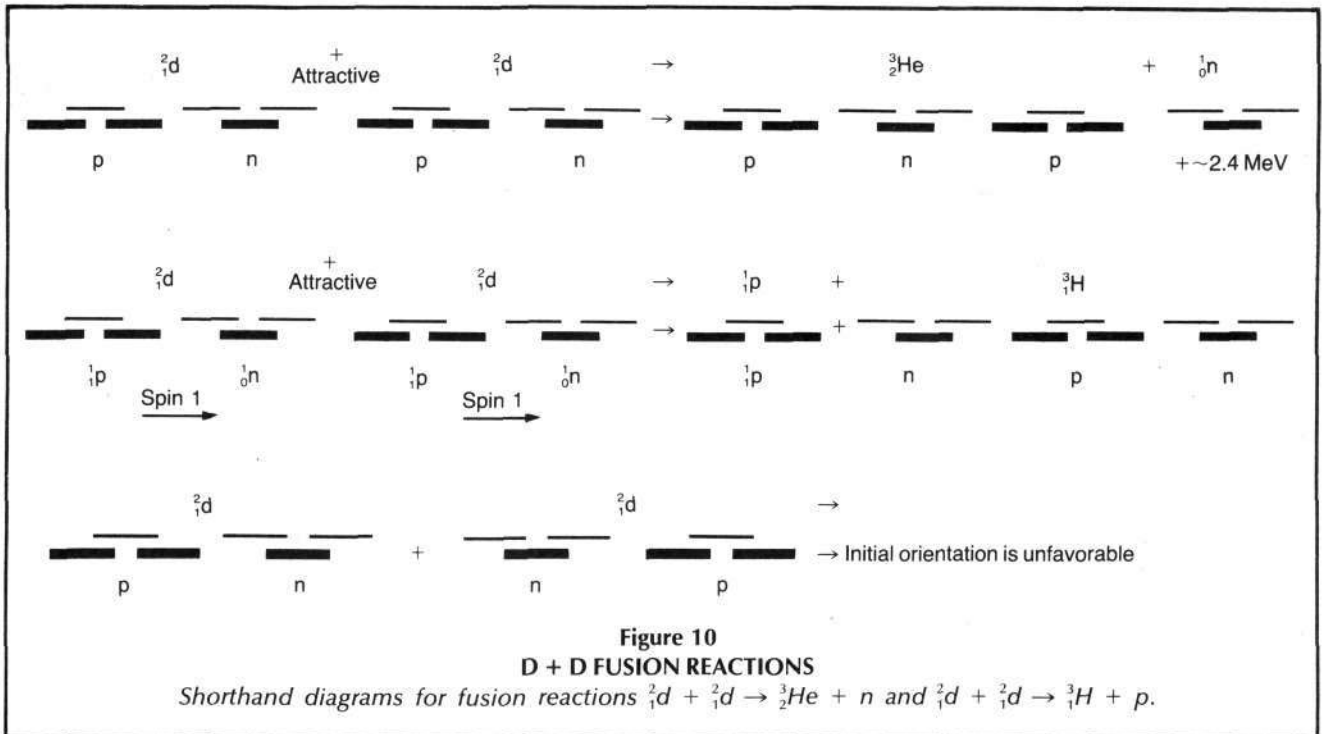
For both the proton and neutron it can be seen that the strong, short-range force that binds the quarks together is the powerful electric attraction between the closely superimposed, adjacent plus and minus toruses formed by the locus of the rotating helical wrapping of their superstrings and the magnetic attraction of their corresponding parallel (not antiparallel) electrical currents. As already stated, this interaction energy between each adjacent bonding pair can

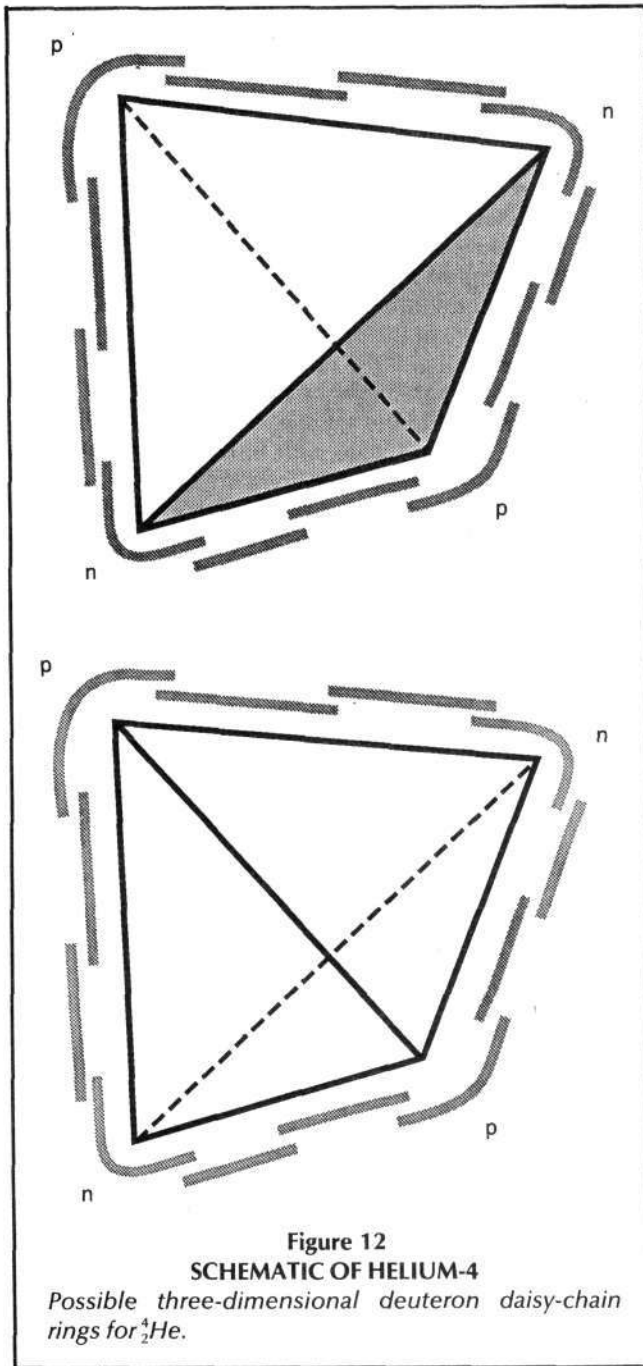
easily be comparable in magnitude to the mass energy of one of the components of the pair. With the geometry of *l'chain* (or living) stringlike *onta*, this short-range strong force can be explained to a college freshman. QED and QCD—with their algebra of gauge symmetries and their lumped (mathematical point) mass and lumped charge—for decades have not been capable of elucidating the strong force for us ordinary mortals.

Figure 5 represents the neutron held in a standing-wave pattern by a strong, externally produced, centrally-inward-directed electric field, which produces some polarization of the neutron. Figure 6 represents the proton held in a standing-wave pattern produced by a strong, externally excited, centrally-outward-directed electric field which produces some polarization of the proton.

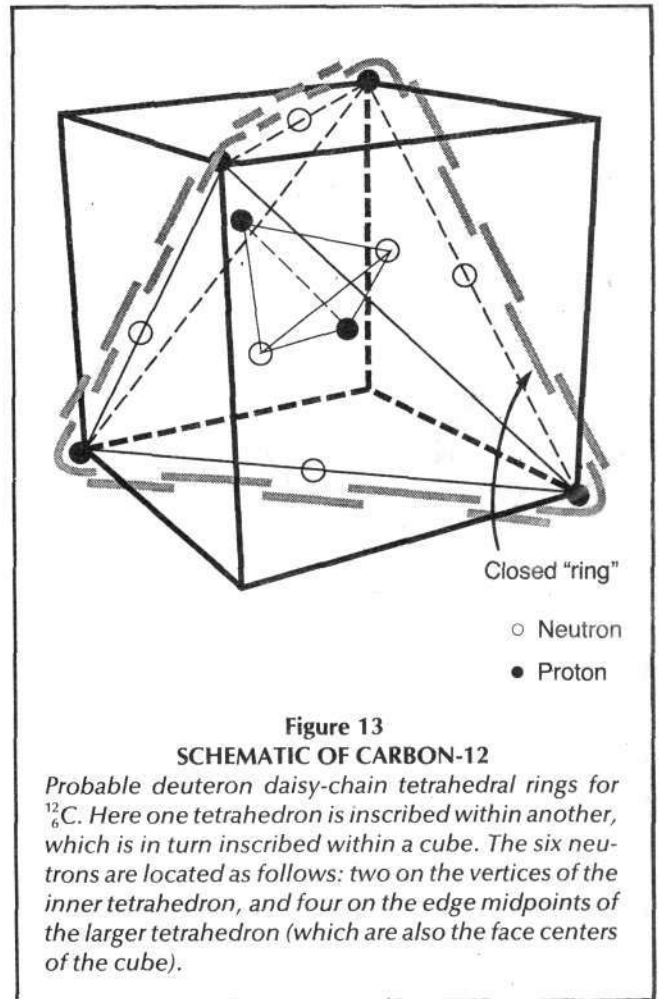
Next we tackle the deuteron, which represents Nature's ability spontaneously to produce fusion energy by bringing a proton and neutron together with the release of energy in the form of a gamma ray of 2.23 MeV energy. If there

are internal motions of the component quarks within the proton and neutron, the standing waves set up by these captive individual quarks might look momentarily as Figures 5 and 6 suggest, where the kinetic energy of internal motion is in the z direction and the center of mass of proton and neutron is stationary in the observer's frame of reference. It can be seen that at this moment the proton and neutron are each polarized into a quadrupole along the z axis. If the neutron and proton should approach one another along a common z axis, it can be seen that when they come close to one another the electrical attraction between the adjacent $+2e/3$ of the proton quark and the $-e/3$ quark of the neutron will pull the neutron and proton together. Experimental measurements of μ_d , the magnetic moment of the deuteron, yield the value $\mu_d = 0.85647$ nuclear magnetons. In this bound state with binding energy of 2.23 MeV, if the proton and neutron spins are lined up perfectly in the same direction (a so-called triplet S state, 3S_1), the sum $u_p + u_n = 2.7896 - 1.9103 = 0.8793$ should be exactly





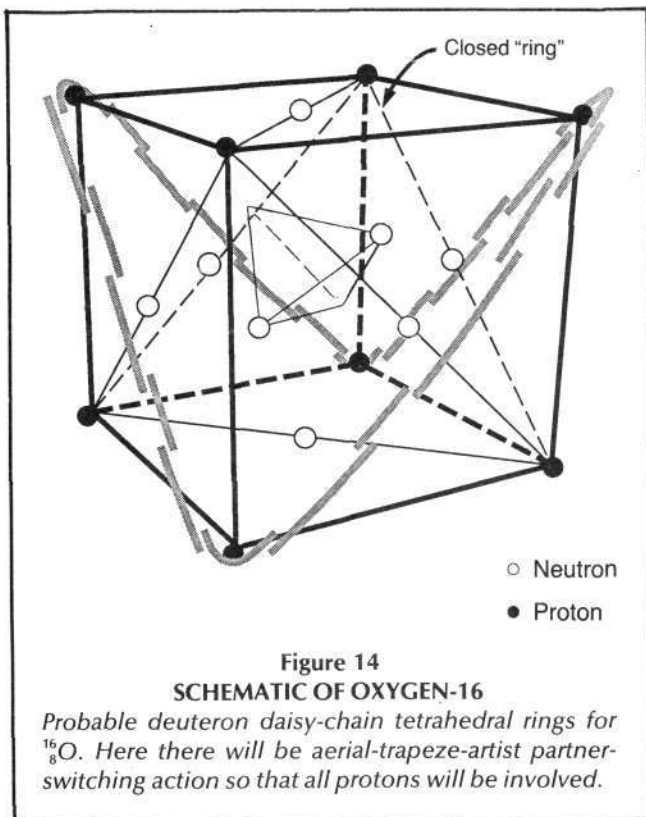
equal to the measured μ_d , which it is not (Figure 7). The discrepancy is accounted for by requiring the deuteron to exist in the 3S_1 for 96 percent of the time and for the remaining 4 percent, to exist in a D state of orbital angular momentum with a quantum number equal to 2. Since in the 3S_1 state all the orientations of the spins $\frac{1}{2} + \frac{1}{2} = \text{spin } 1$ are *a priori* equally probable, the state is considered to be a spherically symmetrical state (hence the "S" terminology). But since there is a 4 percent intrusion by a D state which is not spherically symmetrical, the situation is conventionally diagrammed as in Figure 7. There is also a hypothetical, slightly unbound, virtual singlet state of spin 0, 1S_0 .



