

FUSION

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Sun Day 1978:
More Human Sacrifices?



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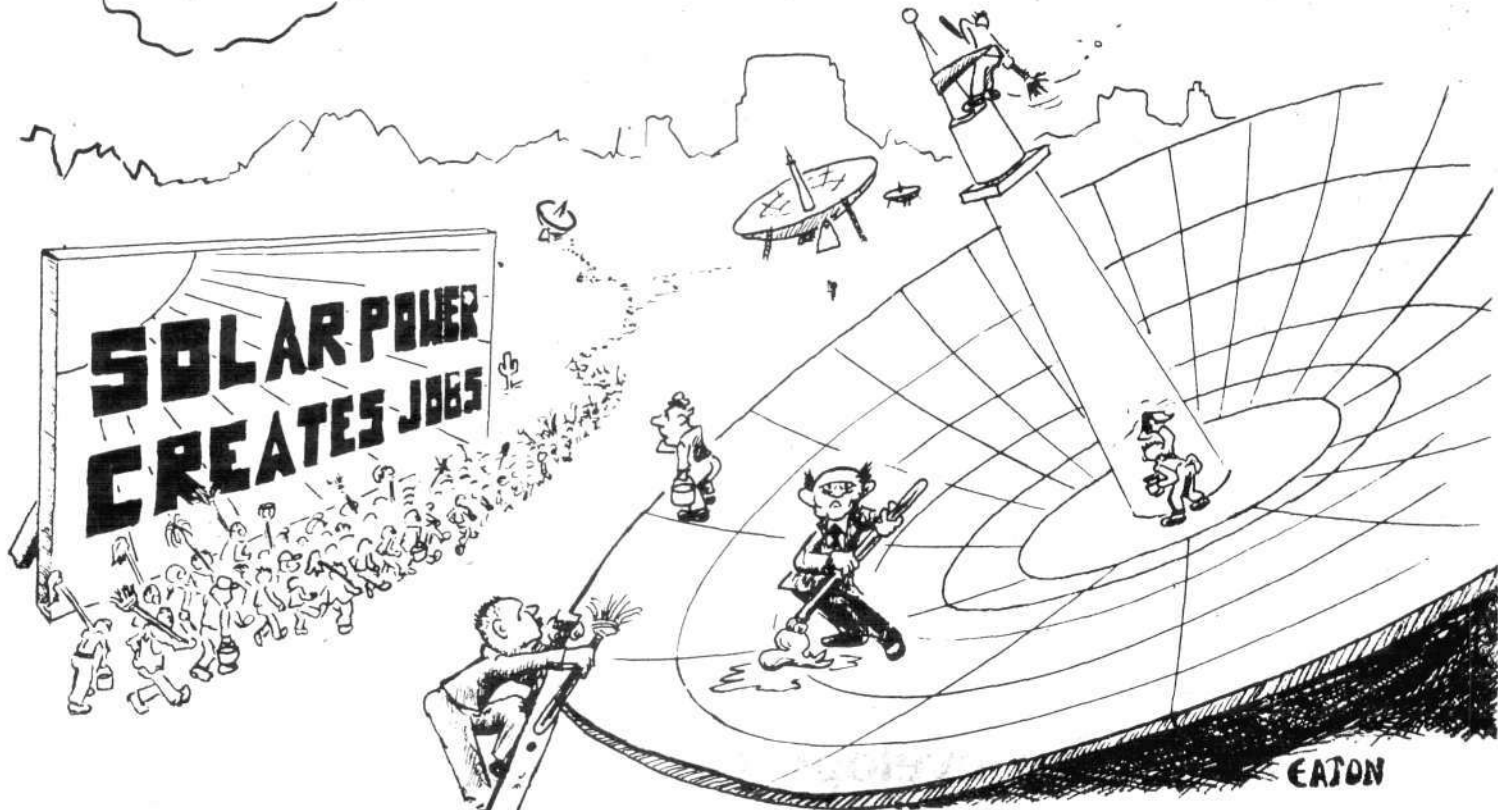
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No More Human Sacrifices



As the cover picture and this issue's featured article on the solar hoax make clear, the ritual insanity known as Sun Day 1978 is not just another counter-culture caper. Sun Day is a key element in an all-out attack on the republican institutions and the industrial base of the United States.

The economic realities that make solar energy such a menace are straightforward: solar power is 10 times more expensive than comparable fossil and nuclear facilities, and any large-scale use of solar power would drive energy prices through the ceiling and destroy millions of skilled, productive jobs. A solar economy would be an economic hell.