In Figures 5 and 6 we have indicated a shorthand representation of the $+2e/3$ and $-e/3$ quarks in the construction of the neutron, and this shorthand notation will be used in the construction of ${}^3_2\text{He}$, ${}^3_1\text{H}$, ${}^4_2\text{He}$, and the larger nuclei. Figures 7(a) and 7(b) show the deuteron in shorthand notation. Figure 7(b) suggests how the standing wave functions for the de Broglie waves of the individual quarks might appear to be fitted to one another in the deuteron. Shorthand notation is also shown. Figure 7(b) attempts to portray for the deuteron the geometry of the bridging nature of the strong force as it is produced by *l'chaim*, stringlike, fermion quarks.

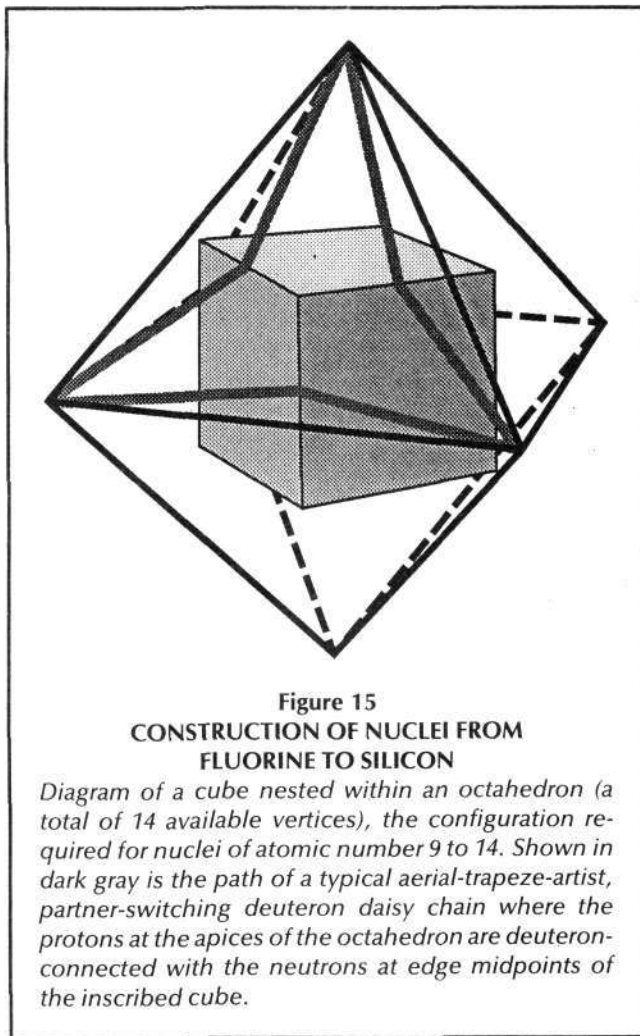
Figures 8 and 9 show respectively ${}^3_2\text{He}$ and ${}^3_1\text{H}$ (tritium) in shorthand notation. Figure 10 in shorthand notation shows the fusion reactions ${}^2_1\text{d} + {}^2_1\text{d} \rightarrow {}^3_2\text{He} + {}^1_0\text{n} + 2.45 \text{ MeV}$ and ${}^2_1\text{d} + {}^1_1\text{p} \rightarrow {}^3_2\text{He} + {}^1_0\text{n} + 2.4 \text{ MeV}$. Note that in Figure 10(c), if the orientation is not advantageous, the effect of the two up quarks (both having charge $2e/3$) being juxtaposed is repulsive instead of attractive.

Of course, the monopole repulsion of the two $+$ charges, one on each deuteron, always is long-range repulsive. Figure 11, in shorthand notation, shows the fusion reaction ${}^2_1\text{d} + {}^3_1\text{H} \rightarrow {}^4_2\text{He} + {}^1_0\text{n} + 14.1 \text{ MeV}$. The simple diagram of Figure 11 implies that ${}^4_2\text{He}$ is a completed, closed shell



or closed ring where the two neutron spins and magnetic moments μ_n cancel each other, as do the two proton spins and magnetic moments μ_p , leaving a nucleus with neither spin nor magnetic moment. It is our intuitive prediction that the "ring" representing ^2_1H in Figure 11 does not necessarily have to lie in a flat plane, but that the protons and neutrons might occupy the apices of a tetrahedron as shown in Figure 12. And it is quite possible for there to be a yawing motion back and forth between the two states depicted in Figure 12.

The rationale for considering this tetrahedral geometry comes from the work of Moon and Hecht (Hecht 1988), who have postulated that in the buildup of the atomic nuclei out of neutrons and protons it is the protons that tend to occupy the sites that are the apices of the five regular Platonic solid figures—tetrahedron, cube, octahedron, icosahedron, and dodecahedron. It can be seen from Figures 7 through 12 that the neutron and proton are not mathematical points and that their constituent fermion quarks are not mathematical points. The forces, rather than being characterized as "exchange forces" between mathematical points, should be recognized as bridging forces produced by charged, stringlike, tensile-strength-possessing, de Broglie-wave-exhibiting *l'chaim* fermions—quarks whose energy of reaction (binding) between one another can be comparable in magnitude to their own individual mass energies. This is the exhibition of the strong force as already described for stringlike, *l'chaim* fermions. In the ^4_2He nucleus and the heavier nuclei yet to be described, the long-range, mutually repulsive coulomb force of the protons on each other will have a tendency to blow the protons away from their joint



center of mass, like the dots on the surface of a spherical balloon as it is being inflated by the increasing pressure of air on its interior.

It is only the tensile-strength-producing bridging forces in conjunction with the strong force of these *l'chaim* plus and minus fermion quarks that hold the protons back and permit them to assume the stable, minimum-free-energy configurations worked out by Moon and Hecht (Hecht 1988). It can be seen from Figure 12 that ^4_2He represents a "closed shell" or perhaps more appropriately a "closed ring" where the net magnetic moment and spin, each of which is distributed (not lumped), adds up to zero. The fact that ^5_2He and ^6_3Li do not exist is an indication that the bonds of ^4_2He are fairly well saturated and do not wish at this stage to pick up individual neutrons or protons. However ^6_3Li and ^7_3Li do exist, so apparently ^4_2He can be persuaded to intermittently unsaturate its bonding to the extent of picking up a ^2_1H (deuteron) or a ^3_1H (triton). From there on we can have isotopes of ^9_4Be and $^{11}_5\text{B}$, but ^8_4Be insists on immediately breaking up into two ^4_2He .

It is apparent from the formation of the ^4_2He ring that the deuteron is the perfect "daisy" for the construction of a daisy chain that can complete the ring for ^4_2He . For the brief

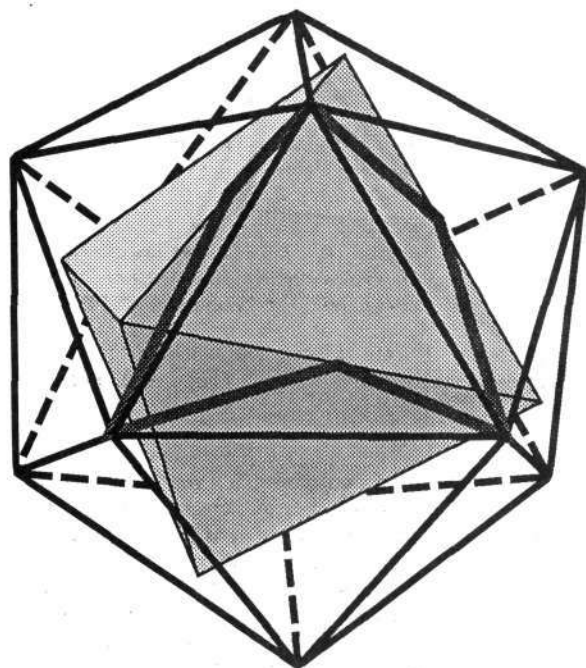


Figure 16
CONSTRUCTION OF NUCLEI FROM
PHOSPHORUS TO IRON

The octahedron (with its inscribed cube, not shown) nested within the icosahedron: 6 of the 20 faces of the icosahedron receive vertices of the octahedron. Each vertex divides the altitude line of the icosahedron's triangular face in the divine proportion. This is the configuration required for nuclei of atomic number 15 to 26. Daisy-chain action shown in dark gray, similar to that of Figure 15, but occurring between the apices of the icosahedron and the edge midpoints of the inscribed octahedron.

life that ${}^9_4\text{Be}$ enjoys before it divides into two ${}^4_2\text{He}$, it very likely follows the Moon-Hecht scheme of the four protons at the apices and the neutrons at the edge midpoints of the tetrahedron. Adding another neutron apparently makes it possible for ${}^9_4\text{Be}$ to resist the tendency to split into two ${}^4_2\text{He}$: ${}^9_4\text{Be}$ exists. And ${}^{10}_5\text{B}$ and ${}^{11}_5\text{B}$ also exist. As Moon and Hecht proceed to construct the geometry of the nucleus, the protons appear at the vertices and the neutrons at the midpoints of the edges of the nested regular Platonic solid figures.

When we come to ${}^{12}_6\text{C}$, a stable and abundant nucleus, let us reproduce the scheme of Moon and Hecht and place thereon the shorthand notation of the bridging plus and minus fermion quarks. The four protons are placed at the apices of a larger tetrahedron and the neutrons are placed at the midpoints of the edges of that tetrahedron, as shown in Figure 13.

The restraining effect of the tensioned deuteron daisy chain is thus abundantly obvious in its role of keeping these protons from flying away. It is assumed that ${}^4_2\text{He}$ is in tetra-

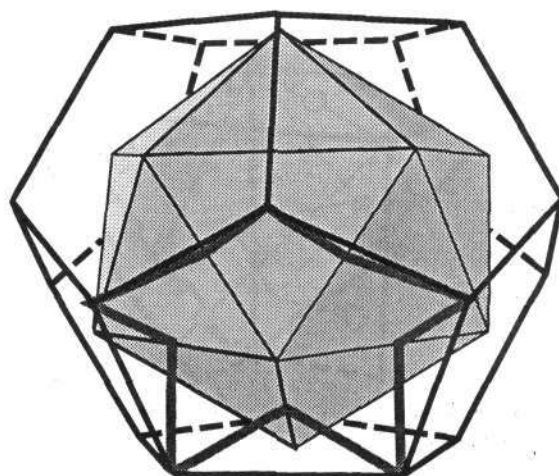


Figure 17
CONSTRUCTION OF PALLADIUM-106
 Daisy-chain action shown in dark gray, occurring between the dodecahedron and its inscribed icosahedron, as in ${}^{106}_{46}\text{Pd}$.

hedral form and is inscribed inside the outer tetrahedron. The circles represent the locations of the neutrons.

Figure 14 shows the configuration for the very stable ${}^{16}_8\text{O}$ nucleus as proposed by Moon and Hecht. They have pulled the two protons out of the closed ${}^4_2\text{He}$ ring and put them at two of the apices of the cube to flesh out its eight apices. Four of the protons at the apices of the cube appear to be left out in the cold since they are not included in the tetrahedral bonding ring shown. These protons can be accommodated in the bonding ring if 50 percent of the time the bonding ring can shift its circuit to include these four protons and avoid the four initially bonded protons, performing like aerial trapeze artist partners. Presumably the bonding ring oscillates rapidly between these two states so that on the average all protons are held in thrall against their mutually repulsive positive charges. With ${}^{20}_{10}\text{Ne}$ the two protons are put back into the inner tetrahedron and a very stable nucleus is formed that has two completely closed "shells." There are an additional two neutrons which must apparently be accommodated at the midpoints of two of the cube's edges. The interior of ${}^{20}_{10}\text{Ne}$ is a ${}^4_2\text{He}$ tetrahedron inscribed within a larger tetrahedron.

An explanatory map for the fiducial stages of the construction of nuclei up through ${}^{106}_{46}\text{Pd}$, as tabulated by Hecht is provided in Table 3.

In the construction of the nuclei of the remainder of the periodic table up through ${}^{238}_{92}\text{U}$, Moon and Hecht propose that a second ${}_{46}\text{Pd}$ nucleus is grown onto the first (Figure 18). In this process the bonding effect of deuteron daisy-chain networks plays an encore role in keeping the protons from escaping and the neutrons from decaying. As Hecht points out, in ${}^{238}_{92}\text{U}$ the 146 neutrons are considerably in excess of the 120 neutrons represented by two ${}^{106}_{46}\text{Pd}$ nuclei. But he recalls that there were a few left over empty faces of the icosahedron into which the octahedron was fitted. The

Table 3
THE MOON-HECHT MODEL OF THE ATOMIC NUCLEUS

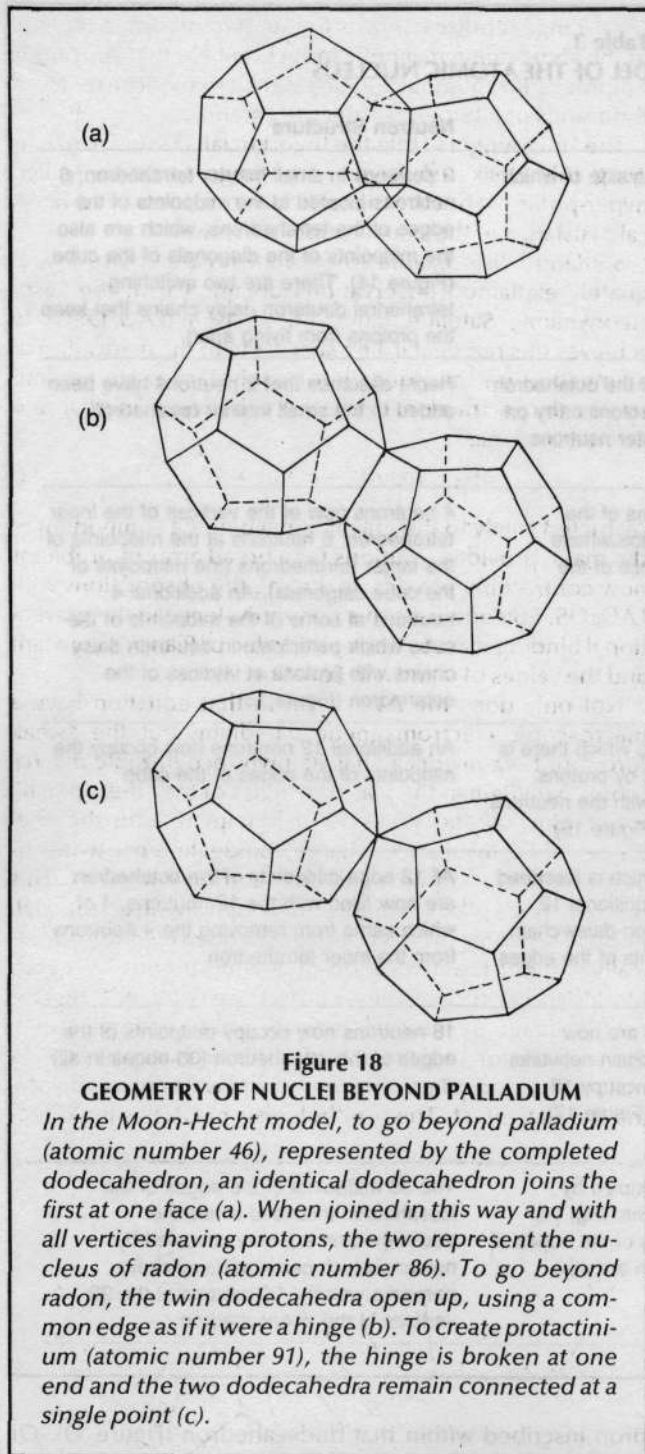
Nucleus	Proton Structure	Neutron Structure
$^{16}_8\text{O}$ Completed proton shell	Eight protons at the 8 vertices of the cube, inside of which are the 2 inscribed tetrahedral daisy chains	2 neutrons in small interior tetrahedron; 6 neutrons located at the midpoints of the edges of the tetrahedrons, which are also the midpoints of the diagonals of the cube (Figure 14). There are two switching tetrahedral deuteron daisy chains that keep the protons from flying apart
$^{20}_{10}\text{Ne}$ A completed atomic shell or period	Two protons placed at 2 of the 6 vertices of the octahedron within which the cube is inscribed. These protons carry on a switched, daisy-chain network with the outer neutrons	Hecht assumes that 2 neutrons have been added to the small interior tetrahedron
$^{28}_{14}\text{Si}$ Completed proton shell	An additional 6 protons placed at the vertices of the octahedron, within which is inscribed the cube whose vertices are located at the center of each face of the octahedron	4 neutrons now at the vertices of the inner tetrahedron; 6 neutrons at the midpoints of the larger tetrahedrons (the midpoints of the cube diagonals). An additional 4 neutrons at some of the midpoints of the cube which participate in deuteron daisy chains with protons at vertices of the octahedron (Figure 15)
$^{40}_{18}\text{Ar}$ A completed atomic shell or period	Of the 12 vertices of the icosahedron, within which there is inscribed the octahedron, four are occupied by protons, which can form deuteron daisy-chain links with the neutrons at the midpoints of the edges of the cube (Figure 15)	An additional 12 neutrons now occupy the midpoints of the edges of the cube
$^{56}_{26}\text{Fe}$ Completed proton shell	All 12 vertices of the icosahedron (within which is inscribed the octahedron) are now occupied by the additional 12 protons (over $^{28}_{14}\text{Si}$), which carry on a deuteron daisy-chain network with the 12 neutrons at the midpoints of the edges of the octahedron (Figure 16)	All 12 edge midpoints of the octahedron are now filled with the 12 neutrons, 4 of which came from removing the 4 neutrons from the inner tetrahedron
$^{84}_{38}\text{Kr}$ A completed atomic shell or period	Ten of the 20 vertices of the dodecahedron are now occupied by protons, which carry on daisy-chain networks (some switching) with the 18 neutrons that occupy 18 midpoints of the edges of the icosahedron (Figure 17), which has a total of 30 edges	18 neutrons now occupy midpoints of the edges of the icosahedron (30 edges in all)
$^{106}_{46}\text{Pd}$ Completed proton shell	All 20 vertices of the dodecahedron are occupied by protons, which carry on a network (some switching) via deuteron daisy chains with the 30 midpoints of the edges of the inscribed icosahedron (Figure 17), which are now occupied by neutrons	The 30 midpoints of the edges of the icosahedron inscribed inside the dodecahedron are now occupied by neutrons which carry on daisy-chain networks with the 20 protons at the 20 vertices of the dodecahedron

latter's vertices took up only 6 of the 20 faces, leaving 14 open. For the "two halves" of the uranium nucleus, that leaves 28 extra locations for neutrons to roost, 26 of which are used to create uranium-238 (26 + 120), the stable configuration. Uranium-240, the heaviest isotope of the last naturally occurring element, with a half-life of 14.1 hours, fills up all 28 of those locations with neutrons, for a total of 148 neutrons. In $^{238}_{92}\text{U}$ one of those neutrons must be used to establish a deuteron daisy-chain link between a proton-filled vertex of the dodecahedron of one $_{46}\text{Pd}$ nucleus and a face of the juxtaposed dodecahedron of the other $_{46}\text{Pd}$ nucleus where there is located the vertex of the icosahedron

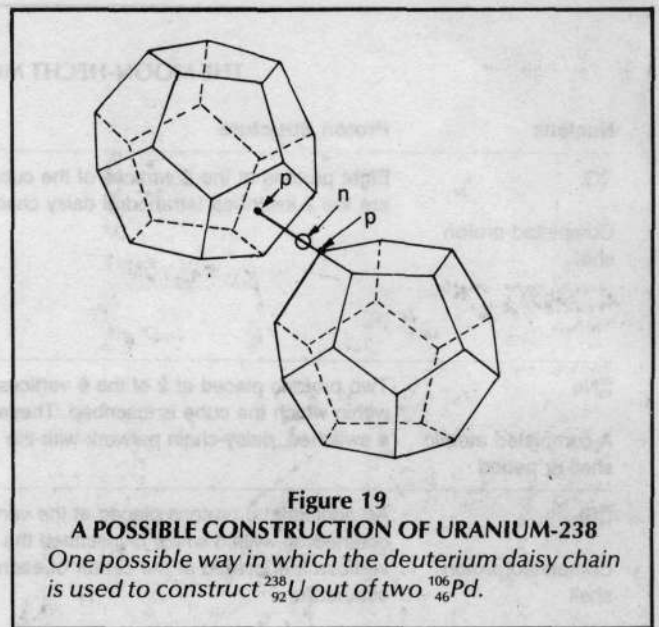
inscribed within that dodecahedron (Figure 19). Or alternatively the daisy chain link between the two $_{46}\text{Pd}$ nuclei can be made as shown in Figure 20. Or the daisy-chain link could be made by a neutron which connects the centers of two faces of the two $_{46}\text{Pd}$ nuclei.

A 'Chaim Filamentary Model of the Neutrino

The accompanying essay for the 1989 Gravity Research Foundation contest contains a simple photon model that involves two filaments, one charged +e, the other -e, projected at the velocity of light and rotating around each other. A more elaborate and probably more accurate model



is shown in Figure 21, where there are north and south magnetic filaments as well as the +e and -e electric filaments. If the positions of the north and south filaments are interchanged, the magnetic and electric fields of the north and south filaments cancel out those of the +e and -e filaments in all regions except very near to the filaments themselves, as shown in Figure 22. The total energy and ability to carry spin is not greatly hampered, because most of the energy is concentrated in the intense electrical



and magnetic fields close to the filaments. However the cross section of the structure is vastly diminished because the area of cross section of the slender filaments is vastly smaller than the whole structure for a photon. We have suggested that the electrical and "magnetic" charges on the filaments of the photon are virtual and induced, rather than being provided by the helically wound, gravitationally equilibrated fiber (the superstring). We now suggest that the charged filaments of the neutrino each possesses a helically wound superstring, plus and minus, north and south. The photon is generated by an oscillating electric dipole, but the neutrino comes from processes involving the rearrangement of elementary *onta*: beta decay of the neutron, decay of pions, muons, and tau mesons, all of which possess superstrings.