Why then did Energy Secretary James Schlesinger order the Department of Energy to throw its full resources behind the week-long Sun Day event? Is it coincidental that the push for so-called soft energy technology parallels the efforts to soften the dollar into oblivion and impose labor-intensive austerity schemes and financial swindles like New York's Big Mac? Not at all. Solar power is just the latest ruse to lead credulous sheep to the slaughter. In this case, if advanced industry and technology are sacrificed on the altar of the solar cults, it will cost two billion human lives.

The sane alternative is obvious. We must revolutionize the world's energy and production technologies by bringing down to earth the real power of the sun — fusion power.

Fusion Power Now!

With the brilliant victory represented by the 27 to 12 vote in the House Science and Technology Committee for full funding of the Clinch River breeder, the way is open to push through a full high-technology nuclear program — from fission to fusion. First on the fusion list is stopping the zero-

growth forces who have been spreading the lie that fusion reactors will cost more than present generators. Along these lines, we applaud the April 14 *Christian Science Monitor* editorial backing fusion, and we reprint excerpts of it below:

For more than two decades, physicists who dreamt of taming hydrogen fusion—the power source of the stars—pursued an ever-receding goal. Now they have the goal in sight and may soon have fusion running in the laboratory. It seems ironic that skepticism should threaten their efforts at this point.

Some theoretical studies suggest that the main line of development now being followed will only lead to industrial juggernauts that no utility could afford. Those who accept this reasoning, including some high energy officials in the Carter Administration, suggest cutting down on fusion development and sending it back to the basic research stage....

Throttling back funding and reorienting research could waste much time and money that have gone into the most successful — and most seriously questioned — line of attack....

Dr. Edwin E. Kintner, acting director of the Office of Fusion Research at the U.S. Department of Energy, has warned researchers in this field that the threat of cutback is serious. He says he and other supporters of fusion are having trouble persuading responsible officials that it is wise to continue to pursue the successful magnetic fusion research line vigorously.

To us, this wisdom seems obvious. We trust President Carter and Energy Secretary James Schlesinger will listen more to the arguments of successful experiments than to the doubts of skeptics who prematurely prophesy economic disaster.

On With Development

The brutal winter of 1978, the prolonged coal strike, and the predicted brownouts to come should have rubbed in the message that the United States cannot continue to careen from one energy crisis to the next. What must become equally clear to all is that the nation will never be free from the threat of energy disaster until James Schlesinger is removed from his post as secretary of energy. On every count—from his near foul-up of the coal strike settlement, his ongoing attempts to scuttle advanced nuclear technology, his outright lies about energy reserves, his outlandish proposals to turn off oil imports from Saudi Arabia in favor of alleged new supplies from the People's Republic of China—Schlesinger's removal is justifiable on the basis of his premeditated actions against the vital interests of the nation.

The removal of this White House saboteur is all the more urgent now that an export and development-oriented faction has emerged in the administration. The grouping includes Secretary of State Vance, Special Trade Representative Robert Strauss, Assistant Secretary of Commerce Frank Weil, and Director of the Export-Import Bank John Moore. Although it by no means has acted in concert or coordinated its activities, the grouping has put forward the basis of a sound alternative policy to Schlesinger's madness: a strong nuclear-based domestic energy program combined with incentives for nuclear exports and financial backing from the Exim Bank and commercial banks.

There are those who would rather wait until 1980 to attempt a change in energy policy. By then, however, the nation could have been destroyed either by the collapse of the dollar or by nuclear confrontation with the Soviets. We can't wait. Leaders of business, science, and labor must speak out now for a nuclear development and export policy to guarantee world peace and economic prosperity.

Calendar

May

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The Industrial Development of Southern Africa
Fusion Energy Foundation
Washington, D.C.
(see advertisement for details)

8-11

Offshore Technology
Houston, Texas

9

Energy and Jobs
in an Expanding Economy
Fusion Energy Foundation
Mary Grove College, Detroit
(see advertisement)

9-11

Vibration Problems
in the Nuclear Industry
British Nuclear Energy Society
Seascale, Cumbria, UK

15-17

Conference on Plasma Science
IEEE
Monterey, Calif.

22-26

Symposium on Nuclear Activation
Techniques in Life Sciences
IAEA
Vienna, Austria

22-23

Industrial Power Conference
Atlanta, Georgia

June

11-14

Canadian Nuclear Association
Annual Conference
Ottawa, Canada

12-16

Symposium on Molecular Spectroscopy
Ohio State University
Columbus, Ohio

18-23

Annual Meeting
American Nuclear Society
San Diego, Calif.

The Lightning Rod

My Dear Friends,

I was pleased you enjoyed my last letter, which no doubt you have forgotten, having read it so long ago. To those of you who remember, it came as no surprise that the ensuing weeks brought a rapid end to the rain of nuclear satellites, although no end to the British efforts to wreck the SALT negotiations and our friendly relations with the Soviet government.