More About Gravitation and Unification

The way in which the long-range, attractive (but very weak) gravitational force is carried by the paired, counter-rotating, counter-transmitting photons (gravitons) is outlined in the previous essay. It also explains the derivation by Donald Conant of the universal gravitational constant, showing that gravitational force is of electromagnetic origin, as is also the short-range strong force that holds the nucleus together. We have here described the process of containment of the protons and neutrons of the nucleus through the instrumentality of the deuteron daisy chains.

A recent scholarly work by Puthoff (1989) revives Sakharov's attempt to show that the attractive force of gravity is an induced effect similar to the van der Waals forces, which is also the point of view of Donald Conant, as graphically illustrated in Figure 14 of the previous essay. Puthoff (1989) employs the mathematical-point model of the elementary particle and the zero-point-energy fluctuations of the vacuum with the accompanying *Zitterbewegung* (jitter) to explain gravity as an induced effect in much the same manner as the van der Waals forces and Casimir forces are ex-



"Nature unified all forces and energy with electromagnetism years ago, for which we are devoutly thankful. The greater cause for rejoicing now is that the l'chaim electron, photon, fermions, and all l'chaim onta are bringing quantum mechanics, the prodigal son, back into the family of classical physics." Here, Winston Bostick at Stevens in 1979.

plained. But the effort still falls short of being able to characterize the essence of mass. The monumental work of Noyes and McGoveran (1989) uses intricate numerology to derive precise values for α , m_p/m_e , and m_n/m_e , but again there is no clear perception of the essence of mass and no geometrical analysis to explain the de Broglie waves or the nature of the strong force, such as is provided by the fermions in Figures 4 through 7 of the author's accompanying essay.

The Ecumenical Message of Electromagnetism

There are recent papers suggesting a small repulsive correction term to what is normally considered to be the "Newtonian"* form of the Universal Law of Gravitation. The corrected form for the potential energy between two masses m_1 and m_2 is proposed to be

$$V(r) = -G_\infty m_1 m_2 / r \cdot (1 + \alpha e^{-r/\lambda}) = V_N(r) + \Delta V(r), \quad (1)$$

where G_∞ is the value of G at $r \rightarrow \infty$, when $\alpha = -(7.2 \pm 3.6) \times 10^{-3}$ and $\lambda = 200 \pm 5m$ are adjusted to fit best the geophysical data.

If the attractive first term, V_N , is analogous to a remotely effective, induced electrical induction van der Waals force, then the second term is analogous to a shorter-range repulsive Casimir force. The author suggests that this feeble

short-range repulsive term is the submicroscopic paradigm of the short-range magnetic induction field that surrounds a dipole radio antenna radiating signals that will be received thousands of kilometers from the antenna.

The "messengers" that the theoreticians fantasize as carrying this weak repulsive, short-range force are called hyper-photons, but the theoreticians provide no geometrical assistance in the visualization of these *onta*.

Soldano (1985) is able to account for otherwise inadequately explained observations obtained with the Laser Geodynamic Satellite launched in 1976 (LAGEOS). He achieves this rather startling success with the invocation of a limitation on the principle of equivalence: He demonstrates that a fractional difference between inertial and gravitational mass,

$$(m_G - m_I)/m_G = -5.05 \times 10^{-11}, \quad (2)$$

restricted solely to the gravitational binding component of the mass, provides solutions for a broad array of problems now confronting physics, including the observations with LAGEOS. Soldano uses this nonequivalence in the gravitational binding mass to derive the value of Planck's constant and the values of α and λ in Equation (1).

Not only does the $\Delta V(r)$ term in that equation have a macroscopic electromagnetic paradigm, but the "weak force" of beta-ray decay has its own recognizable macroscopic paradigm in the plasma physics of the "theta pinch" effect (Bostick and Wells 1963), complete with the analogues of CP invariance (charge conjugation/parity invariance), helicity, and beta and antineutrino emissions. This macroscopic, plasma-physics paradigm involves the Hall effect. The whole process can be described electromagnetically without the invocation of any mysterious, esoteric, hidden forces such as the conjured "weak force." The current language of the "electroweak force" is now entirely appropriate for this "rare bird," this archaeopteryx, this macroscopic paradigm derived from plasma physics involving the Hall effect. The ornithologists of GUTs should rec-

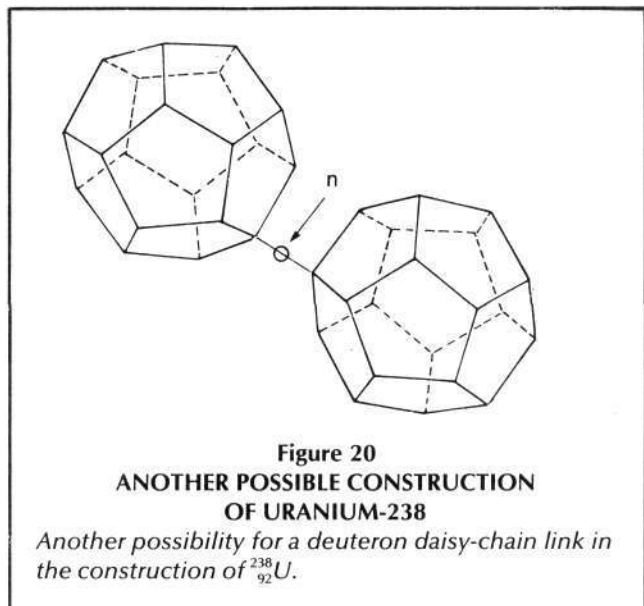


Figure 20
ANOTHER POSSIBLE CONSTRUCTION
OF URANIUM-238

Another possibility for a deuteron daisy-chain link in the construction of $^{238}_{92}\text{U}$.

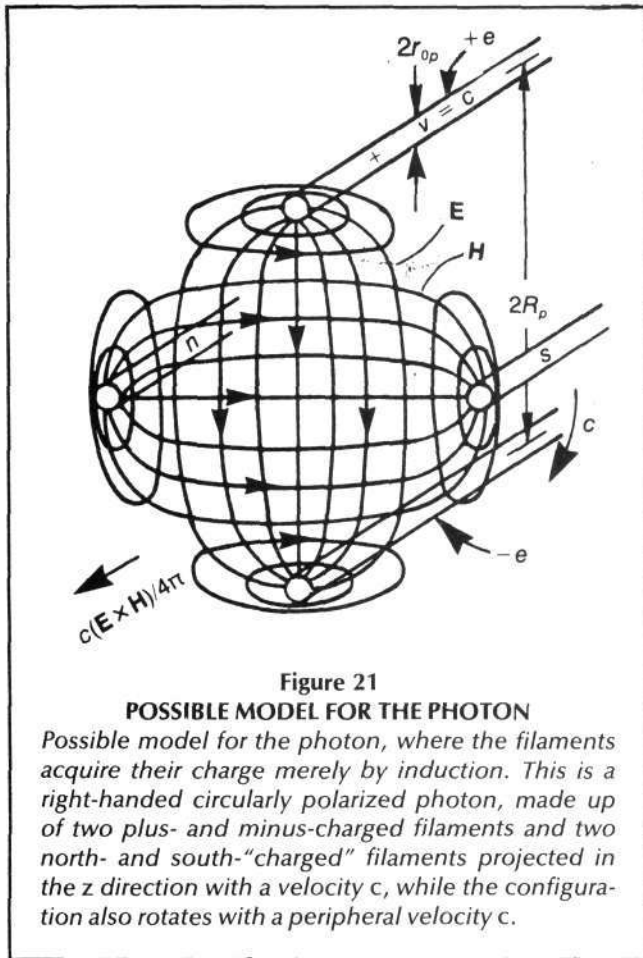


Figure 21
POSSIBLE MODEL FOR THE PHOTON

Possible model for the photon, where the filaments acquire their charge merely by induction. This is a right-handed circularly polarized photon, made up of two plus- and minus-charged filaments and two north- and south-“charged” filaments projected in the z direction with a velocity c , while the configuration also rotates with a peripheral velocity c .

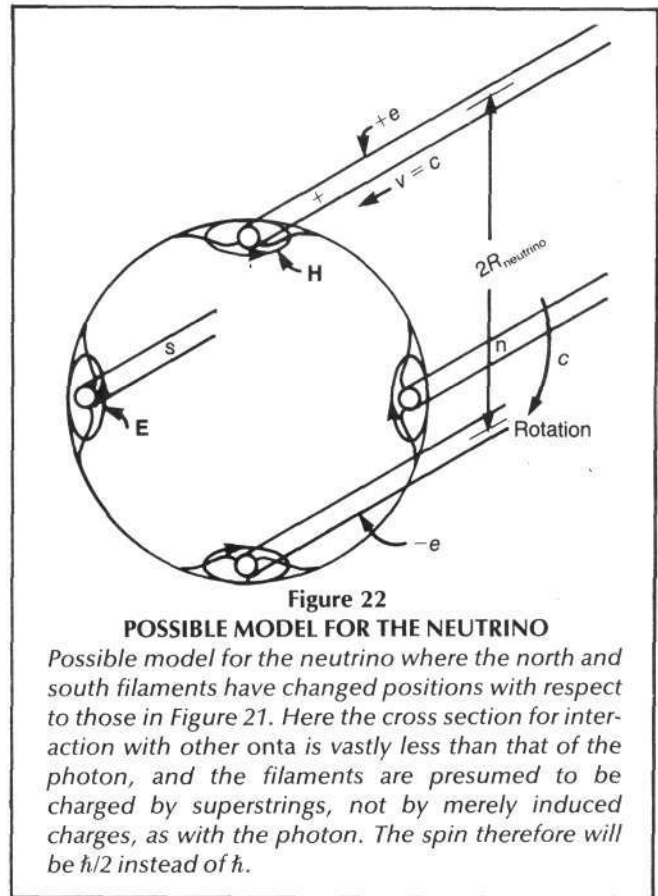


Figure 22
POSSIBLE MODEL FOR THE NEUTRINO

Possible model for the neutrino where the north and south filaments have changed positions with respect to those in Figure 21. Here the cross section for interaction with other onta is vastly less than that of the photon, and the filaments are presumed to be charged by superstrings, not by merely induced charges, as with the photon. The spin therefore will be $\hbar/2$ instead of \hbar .

ognize this as yet another important link in the philogenetic structure of unification through electromagnetism.

It is the author's hope that the accompanying essay with this sequel will help the superstringers and supergravitationalists of 1990 to see what can be accomplished toward unification with a concept judged worthy by the Gravity Research Foundation in 1958 and 1961, but since largely ignored.

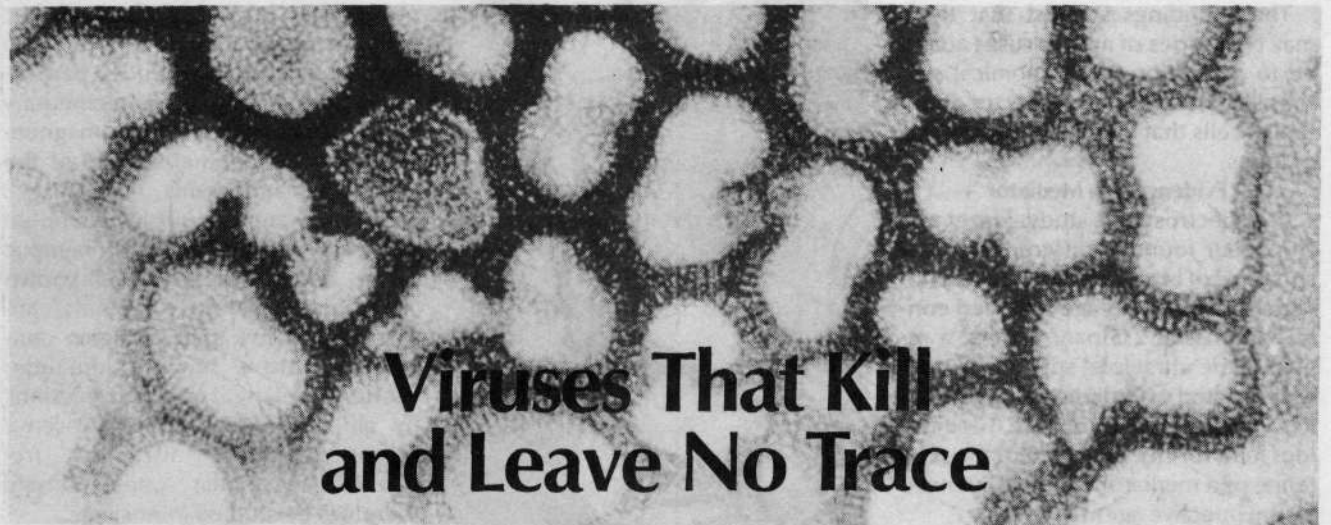
Nature unified all forces and energy with electromagnetism years ago, for which we are devoutly thankful. The greater cause for rejoicing now is that the *l'chaim* electron, photon, fermions, and all *l'chaim onta* are bringing quantum mechanics, the prodigal son, back into the family of classical physics. Gone will be the schizophrenia of duality—the apartheid syndrome in scientific thought represented by Aristotelian logic. In its place will come the analogue of the *filioque* (the principle that the Holy Spirit envelopes and proceeds from both Father and Son), with its ecumenical message of electromagnetism. The divisive, misleading, jealousy-producing tenet of lump mass will be buried forever.

Note

* The author is informed by one historian that this form was given to Newton by Hooke and that the “law” was very likely understood by Kepler.

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Viruses That Kill and Leave No Trace

by James W. Frazer, Ph.D.

Centers for Disease Control

Viruses have been associated with disease classically by the appearance of an inflammatory response, cell death, and diminished organ function. Extracts of the lesions cause a similar disease when applied to healthy plants or animals.

The first virus isolated, tobacco mosaic virus, and the first animal virus isolated, the causative agent of hoof and mouth disease, were both identified using this approach (Ivanovski 1899, Loeffler and Frosch 1898); and these evidences of viral disease are still taught to students in texts of medicine, microbiology, virology, pathology, and immunology.

In the early 1970s, Michael Oldstone of the Department of Immunology at Scripps Institute and Clinic in Pennsylvania began questioning whether morphological damage to the infected cell invariably accompanied viral infestation and appearance of disease.*

In a masterful series of experiments involving many coworkers over many years, viral interference with the production of cell hormonal products was shown to occur when there was *no* discernable damage to the infected cell in visible light or with high resolution electron microscopy. The cell products measured included cerebral neurotransmitters (acetylcholine), whose presence was due to lower quantities of both synthetic and degradative en-

zymes; production of sulfated glycoproteins by chick chondroblasts; synthesis of growth hormone, producing abnormal growth and glucose regulation; insulin production by islet cells of the pancreas; and production of thyroglobulin by thyroid cells.

In each instance, there was no morphological damage to the cell, but a defect in transcription of hormone-specific RNA was found. There was no change in total cellular RNA or DNA, nor in normal metabolic enzymes.

Diminished specific antiviral immunoglobulin synthesis was found after infection with measles virus, cytomegalovirus, or influenza virus. (Immunoglobulins are proteins with the ability to bind to other molecules, but with great specificity; antibodies are immunoglobulins.)

Immunosuppression is a fairly common adjunct to many viral infections, but these studies showed that there was unexpectedly specific action against specific antiviral immunoglobulins, which allowed transport of the virus and its multiplication at distant sites. Specific antiviral action of NK cells (natural killer cells, a kind of T-lymphocyte) was cut off by such lymphocytotropic viruses.

Wallace Rowe showed that the infectious agent LCMV (lymphocytomegalovirus) could induce disease by activation of the immune system

(1954). This idea was taken up by Peters et al., who started looking for a "mediator" that could be associated with the damaging features of hemorrhagic fevers (1987).

Liu et al. found that the sulfidopeptide leukotrienes do circulate in the blood at different levels when infected animals are compared to uninfected controls (1986). The Pichinde virus used by Liu is an arenavirus that seemingly produces symptoms only in strain 13 guinea pigs, not in other experimental animals or man; therefore, it can be studied at a lower biocontainment level than other, more infectious agents. The system has been used as a model for Lassa fever in man. (Arenaviruses are retroviruses in the same class as the AIDS virus, having the same appearance and producing the same symptoms.)

In strain 13 guinea pigs, death usually occurs about two weeks after inoculation with the virus. Death is usually associated with excessive metabolism that consumes body fat and protein (cachexia) and gradual cardiac failure.

Viruses can interfere with the production of cell hormonal products without any discernible damage to the infected cell. Here, an arenavirus. Some arenaviruses have been shown to disrupt RNA transcription in a very specific way.

No virus could be detected in the heart, but there was an extreme loss of cardiac muscle mass.

These findings suggest that there may be a series of arenaviruses adapted to disruption of biochemical synthesis pathways for platelets, or endothelial cells that line the blood vessels or lungs.

Evidence of a Mediator

In a spectroscopic study, Frazer and Liu (1990) found a difference in absorbance of blood plasma between infected animals and age-matched control animals at 235 nanometers, a region of the ultraviolet spectrum usually associated with diene conjugates or keto groups on long chains. The findings lend further credence to the existence of a mediator that is influenced by the infective agent.

The data on viral-based hemorrhagic fevers are far from complete, but they are consistent with the idea that a series of arenaviruses are specialized to interfere with synthetic steps for platelets or endothelial cells having consequences in cardiac or pulmonary function. The possibilities are being investigated in several laboratories.

It appears that one class of arenavirus activity is the direction of RNA transcription away from normal synthesis of products with amazing specificity and efficiency. This capability allows rapid dissemination of the virus via suppressed lymphocytes or macrophages followed by alteration of transcription in target cells. It is quite possible that several "diseases of unknown etiology" may actually be the result of very specific viruses.

AIDS research, and research at a fundamental cellular level is already starting to focus on steps required to synthesize and transport messenger RNA (mRNA) from nucleus to cytoplasmic translation sites, and get rid of nuclear RNA splice products not immediately required (Chang and Sharp 1990). Rev is a polypeptide that specifically binds to an RNA sequence known as the Rev response element, and regulates cytoplasmic, but not nuclear specific, HIV RNA, perhaps by suppressing nuclear destruction of the viral RNA. Such a system may allow a pharmacological or physical (specific frequency ultraviolet radiation) attack



The author suggests that drugs or specific frequency ultraviolet radiation could be used to destroy the precursors to viral protein synthesis. Here, Frazer in his laboratory.

on the mRNA precursors to viral protein synthesis.

Self-Induced Transparency

Getting ultraviolet radiation to important sites deep with the body presents a serious problem, since most ultraviolet in the frequency range of 200 to 300 nm is absorbed within a few mm of tissue. One trick that might be used is called self-induced transparency, usually associated with short-pulse lasers.

Adam Bruckner, then at the University of Washington in Seattle, used short laser pulses to visualize the retina behind cataracts as long ago as 1973 (Bruckner 1973). One would use a frequency-doubled argon ion laser and a pulse isolator such as the CS₂ cell now used in streak cameras. Considerable development would be required for pulses of about 10⁻¹³ sec duration with the necessary stability and distance of penetration into tissue. The prospects do not put this high on anyone's priority list.

In a paper on what W.R. Adey has since called "molecular whispering" (Adey 1990), we proposed a mechanism for the demonstrated specificity

of macromolecular association shown by Rev and the mRNA response element (Frazer and Frazer 1987). We proposed that known electromagnetic emissions from functional groups on one molecule would induce a particular conformation in a complementary molecule allowing an electromagnetically induced geometric "fit" of the two molecular domains.

Such a system could be disrupted by other, stronger electromagnetic waves, and perhaps the well-known "temperature sensitive mutants" are evidence for this (that is, higher temperature means higher amplitude, shorter wavelength infrared emissions by all molecular species present). Means of getting "disrupting" frequencies to cellular systems should therefore be studied intensively.

James Frazer has pioneered in many areas of optical biophysics, including new treatments for cancer tumors.

Notes

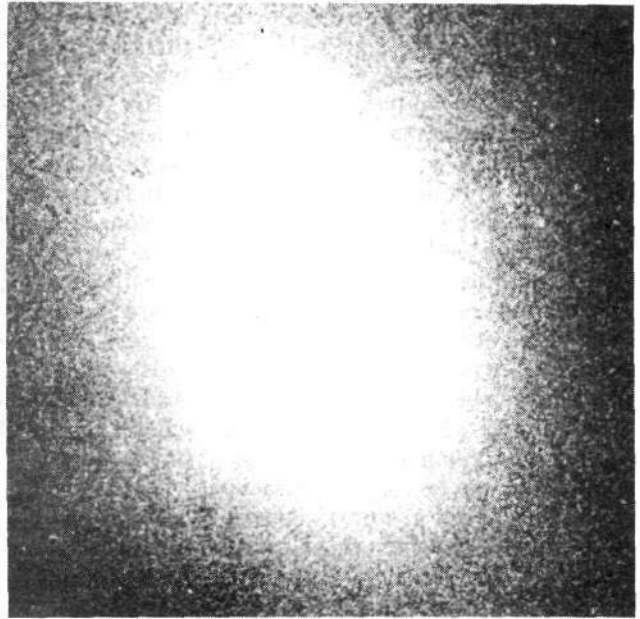
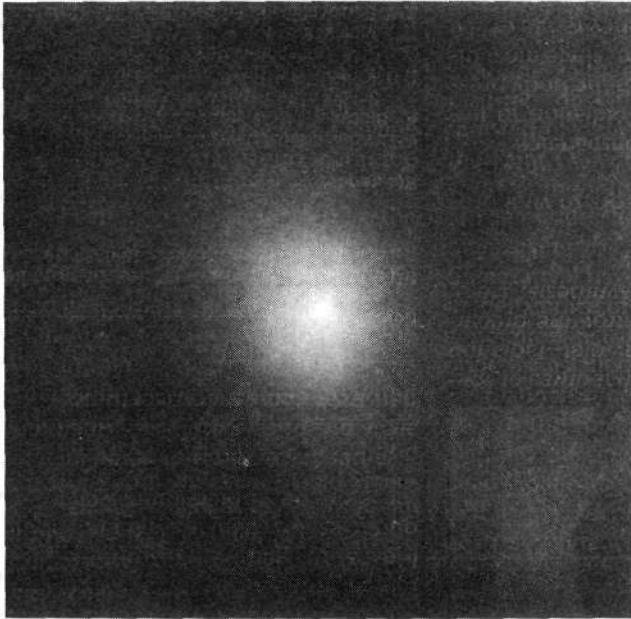
- * For a fascinating review of this story, see the *Journal of Infectious Diseases* 159:384, 1989.