But let us leave that for another time, and consider instead an equally amazing stupidity being promoted by our American government with the assistance of the Eastern press, the universities, and even some labor unions throughout the Nation: the environmentalist Sun Day.

Lord knows, I am a strong supporter of Sundays — agreeing with the Creator that six days' work require a minimum of one day's reflection. I have strong regard for the Sun, also, as the primary source of the radiant energy upon which life on our planet depends. But I am not about to enter some heathen ritual of sun worship, if only one day a year, having seen enough of the superstitions of the Indian tribes to know that someone will shortly propose we extend our genuflections to some other animal or vegetable species.

A recent editorial last month in the *New York Times* bears directly on this problem. According to *The Times*:

New extra-high voltage power lines will soon traverse more than 200 miles of upstate New York....In bad weather, they may glow, and crackle like bacon frying....People who live



near them fear their electric and magnetic fields. One farmer has suggested they might fry birds in midair.

As it happens, I know this farmer in upstate New York, and a sorry fellow he is. To this day he refuses to eat tomatoes, claiming they are poisonous. Why, it was only several years ago that he permitted electric lights to be installed in his farmhouse (still not in the barn — he doesn't want to frighten the animals), because he read a similar warning in the *New York Times* way back in 1878 that: "the retina of the human eye is habituated to a certain given intensity of illumination which is many degrees below that of electricity. (This) raises the point whether the properties of electric light are such as to render it safe...."

It is astonishing that whenever the forces of Nature are brought more fully under man's control, some fear

of banshees rises up to brand these phenomena occult and demonic — "fear their *electric and magnetic fields*" or "*intensity of illumination*." Doesn't the *New York Times* know, as every schoolchild knows, that these electromagnetic fields are the sum total of radio and TV transmissions and, in fact, power everything electrical, including the *Times*'s typewriters?

This banshee cry, a kind of religious observance with the environmentalist movement, arises with such regularity that it should be given its own name, and I would propose the "First Law of Them Paranoics." In deference to the dictionary-writers of the Royal Society, I define the law thus:

FIRST LAW OF THEM PARANOICS: The magical power of an object of human understanding increases exponentially as it approaches comprehension.*

Our British foes, who have held seances and dabbled in the black arts since the days of Newton and Locke's alchemy, were the first moderns to recognize the usefulness of this Principle and apply it throughout their Empire. It lies fully within the lawful domain of the First Law of Them Paranoics that Energy Secretary Schlesinger, along with paranoics Barry Commoner and Amory Lovins, has organized the pathetic Sun Day cult.

The First Law Explicated

Here the beauty of the First Law becomes evident: Worship the sun as an object of incomprehensible mystery and power! Propitiate the Sun God upon whose largesse man's future depends! *But do everything possible to sabotage and destroy fusion energy development here on earth* — to prevent man's mastery of the laws of the fusion process that is the power of our Sun.

A crowning irony of this subject concerns my poor farmer friend (his name, so help me, is Richard). Poor Richard, though parsimonious as a small town preacher or Ralph Nader, had already invested heavily in a headdress for the local Sun Day festival when he learned of a recent court decision returning his farm, along with most of upstate New York, to its original proprietors — the Oneida Indians. (Something about respect for Tribal Waters.) Poor Richard has opted to stay on the reservation, however. And although he plans to continue worshipping the electric and magnetic fields radiating from his high-tension wires, he is dutifully removing the electric lights from the farmhouse because they're in violation of tribal customs.

Yr Obedient Servant,

Bonj. Franklin

* Or alternatively: The magical powers vary directly as the manipulated masses, and inversely as the proximity of compr-hension.

Letters

Using Explosives To Get Fusion

To the Editor:

The apparatus shown on p. 71 of the December-January issue is very similar to that described by Zygmunt Fonberg in a note "Evidence of Nuclear Transmutation in the Course of Explosion of Shaped Charges with Lined Cavity," *Journal of Chemical Physics*, Vol. 19 (1951), p. 383.

Unfortunately experiments by Plain, McLaughlin, and Odencrantz, *Journal of Chemical Physics*, Vol. 20 (1952), p. 1049, did not confirm these results. The estimate of the temperature in these experiments was almost 20,000° K and because of real gas effects such as ionization it is difficult to see how conventional explosives could create temperatures of 5 million degrees as claimed.