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Hubble's First Computer-Restored Images

by David Cherry



NASA/STScI

A very substantial improvement in resolution is expected when state-of-the-art image processing is applied to certain Hubble observations, announced a Space Telescope working group July 6. A large improvement, it said, would be realized in the case of point-like objects standing out against a dark background, such as star fields that are not very dense. But objects with complex features, such as planets, planetary nebulae, and supernova remnants, according to the group, would also benefit from image processing to a lesser extent.

When the Space Telescope Image Processing Working Group made the announcement, the mass media were busy bashing NASA and trashing the Space Telescope over the aberration discovered in its primary mirror. The good news went unreported.

On August 13, five weeks after the Working Group's announcement, its expectations were fulfilled when NASA released the first processed image. That first image was a 40-second exposure with the Wide Field/Planetary Camera in wide field mode of the dense star cluster R136 (back cover).

R136 lies within 30 Doradus, a naked-eye nebula in the Large Magellanic Cloud.

After processing, the image has a resolution of 0.1 seconds of arc, the intended resolution of the wide field mode. Astronomers hope to obtain images of R136 to a resolution of 0.05 arc sec or better with the Wide Field/Planetary Camera in the planetary mode (intended resolution 0.043) and with the Faint Object Camera (intended resolution also 0.043).

At the faint end of the range of planned observations, results from the Wide Field/Planetary Camera and the Faint Object Camera will still fall short of the intended resolution by a factor of 10. Therefore, the astronomers using the Wide Field/Planetary Camera will have to be very selective in their choice of targets until a second generation instrument with corrective optics is installed in 1993 or late 1992.

At launch time, no second generation of the Faint Object Camera was planned, but now its builder, the European Space Agency, is considering building a second instrument, with possible financial participation of

NASA, at a cost of about \$100 million.

NASA is also seriously considering an option for fully correcting the existing Faint Object Camera and the two

A first look at a galactic nucleus with Hubble's Wide Field/Planetary Camera, in planetary mode, taken Aug. 17. This is the galaxy NGC 7457, 40 million light years away, or more than half way to the massive Virgo cluster of galaxies. A single image is shown here adjusted to high contrast (left) and low contrast (right—the graininess is noise). The image at right is not an enlargement. The spectrum of NGC 7457 indicated no particular activity at the nucleus, so astronomers expected the same smooth increase in brightness in the right-hand image that is seen on the left.

"Of course, we didn't think there was any core there," James Westphal of Cal Tech commented. Instead, a compact, sharply defined region of brightness is seen, with a star density at least 400 times greater than estimated from ground-based observations. When the Faint Object Spectrograph is trained on the nucleus, its rotational dynamics will be discovered.

spectrographs. It would use the space now occupied by the High Speed Photometer for a device that can put the right corrective optics in place for each of the three instruments on command. Under this option, the second-generation Wide Field/Planetary Camera and this special device would both be installed from the Shuttle in one operation.

Because of the extreme density of the R136 cluster—at least 60 stars are packed into a distance equal to that between the Sun and our next-nearest star (only 4 light years distant)—it is expected that all Space Telescope star cluster images will have at least the degree of resolution seen in the R136 image. Longer exposures, finer instrument calibrations, and improvements in the image-processing routines will produce even better results.

The image of R136—a cluster thought to be a single massive star until 10 years ago—is only the starting point of a project to study the temperatures, masses, and chemical composition of its individual members. The cluster of very young, hot, massive stars is reasonably supposed to have arisen from a common origin, and the distribution of different star masses in the cluster discloses information about how stars form and by what processes they produce the chemical abundances observed in the universe.

Image Restoration

Hubble specifications called for 70 percent of the light from a point source to be concentrated within a circle 0.1 arc second in diameter. The spherical aberration causes only 15 percent to fall within that circle and the rest to spill out into a large halo around the source. In computerized image restoration, the position and brightness of the source is measured and the 15 percent of the light within the tiny circle is relied upon for the image, while the amount and distribution of light attributable to its halo is computed and removed from the image. This produces a cleaner image and makes it easier to detect faint stars obscured by the halos of other stars.

A factor limiting the accuracy of this procedure is the precision with which one knows what the point-source image *should* look like. The exact distinction between image and halo depends

on this. The problem arises because the image of a point source in an optimal optical system is not a perfect point, but an Airy disk arising from diffraction at the aperture (Figure 1). The actual light distribution, or point spread function, for a given wavelength at a given Space Telescope focus setting will be found to greater precision as experimentation with the telescope continues.

The "noise" in the images also places a limit—a fundamental one—on the accuracy of this image restoration. For faint sources, the number of photons collected is small, leaving some uncertainty as to the exact point spread function of the source, and hence the exact amount of halo subtraction required. This factor also affects even the brightest star images to some extent, resulting in some difficulty in detecting faint stars against the background of multiple overlapping halos.

The image restoration process can be accomplished through various techniques, most of which use the same basic mathematical tool, the Fourier transform (Figure 2). Robert Stachnik, chairman of the Space Telescope Image Processing Working Group, explained in an interview:

"In straightforward image processing, you start with the Fourier transform of the aberrated image of an isolated star, as a point source, and the Fourier transform of the aberrated image of an extended object such as Mars or a distant galaxy. You divide the transform of the object by that of the point, and then go back from the resulting transform to the image again. This is done routinely in image processing and can get you a long way back toward a very high quality image, limited only by fundamental physical characteristics of the imaging process such as the wave character of light and the existence of diffraction."

Stachnik pointed out that computerized mathematical image processing techniques are not foolproof. "The procedures involved are not very intuitive. If you put a filter on your camera, it's pretty easy to see how the image is changed. In the case of going through a Fourier transform, an inverse Fourier transform, Wiener filtering, and putting in place a low- or high-frequency

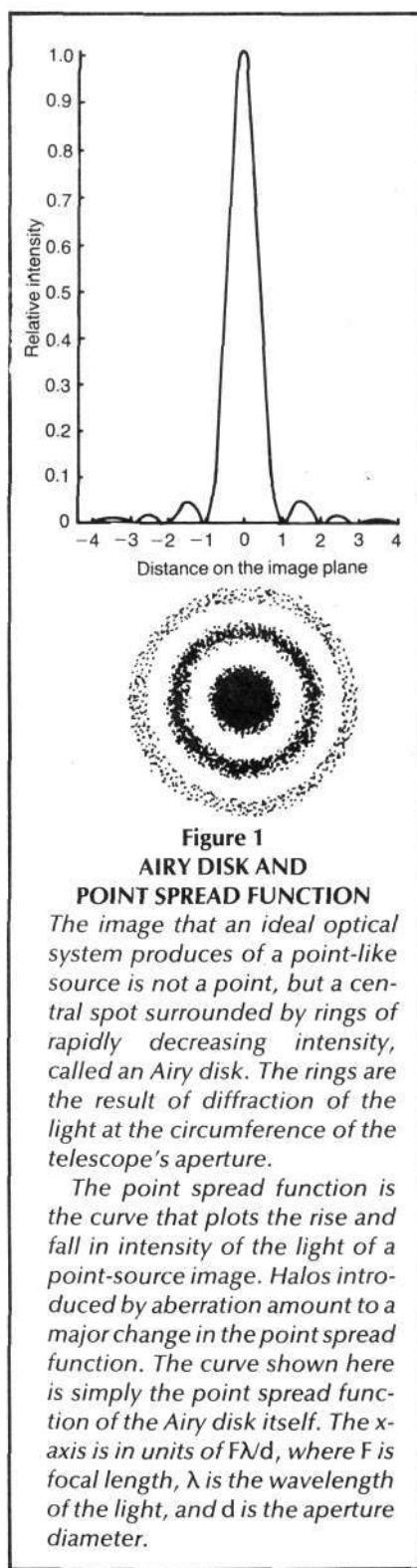


Figure 1
AIRY DISK AND
POINT SPREAD FUNCTION

The image that an ideal optical system produces of a point-like source is not a point, but a central spot surrounded by rings of rapidly decreasing intensity, called an Airy disk. The rings are the result of diffraction of the light at the circumference of the telescope's aperture.

The point spread function is the curve that plots the rise and fall in intensity of the light of a point-source image. Halos introduced by aberration amount to a major change in the point spread function. The curve shown here is simply the point spread function of the Airy disk itself. The x-axis is in units of $F\lambda/d$, where F is focal length, λ is the wavelength of the light, and d is the aperture diameter.

cutoff, small features may be introduced into an image. People familiar with image processing know that just means you can only trust features that have a certain strength."

In any image processing, Stachnik

added, it is important to have algorithms—mathematical routines—that either do not introduce artifacts, or else do so only in a known way.

What Image Processing Cannot Do

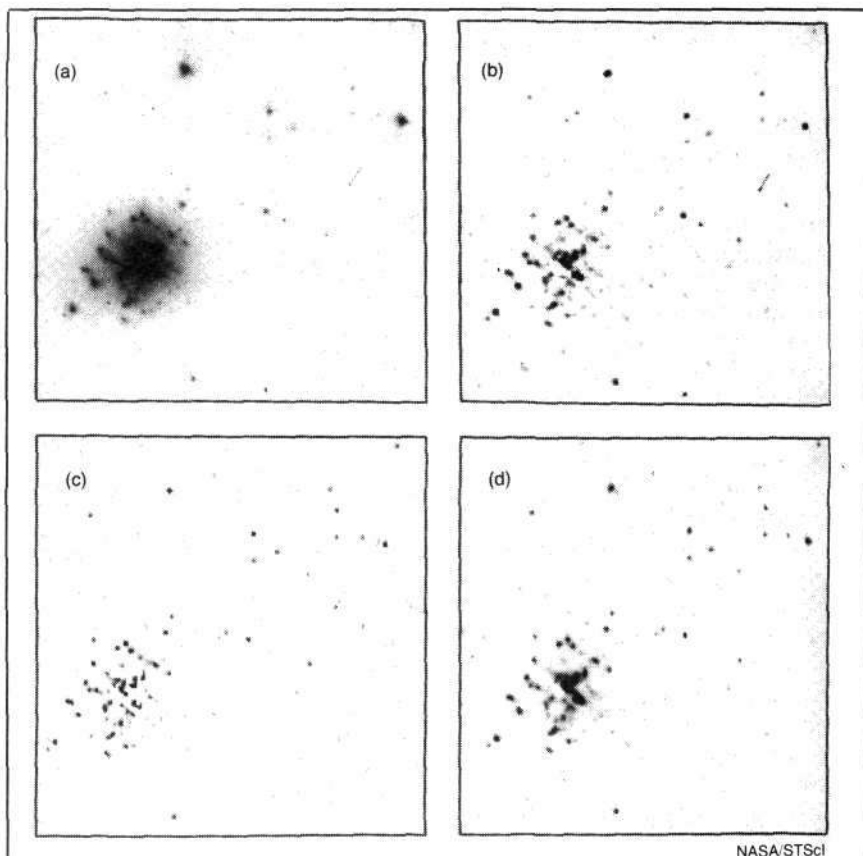
Each of the cameras, spectrographs, and other instruments on the Space Telescope was built by a different team of scientists. Each of these teams has been granted large amounts of observing time in the first two years of operation as Guaranteed Time Observers or GTOs. The teams have developed major observing programs that push the instruments to their limits in hopes of answering the most difficult questions. It is these observing programs that are most seriously inhibited by the spherical aberration, even after allowing for image restoration.