William Squire
Professor, Department of Aerospace Engineering
West Virginia University

The Editor Replies

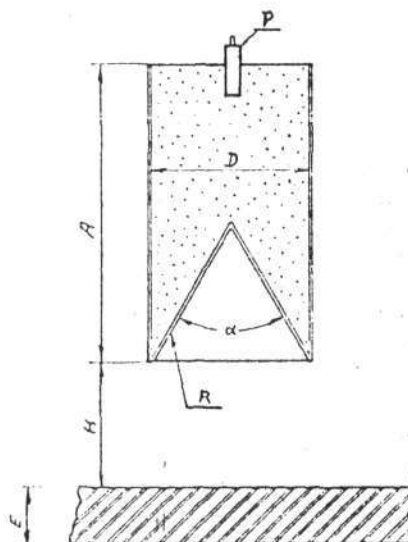
The 1950 experiment reported in the Fonberg note in the *Journal of Chemical Physics* bears a striking resemblance to the Polish experiment described in the December 1977 issue of *Fusion*. The accompanying illustration, taken from Fonberg, shows the same conical arrangement of target and explosive that the Polish group reported they had used to achieve fusion temperatures and

measurable quantities of neutrons by focusing the explosion on a target of deuterium gas.

However, the leader of the Polish research group, Dr. Sylvester Kaliski indicated in private conversation that he thought the most important difference between his experiment and previous research along the same lines was the machining of the high explosive. The most difficult problem his group faced, Kaliski said, was machining the conical charge to tolerances of 1 micron. Without this careful shaping of the explosive, the shock waves from the detonation did not converge and no neutrons were detected. The fact that the success of Kaliski's experiment depends on such a high degree of symmetry (necessary for sufficient energy focusing) points toward the source of the poor reproducibility of the results for this type of experiment. Perhaps this is the problem that Plain et al. encountered.

We welcome more discussion of this area of research by our readers. The initiation of fusion using chemical explosives is, unfortunately, another area so highly classified that informed discussion of its scientific significance is seriously impeded.

THE FONBERG EXPERIMENT



A—20 to 30 cm, D—6 to 15 cm, α —20° to 90°, H—0 to 30 cm, E—2 to 20 cm, P—detonator, R—retainer.

News Briefs

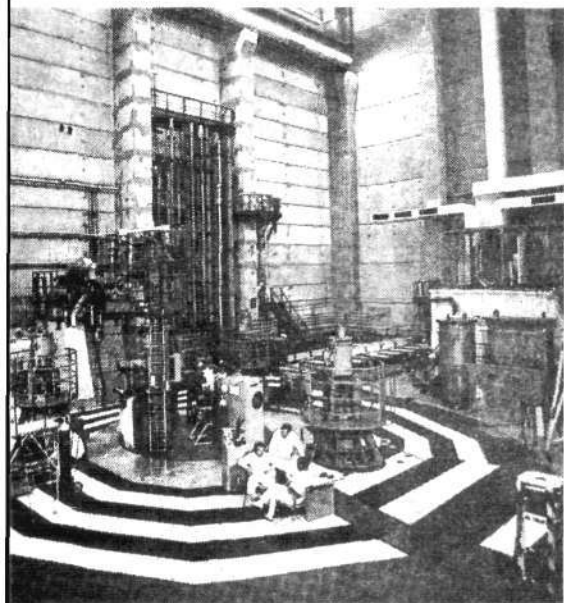
EUROPE STANDS FIRM ON U.S. DEMANDS FOR NONPROLIFERATION

A U.S. State Department spokesman announced April 11 that according to the terms of the Nuclear Nonproliferation Act of 1978 signed into law March 10, the U.S. was embargoing all pending licensing approval for shipment of uranium to the nine European countries that are members of Euratom, the European Economic Community's nuclear supply authority. The announcement followed the refusal of the Europeans, led by the French, to submit to the terms of the act, which the Euratom nations regard as a bad piece of legislation that unilaterally imposes U.S. controls over their internal and foreign affairs in violation of existing international agreements.

The controversial new law, known earlier as the Percy-Glenn bill, specifies that Euratom must notify the U.S. government within 30 days of the enactment of the law of its initiation of renegotiation talks with the U.S. over the basic provisions of the U.S.-Euratom treaty signed in 1958 during the Atoms for Peace era. The embargo took effect April 9, 30 days after the signing of the bill.

The law further specifies the cutoff of uranium supplies to any nation that refuses to endorse the concept of nonproliferation and no nuclear technology transfer control to a "non-nuclear-weapon" state.

The showdown on nonproliferation could prove to be one of the most destructive issues for the United States foreign relations, not only with Europe and Japan but also with countries like India that depend on U.S. uranium to fuel nuclear power plants for providing electricity.



The French Phenix nuclear breeder

CARTER PRESSURES CONGRESS TO PASS ENERGY BILL

President Carter is making a "last ditch" attempt to pressure Congress to break its deadlock on the National Energy bill, stalled in Congress since last summer over provisions dealing with natural gas and a crude oil tax, Washington sources report. The president spent hours with leading House and Senate energy conferees April 11 and 12, but to date no agreement has been reached. One of the conferees, Sen. Pete V. Domenici (R-N.M.) told the press "We have to get far down the line this week or there will be no energy bill."

Energy Secretary Schlesinger, who met with oil industry representatives in early April to try to gain their support for the Crude Oil Equalization Tax section of the energy bill, threatened that if Congress failed to impose a tax on oil, the president would have no choice but to impose a \$5 to \$6 per barrel tax on imported oil. Congressional opposition to the administration's plan centers around Schlesinger's insistence that the tax revenues not go into guaranteeing expanded national energy production.

CEQ PROPOSES A SOLAR AMERICA

The Council on Environmental Quality, an environmentalist grouping in the Executive Office of the President, released a 52-page report April 12 asserting that "by the year 2000 the U.S. will be producing one-fourth of its energy base from solar technologies."

According to Gus Speth, a council member, by the year 2000 solar technologies will fully meet the energy needs of the nation's 33 percent energy growth. "For the period 2020 and beyond it is now possible to speak hopefully and unblushingly for the U.S. becoming a solar society. The national goal of providing significantly more than one-half of our energy from solar sources by the year 2020 should be achieved, if our commitment to that goal and energy conservation is strong," Speth said.

At the press conference unveiling the report, however, Speth was far from unblushing as reporters questioned the factual and conceptual lapses in the report.



Council on
Environmental Quality
April 1978

Reporters pointed out for example, that the report assumes a projected energy base of 100 quads (a quad is 10^{15} btu) in the year 2000 from the current 76 quads, while even Schlesinger's minimal energy program projects a 115 quad minimum for the same year. Reporters also questioned the council's assertion that a doubled GNP in the year 2000 would require only 33 percent more energy, their statements that solar energy could efficiently reach and sustain a high heat level, and the claim that there is "tremendous support for solar energy in Congress," while the truth is that there is just a handful of congressmen on the solar bandwagon.

CALIFORNIA AFL-CIO DEMONSTRATORS: GIVE US ELECTRICAL POWER, NOT BROWN

Plumbers and pipefitters from AFL-CIO Local 467 picketed in front of a California AFL-CIO convention April 6, held to endorse the state's zero-growth Governor Jerry Brown for the upcoming Democratic primary. The progrowth picketers handed out leaflets that said: "Jobs require electrical power — lots of it....Governor Brown's attitude toward power is best summed up by his chairman of the Public Utilities Commission in his answer to the San Diego Power and Light when they said they needed the Sundesert nuclear power plant for their energy and job needs of the future: 'Buy your power from Mexico.'"

The leaflet continued: "We are not here to represent Zen Buddhists, alternative lifestyles, schools of philosophy, liberal elitists, conservative statists, or even the Democratic Party....We were sent here to support politicians who will adopt policies that will provide the opportunity for a decent job at a decent wage for all the workers in the state....Let us give to the politicians what they give to us. That means we give to Brown the same support he has given to us — none."

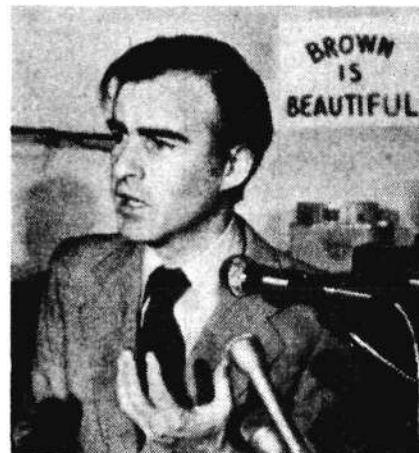
ROCKEFELLER FOUNDATION REPORT CALLS FOR WORLD COOPERATION TO INCREASE ENERGY SUPPLY

The Rockefeller Foundation released a far-reaching working paper on the energy crisis March 29 that urges the industrial nations, the Organization of Petroleum Exporting Countries, and the Less Developed Countries to begin immediate collaboration to resolve the impending energy crisis of the 1980s or face a severe international crisis.

The major policy recommendations of the report call for greater petrodollar investment in the industrialized states and the Less Developed Countries, the promotion of research and development of nuclear energy as the most viable alternative to petroleum, a major exploration and production drive to increase world petroleum output, technological aid from the advanced Western countries to help the Soviet Union to develop its vast petroleum resources, and the reconvening of the Conference of International Economic Cooperation (known as the North-South talks) to facilitate resolution of both the energy problem and Third World development.

The report, which was compiled by a team of international energy analysts, specifies that "assured access to uranium and enrichment services are essential elements in the security of nuclear fuel supply" and that "the successful development and commercialization of the breeder reactor would open up the possibility of greatly extending the usefulness of uranium resources."