James Westphal of Cal Tech, leader of the Wide Field/Planetary Camera instrument team, discussed the problem in an interview: "For very, very distant galaxies—which means very young ones—are they all elliptical out there, or are they all spiral, or are they mixed together as they are now, or what? That's a very fundamental question with important implications, and we aren't going to get the answer until we get the second camera up there."

About half of all planned Guaranteed Time observations are feasible without the installation of replacement instruments with corrective optics, according to Rick White, an astronomer at the Space Telescope Science Institute involved in the image restoration effort. The instrument teams have been given the option of deferring their observations until the relevant replacement instrument is installed. For the Wide Field/Planetary Camera, about 80 percent of planned Guaranteed Time observations will be deferred, according to Westphal.

Beyond the instrument teams are the General Observers (GOs); that is, all other astronomers and astrophysicists, who apply for Space Telescope time as they would for any major ground-based telescope. General Observer projects for the first year of operation had already been chosen when the telescope went into orbit. Of these, about 80 percent are still feasible, according to White.

For spectroscopy, the impact of the spherical aberration can be reduced



NASA/STScI

Figure 2
IMAGE PROCESSING TECHNIQUES
APPLIED TO IMAGE OF STAR CLUSTER R136

The Space Telescope "remains very, very much alive," said project scientist Ed Weiler when these pictures were released Aug. 13. While performing no miracles, computer image processing is greatly improving the usefulness of the Space Telescope, pending installation of adaptive optics.

The enlarged but unprocessed image of star cluster R136 is shown in (a). Aberration in the primary mirror produces a halo around each star, which leads to a combined effect of a general fuzziness. Three different algorithms were used to subtract the halos in the other three images: Jansson's constrained iterative method (from the Space Telescope Science Institute) (b); a constrained least squares/maximum entropy method (from the Goddard High Resolution Spectrograph team) (c); and Lucy's iterative method (from the Wide Field/Planetary Camera team) (d). Cosmic ray hits on the imaging plane have been removed from (d). In the other images, the linear feature in the upper right quadrant is a highly oblique cosmic ray hit.

using the same principles as are involved in image restoration. The alternative is to reduce the aperture at the focal plane, so that the halo is not used. The smaller aperture then requires a sixfold increase in exposure time to obtain the same amount of light.

"From the simulations we've done," White said in an Oct. 1 interview, "you are really better off just using the smaller aperture. If you use the larger aperture, by the time you do the com-

puter processing to get back the high resolution spectra, the noise has been amplified at the same time. The spectra end up not being as good as those obtained through the small aperture for the same exposure time. This is our current understanding. All the results so far are on simulated data. We don't have any real spectra taken through the telescope with which to experiment, but within the next month or so we expect to get some."

Why the Space Telescope Has No Peer

Lyman Spitzer, Jr., more than any other individual, has been the driving force behind the Space Telescope, ever since he proposed it in 1946. Spitzer, now Professor Emeritus at Princeton University, was interviewed by David Cherry before launch on March 7, and again on Nov. 2, 1990. Excerpts follow.

Question: In 1982, you joined John Bahcall in writing an article for *Scientific American* on the Space Telescope. In the article, the two of you referred to the "beginning of time," adding parenthetically, "if, as the standard big-bang model of cosmology assumes, time actually had a beginning." Will the Space Telescope give us some clues about that implied question?

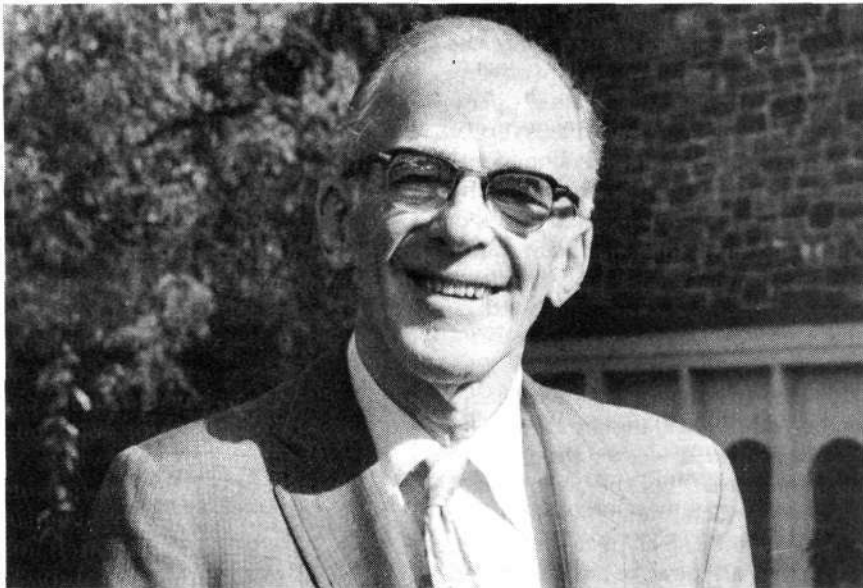
The origin and evolution of the universe is still a fascinating fundamental question for astronomy. We expect the Hubble Space Telescope will help in several ways in exploring this question. In particular, this telescope should obtain sharp images of galaxies as they were billions of years ago, when the universe was still very young.

Question: Are there any Space Telescope projects that you have prepared?

I have a project, proposed in collaboration with my friend Bob O'Dell at Rice University, that is concerned with a particular interest of mine, which is matter between the stars.

I have been interested for many years in what goes on in the spaces between the stars. We got some very interesting information with the Copernicus satellite that had a Princeton telescope-spectrometer, and we'd like to extend that work.

The observations that I have included in our joint program are designed to tell us the physical conditions in the gas between the stars—composition, density, temperature, motions—and to clarify how this gas affects the evolution and future fate of our galaxy.



Princeton University

Lyman Spitzer, Jr.: The Space Telescope will help explore a fascinating fundamental question—the origin and evolution of the universe.

Question: Critics of "big science" are naturally critical of the Hubble. Some of them argue that fundamental science never requires big capital investments.

I would disagree. You need big telescopes to get results on faint, distant galaxies. I was principal investigator of the Copernicus satellite, which wasn't very big science, but at least in its day it was regarded as rather expensive; the observations that we obtained revolutionized our understanding of the interstellar gas. Now whether that's fundamental—maybe most of astronomy isn't fundamental and you can throw it all out. Maybe it's all just applied physics!

Question: Where in terms of urgency would you rank putting up a Schmidt telescope, either in orbit, or on the Moon?

Well, that would take a little study. This would be an optical telescope I presume, and for looking in the ultraviolet. The images produced by a Schmidt telescope on the ground are so sharp—the focal length is so short—that the smearing of visual im-

ages as a result of atmospheric irregularities is not so important. And to really get a big survey, you need large-area detectors, which have not yet been developed. Now they may be developed for ultraviolet light in the next decade or two—things are going very rapidly.

Question: Advocates of an orbiting Schmidt telescope emphasize that objects and parts of objects with low surface brightness—the outer reaches of galaxies, for example—are invisible from ground telescopes because they are washed out by diffuse light in Earth's atmosphere. Doesn't this represent another frontier?

I can well imagine that ultraviolet observations obtained with an orbiting Schmidt telescope would be important for astronomy. Of course, detailed studies are required to determine the relative priority of various instruments.

Question: As you know, the European Southern Observatory is planning the Very Large Telescope (VLT), which is to have "adaptive optics" capable of cor-

recting 60 times a second for the changing distortions of the atmosphere. This is seen as a way to eliminate the problems the atmosphere causes astronomers without sending the telescope into space. The claim is that its images in visible light will be of comparable quality to those the Space Telescope was designed to obtain. The *New York Times* [July 20] emphasized that this meant "comparable quality, at a bare fraction of the cost" of the Hubble. How well founded are these assertions?

The actual resolution of the Space Telescope at the moment is rather close to what had been planned. There are some 20 papers being submitted to the *Astrophysical Journal Letters* for publication in a special issue, presenting all sorts of scientific results obtained with the use of this high resolution. When they appear [in early February 1991], they are going to make quite some scientific impact.

I don't think any telescope on the ground has yet achieved this resolution. In principle, it would be possible to get to this resolution with a ground-based telescope with adaptive optics. But to do it, you need quite a bright reference star very close by, so for many objects one wants to look at, this technique is ruled out.

Question: It is also clear that its observing capabilities will vary from one part of the spectrum to another, as Horace Babcock's review in *Science* ["Adaptive Optics Revisited," July 20, 1990, p. 253] acknowledges. Babcock apparently told the *Times* that at visible wavelengths, the resolving power of adaptive optics in a ground-based telescope "may exceed" that of the Hubble. But in the ultraviolet. . .

You just don't see the ultraviolet from the ground.

Question: Also in the infrared, there are bound to be significant limitations.

I suppose adaptive optics will be done, although it is still technically difficult. To get around the need for a bright reference star, there are paper-and-pencil discussions of using a laser beam in the telescope, to obtain the light echo from the atmosphere, instead. Babcock mentions this. There are various problems and uncertainties about that. It is conceivable that in

time such a technique could lead to high resolution all over the sky.

There are numerous unanswered questions, such as whether there are crucial differences between the light coming back from the laser beam and that coming from the star, whether the laser beam would be powerful enough, and whether you will get scattering by dust particles from the laser beam interfering with the observations. There are many such problems, but I was very interested to read Babcock's article.

Question: Aren't the Space Telescope and ground-based adaptive optics complementary technologies, rather than primarily competitive?

They are partly complementary in that only the Space Telescope can see in the ultraviolet. They are also partly competitive in the area of high resolution in visible light. At the moment, the Space Telescope is *far ahead*.

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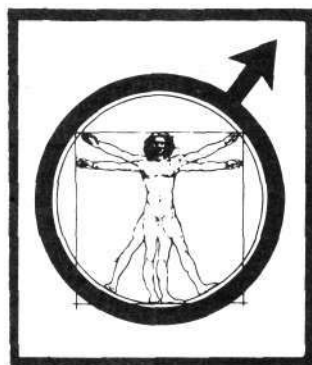
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Oberth, But Not at His Best

Primer For Those Who Would Govern

Hermann Oberth
 Williamsville, N.Y.: West-Art, 1989
 Paperback, 304 pages, \$23

A new book by Hermann Oberth in English! The author is the great space scientist who inspired a whole generation in the development of space rocketry—among them Wernher von Braun, Arthur Rudolph, and Krafft Ehrlicke.

The advertisement for the book in *21st Century* appeared to be somewhat awkward in English, but I felt my reading knowledge of German would help me overcome potential mistranslation. My other hesitation was that I had heard that Oberth had spent much of his long retirement in parapsychological investigations, and it was not clear to what extent the content of this book derived from parapsychological insights. However, my familiarity with Oberth's earlier publications that dealt with the application of advanced technology to solve worldwide development problems led me to put aside my hesitations and order *Primer for Those Who Would Govern*.

The publisher of the book is B. John Zavrel, President of the Arno Breker Society International, an organization which Oberth suggests can help promote German-American friendship.

Looking through the table of contents of the *Primer* I found relatively few pages that appeared to be devoted either directly or indirectly to technical matters. I began to suspect that my hesitations were being confirmed in spades.