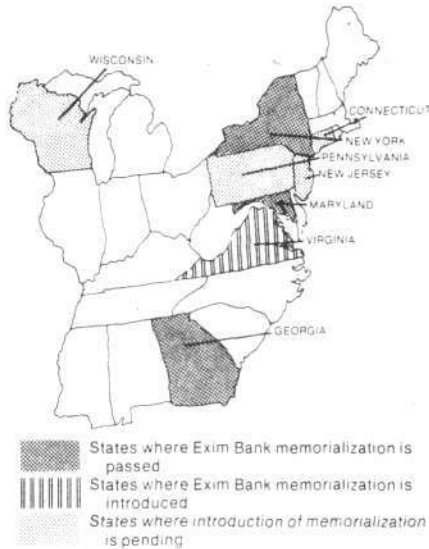
"If the U.S. government meant to set a nonproliferation example for other countries by deferring indefinitely for itself the use of plutonium fuel in light water reactors, and by limiting its breeder reactor development program," the report says, "perhaps the message would have been better received in other countries if it had been accomplished by redoubled U.S. efforts to develop its own indigenous energy resources, thus freeing foreign oil for others....Instead the U.S. action retards the development of nuclear options which the U.S. itself may need in the future, without clearcut compensating acceleration of other supply alternatives."



California's Governor Brown

ROCKEFELLER LAUNCHES U.S.-ARAB DEVELOPMENT PROJECT

Nelson Rockefeller will visit Saudi Arabia and Kuwait in April to confirm arrangements for a new corporation that will use the dollar holdings of the leading Arab oil-producing countries to purchase high-technology U.S. exports in order to industrialize the Third World. Rockefeller reportedly notified the State Department about his trip and no objection was recorded. The new corporation, tentatively called "Sarabam," was described in the *New York Daily News* as "a new development corporation that could create thousands of jobs, affect balance of payments accounts, currency valuations and the standard of living in many countries."



THREE STATES PASS RESOLUTIONS FOR EXPANDING EXIM BANK, NUCLEAR POWER

Three states to date — Georgia, Maryland, and New York — have passed resolutions calling for the expansion of the Export-Import Bank and the development of nuclear and fusion power in order to strengthen the dollar. The resolutions, called memorials, have been forwarded to Congress and the president as an expression of what the state desires as national policy. Five other states have pending resolutions (see map).

The Georgia resolution begins with a call for the administration to "go bullish on America" and ends with the following statement on energy:

"BE IT FURTHER RESOLVED...the administration is hereby urged to replace its energy program with one which emphasizes the development and utilization of existing and yet-to-be discovered fossil fuels; the mobilization of our advanced research and development capabilities to expand existing nuclear facilities, proceeding with the breeder program; and allocating the necessary funds to expand our nuclear fusion program to have reactors on line by the 1990s."

PEMEX CONTRACTS \$1 BILLION EURODOLLAR LOAN

Over 60 international banks have joined to lend Mexico's government oil company, Pemex, \$1 billion to continue its ambitious and successful oil development program. The deal was made on terms advantageous to Mexico — low interest and long maturity. Pemex director Jorge Diaz Serrano, in London for the signing of the loan, announced that Mexico was upgrading its port facilities on both the west and Gulf coasts, and exploring the possibility of contracting tankers to take Mexican oil to Europe, since the tankers normally return east across the Atlantic empty after delivering oil from the Mideast to the U.S.

DINOSAURS AND SOLAR ENERGY

A faction of the paleontology community now believes that dinosaurs generated body heat metabolically (that is, endothermally) in order to reach their physiological temperatures, rather than using the primitive ectothermal method of lying on rocks to absorb solar energy, as previously thought. As the April 8 issue of *Science News* reports on the raging dinosaur debate, "...running a continuous internal furnace is expensive, far more costly than the solar energy approach of reptiles." In fact, the magazine reports that endotherms capable of moving about at will rather than only when weather conditions permit, require two to four times the energy (food) than the ectotherms.

Interestingly, the best evidence that the dinosaurs may not have been warm blooded is that they had a soft brain structure. Although the FEF has no official position on the dinosaur question, we note on the one hand the similarity between solar advocates and this aspect of the dinosaur, and on the other hand their ectotherm personalities.



Washington

Full Funding Voted for Clinch River

The House Science and Technology committee killed a compromise amendment offered by subcommittee chairman Walter Flowers and Energy Secretary James Schlesinger that would have allowed the Carter Administration to divert the \$80 million approved for the Clinch River breeder reactor to a two-year study and to phase out the project. In a 27 to 12 vote April 12, the committee sent an alternate amendment proposed by Rep. Marilyn Lloyd to the House floor. The Lloyd amendment provides \$172.5 million for construction and \$35 million for a 30-month study of alternate breeder technologies.

Schlesinger had proposed a "heads I win, tails you lose" compromise on Clinch River in late March that involved his promise to conduct a 30-month study of a substitute breeder program allegedly bigger and better than Clinch River. In exchange, the secretary wanted a committee amendment that would have permitted the already voted-up budget authorization for the project to be used to shut Clinch River down.