Oberth's approach to philosophy and politics, as reflected in his *Primer*, appears to me to be a hopeless intermingling of widely eclectic—and often contradictory—elements, uncharacteristically lacking his former pithiness of expression. How different is Oberth's approach to the development of rockets! In the foreword to *The Moon Car*, Oberth's delightful little book on the design of a lunar vehi-

cle, Heinz Gartmann writes:

"For Hermann Oberth the rocket has always been just a means to an end; he saw realities in space where others still thought there were only utopian dreams. He did not need expensive laboratories and testing areas costing millions of dollars. His creative genius was all that was required to establish the foundations for the rocket industry."

In technical matters, then, Oberth always resolves disputes on an objective basis, relying on his own creative genius. In nontechnical matters, on the other hand, Oberth appears to mistrust his own creative genius, relying instead on others.

The Importance of Technology

When Oberth wrote *Ways to Spaceflight* in 1928, he foresaw that "a certain probability exists that a new world war will break out in 10-20 years." He expected central Europe to serve as a "concentration area and theater of war." In this context, he promoted the development of the rocket projectile as the only available means to settle differences between opposing armies before they could become bogged down in the kind of war that had been fought 10 to 15 years earlier.

Oberth stated: "I desire this weapon because I desire peace. In my opinion, war can be prevented only by creating weapons which the public respects and with which it does not wish to become acquainted (p. 279)."

In the same location, Oberth also suggested that the development of advanced weapons would allow smaller armies, putting more people back into productive work. Oberth returns to this theme in *Primer* when he discusses the fragmentation of science and how to overcome it—one of his best sections, in my opinion.

Here, Oberth states, "The outbreak of World War II would have been just as unlikely [as the coming to power of Hitler] if the intelligentsia had recognized the importance of rocket technology, the atomic bomb, and space



travel in time (p. 216)."

This idea that the most advanced technology is the best for fighting wars but also for winning the peace—for industry, agriculture, and environmental protection—Oberth fails to develop into a thorough-going philosophy of technology in the manner of a von Braun, a Saenger, or an Ehrlicke.

Redstone Arsenal

Returning to Gartmann's foreword, we find *The Moon Car* placed in the context of a fall 1958 editorial demand in the U.S. journal *Missiles and Rockets* that the armed services should begin the planning of a base on the Moon without delay. We now know that the Army Ballistic Missile Agency in Huntsville under General Medaris with von Braun as the head of the development team conducted a lunar base study called Project Horizon. This pioneering project officially began in March 1959, and the report volumes were published in June 1959.

In light of this extremely short cycle to produce reports several hundreds pages in length, it is obvious that conceptual work had been under way during the same years when Oberth was employed there. Gartmann states that Oberth was the first investigator—already in 1953—to seriously consider the design of a vehicle that could be used without paved roads on the un-

Continued on page 87

A Voice of Reason in Defense of Science

Trashing the Planet: How Science Can Help Us Deal with Acid Rain, Depletion of the Ozone, and Nuclear Waste (Among Other Things)

Dr. Dixy Lee Ray with Lou Guzzo
Washington: Regnery Gateway, 1990
Hardbound, 206 pages, \$18.95

Dixy Lee Ray writes of her youth: "It was a time of optimism and progress. It was a time of improvement in our standard of living that made our society and our nation the envy of the world. It was a time when the use of knowledge was expected, when the myriad applications of science through technology made living on this planet easier and better. . . ."

She contrasts this to the present: "Such progress continues, but it seems that hardly anyone enjoys it any more. Too many people have exchanged confidence for despair, too many have come to fear technology. . . . [W]e seem to have become a nation of easily frightened people. . . ."

So begins a thoroughly delightful book, chock full of information, polemics, and humor. Hopefully a paperback edition will quickly follow and flood the nation in millions of copies, destroying the credibility of the environmentalists and their myths.

Ray was formerly governor of the state of Washington, chairman of the Atomic Energy Commission, assistant secretary of state in the U.S. Bureau of Oceans, and long-time member of the Zoology Department of the University of Washington. She is a scientist in the best sense of the word, not a technician who merely masters procedures and facts, but one who is committed to bettering the human condition. She has dedicated her life to enhancing those qualities in her fellow citizens that distinguish them from beasts: reason and creative problem-solving.

Without man, much of our planet would regress to deserts, Ray makes it clear. "This old earth has been through a lot, including drastic climate changes, without any help from humans," she says.

The hysteria about the so-called dangers of industry, chemicals, modern agriculture, and nuclear power,



she argues, has no foundation in fact, and much of it is fostered by deliberate lying.

Ray's book provides the reader with a thorough, yet compact, scientific discussion of the leading environmental issues in nontechnical language—acid rain, Alar, asbestos, PCBs, dioxins, global warming, DDT, the greenhouse effect, nuclear energy, radon, radiation, and solar and wind power. In addition, she proves the crucial point that the purpose of much of environmentalist policy is to reduce the human population.

Her review of the banning of DDT in 1972 by the Environmental Protection Agency (EPA) is a case in point. Before the development of this mosquito-killing agent, malaria struck about 200 million people each year and killed about 2 million a year. DDT use put malaria well on the way to extinction, but by 1978, six years after DDT's ban in the United States, malaria was back with a vengeance. Today there are more than 800 million cases and 8.2 million deaths per year.

Ray demonstrates that the allegations against DDT have never been substantiated, and that in fact, the 1971 hearings by the EPA recommended, "There is a present need for the continued use of DDT for the essential uses defined in this case." Nevertheless, EPA administrator William Ruckelshaus banned all uses of DDT. Years later, Ray reports, Ruckelshaus admitted that the decision was political, not scientific.

Ray blames the media for much of the hysteria-mongering that created the basis for the ban on DDT—and that around Alar on apples two years ago. They do it deliberately, she says, and she quotes Ben Bradlee, editor of the *Washington Post*: "To hell with the news! I'm no longer interested in news. I'm interested in causes. We don't print the truth. We don't pretend to print the truth. We print what people tell us. It's up to the public to decide what's true."

Do the human race a favor: Buy this book for the environmentalist in your family!

—Patrick Ruckert

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Oberth

Continued from page 86
even lunar surface.

According to the *Primer*, Oberth concluded an investigation into an unmanned flight to the Moon and the outlook report, "The Development of Rocket Technology in the Next Ten Years," at Redstone Arsenal in the years between the publication of his books *Man into Space* (1954) and *The Moon Car* (1959). Oberth's work at Redstone Arsenal has, to my knowledge, never been published in the open literature.

My modest proposal to *Primer* publisher B. John Zavrel is that he publish or republish in English translation Oberth's technical studies of the 1950s, declassifying them first, if that is still necessary.

—Robert D. Allen



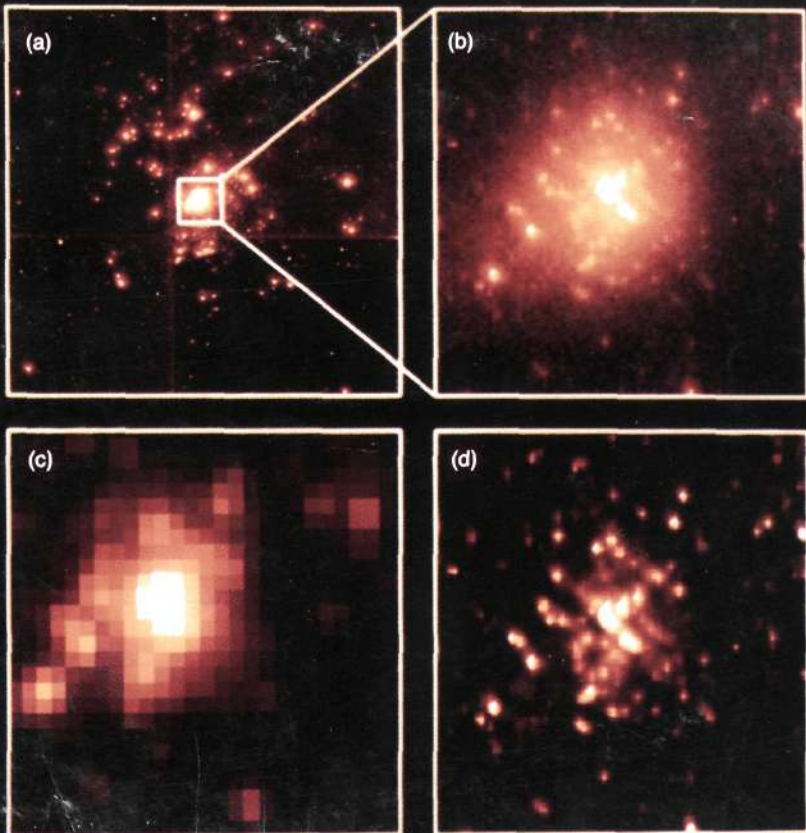
NASA

In search of truth: The Upper Atmosphere Research Satellite, scheduled for launch in fall 1991, will measure the internal structure of the upper atmosphere and the external influences that affect it, including temperature profiles and concentrations of ozone, methane, water vapor, CFCs, and other constituents.

What a difference resolving power makes! The Hubble Space Telescope's Faint Object Camera on Aug. 3 produced the image in (a) of a cluster of tightly packed young stars in the 30 Doradus nebula, 160,000 light years from Earth in the Large Magellanic Cloud galaxy. The very hot and massive young stars in this compact star cluster have bright cores only 0.1 arc seconds in diameter. The cluster is enlarged in (b).

In a photo of the same area made with the European Southern Observatory's 2.2-meter telescope in Chile (c), the images of the stars are 0.6 arc seconds wide. Computer processing improves the Space Telescope's image (d), reducing the halos around the stars in (b) caused by the telescope's mirror error, and resolving the two brightest stars, although they are only about .06 arc seconds apart.

NASA



In This Issue

THE TRUTH ABOUT THE GREENHOUSE EFFECT AND OZONE DEPLETION

There are too many people in the world who think that there are too many people. This is the most important fact to know about "global warming" or the "ozone hole." Why? As Dixy Lee Ray, Marsha Freeman, and Rogelio Maduro demonstrate in this issue, there is **no** scientific evidence behind the catastrophe scenarios. The draconian economic remedies proposed to ward off alleged climate disasters are based not on science but on ideology: the belief that a too-numerous human species is destroying a fragile planet. It is not true. People are the planet's most important natural resource and we need more of them. The human mind has a unique capability to solve seemingly impossible problems, develop new technologies, and create new resources, thus continuously perfecting man's dominion over nature.

FROM LABORATORY PLASMAS TO SUPERSTRINGS: A SPECIAL FEATURE BY WINSTON BOSTICK

Since the 1950s, plasma physicist Winston Bostick has been experimenting with magnetized plasmas produced in a plasma focus fusion device. The beautiful filamentary plasmoids that he observed and photographed led him to conceptualize the electron, in the tradition of Eugenio Beltrami, as a force-free "plasmoid" superstring. In the two essays presented here, Bostick geometrically models not only the electron but also nuclear matter. His constructions of closed superstrings show how the known properties of matter in the nucleus arise and what forces sustain their existence. This is accomplished in the classical tradition, without recourse to any Newtonian lump mass or embarrassing renormalizations.

SHARPENING OUR VIEW OF THE UNIVERSE

The Hubble Space Telescope has already begun to provide images of star clusters, galactic nuclei, and quasars, some of which are almost 10 times sharper than any previously obtainable. David Cherry reports some of the first spectacular results of this new resolving power and the image restoration techniques that are alleviating the much-ballyhooed mirror error.