Despite intensive lobbying by Schlesinger, and the threat of a presidential veto, committee members held firm. As one pro-breeder congressman put it, "We have a responsibility as representatives to do what this country needs and not be deterred by the threat of a veto."

One of the leaders of the pro-breeder fight, Rep. Mike McCormack, a former nuclear physicist at the Hanford, Wash. research labs, told a *Fusion* Washington correspondent on the day of the vote:

The action by the Science Committee today in continuing the Clinch River Breeder program is a major victory for the American people. The breeder program is absolutely essential to providing adequate

supplies of energy to this nation. Without the breeder program, this country would face economic catastrophe before the end of the century, perhaps before 1990. Today's vote tells the world that Congress intends to reduce American dependence on imported oil and to produce the cleanest, cheapest, safest, and most environmentally

acceptable source of energy available to this country.

The strong House vote is expected to send the Clinch River amendment to the Senate floor like a lion instead of the lamb Schlesinger intended for slaughter, another congressman commented.

See *Special Report on Clinch River*, page 18.

Supreme Court Rules for Nuclear Power

The U.S. Supreme Court ruled April 3 that the lower courts cannot substitute their judgment on nuclear power for that of the Congress, which has already made the choice to develop nuclear power. The ruling is a major setback for the antinuclear environmentalists and their efforts to sabotage nuclear power.

The high court's decision upset previous rulings of the Circuit Court to accept environmentalist claims that

conservation is a reasonable alternative to building a nuclear power plant. The lower court had directed the holding of an entire round of new Nuclear Regulatory Commission hearings to consider conservation as an alternative technology, — a tactic that would have delayed already stalled power plants to death.

The decision came on two consolidated cases, *Vermont Yankee Nuclear Power Corporation v. Natural*



The amicus curiae brief that outlined the constitutional issues in the nuclear power case was prepared by Gerald Kaufman [1], Edward Spannaus, and attorney David Heller of the U.S. Labor Party staff.

Photo by Ulanowsky

Resources Defense Council (No. 76-419) and *Consumers Power Company v. Aeschliman* (No. 76-528). It was a unanimous (7-0) decision, with two abstentions.

Written by Justice William Rehnquist, the Supreme Court decision, criticized the Circuit Court for "improperly intruding" into the Nuclear Regulatory Commission's licensing proceedings and for attempting to substitute its judgment for that of Congress. "Congress made the choice to at least try nuclear energy," said the court, and this policy cannot be changed by exercise of judicial review. This is a judgment for Congress and for the states, not for the courts, said the Supreme Court.

This decision is a stinging defeat for the antinuclear movement, which has been allowed to run wild in the lower courts for the last seven years. Ever

since Secretary of Energy James Schlesinger (then chairman of the Atomic Energy Commission) refused to appeal the Washington D.C. Circuit Court's ruling that stalled the 1971 Calvert Cliffs nuclear plant, the courts have been used to delay the construction of nuclear plants.

This is the first time that the Supreme Court directly reviewed the application of the National Environmental Policy Act to the Nuclear Regulatory Commission, and therefore, the decision potentially can bring a halt to the use of NIPA to sabotage nuclear power.

The incompatibility of the lower court's decisions against nuclear power with the U.S. Constitution's commitment to scientific and industrial progress was put before the court in an amicus curiae brief submitted by the U.S. Labor Party.

Kintner: 1979 Budget Cuts Threaten Fusion Research

Dr. Edwin E. Kintner, acting director of the Office of Fusion Energy in the U.S. Department of Energy, warned that federal budget funding cuts for 1979 put the entire fusion research effort in serious danger of collapse.

The scientific and congressional supporters of fusion are "having difficulty convincing those in policy-making positions above and around us that fusion is worth pursuing," Kintner said. This is happening, he continued, just when the U.S. thermonuclear fusion research effort is on the verge of the long-sought goal of "scientific breakeven," a large-enough fusion reaction that would prove the feasibility of developing virtually unlimited world energy resources from the fusion process.

The demands that the ultimate "cost benefits" of fusion be precisely estimated now as a condition for continued funding, Kintner said, is tantamount to "asking the Wright brothers to cost out the 747 in advance of their first tests at Kitty Hawk."

Kintner, who was speaking at the April 7 dedication of the second generation Alcator tokamak fusion reactor at the Massachusetts Institute of Technology, cited a report issued by the International Fusion Research Council, an advisory body to the International Atomic Energy Agency: "In view of the great progress achieved in fusion since 1970, the council is convinced that the time is ripe to make a large and aggressive effort toward the practical demonstration of fusion power at the earliest possible date."

Kintner's remarks are viewed as an attack against Energy Secretary Schlesinger, who together with personnel at the Office of Management and Budget have made substantial cuts or funding freezes in the fiscal year 1979 budget for basic fusion research in promising areas. (See "Schlesinger 1979 Energy Budget Makes Fusion Impossible," *Fusion*, March 1978, P. 10.) The freeze includes projects such as the Princeton Tokamak Reactor, which is now near breakeven.

Labor Party Calls For Schlesinger Ouster

The U.S. Labor Party has requested that the Congress and President Carter review the recent conduct of Energy Secretary James Schlesinger and the Department of Energy in preparation for firing him for consistently acting against the national interest. The party urged the appointment of a secretary who would set the Energy Department on a course that will encourage energy research and development and advanced industrial policies in the national interest.

The party charged that Schlesinger has acted to: (1) sabotage the nuclear power industry and the development of controlled fusion power; (2) sabotage the coal strike negotiations and block proper contingency arrangements; and (3) implement a zero-growth program for America, encouraging policies that would deindustrialize the country.

DOE Trains Fusion Engineers

The Department of Energy's Office of Fusion Energy announced that its pilot program to train a new classification of energy specialist, the fusion engineer, had awarded certificates of achievement to the first five students to complete the one-year program.

The Graduate Education Program in Fusion Technology was conducted by Westinghouse Electric Corporation in Pittsburgh under a \$55,400 grant from the department. Another five students will be selected this year.

Under the program each student spends six months working with Westinghouse engineers on practical engineering problems related to fusion.

Sun Day: Umbrella for Antinuclear Terror

In the last few weeks before the scheduled Sun Day 1978 celebrations, May 3 through May 9, the organizers of the environmentalist campaign have made public their intentions to use violence and terrorism against nuclear power plants.

Although the Sun Day literature is geared to sell "soft" energy alternatives like windmills and biomass to the majority of Americans who believe that nuclear energy and high technology are vital for the country's future, the speeches of the Sun Day organizers leave no doubt that they plan to use antinuclear terror where environmentalist propaganda fails.

Speaking in Seattle April 5, the national chairman and originator of Sun Day, Dennis Hayes, described a typical terrorist scenario to a group of Northwest environmentalists. If legal means fail to stop nuclear power plants, this might force antinuclear environmentalists into such "drastic action" as detonating a nuclear bomb in New York City's World Trade Center, Hayes said.

In the same speech Hayes also predicted the likelihood of terrorism against the Trident nuclear submarine by the California-based New World Liberation Front.

Hayes, who is also a director of the Worldwatch Institute, is on a national tour to organize for Sun Day. The other prominent environmentalists who are on simultaneous tours of the nation are Sam Lovejoy, a convicted antinuclear terrorist, Amory Lovins of the *Friends of the Earth*, and Dr. Barry Commoner.

Lovejoy was reported by the newspaper of the antinuclear Trojan Decommission Alliance in Oregon, *The Shut Down Times*, to say: If all else fails in efforts to shut down the Trojan Nuclear Reactor, "it is conceivable that citizens could occupy or

disrupt the power lines which run from these plants."

On the so-called grass roots level, organizers of Sun Day sympathy actions in late April have admitted that they are planning to tear down fences and sabotage power lines. The actions include the nuclear plants in Barnwell, S.C. and Rocky Flats, Colo. and the Trident submarine base in Bangor, Wash.

The Drug Cult Circuit

One of Sun Day's top organizers is Tom Kay (also known as the Solar Kid), a staff member for the national drug cult magazine *High Times*. Kay, whose particular target group is the drug and religious cult freaks, was

more explicit than Hayes and Lovejoy in his call to violence. In a recent interview Kay said:

Sun Day will be the beginning of a New Age Movement... that could be the best thing that ever happened to this country... The real issue is antinuclear... We are asking that all people, as a voice against nuclear energy, turn off all their lights at 8 PM... If they don't stop nuclear energy we'll just blow them up. If it is feasible to blow up a whole system, we'll do it.

Kay was arrested by New York City police April 8 while sitting on top of a



New York flagpole. He had boasted that he planned to sit on the flagpole for at least three weeks to publicize Sun Day. Police brought Kay to the psychiatric ward at Bellevue for observation.

Investigate Schlesinger

This flagrant threat of violence makes it all the more egregious that the Sun Day event from the beginning has had the blessing and funding of U.S. Energy Secretary James Schlesinger. Schlesinger sent a signed memorandum to all Department of Energy officials Jan. 25 directing them to participate in Sun Day in all possible ways, including funding consumer and environmental groups. "The broad objectives of Sun Day are consistent with major objectives set forth in the National Energy Plan....I have designated the Assistant Secretary for Intergovernmental and Institutional Relations as the focal point for Sun Day policy guidelines," the Schlesinger memo stated.

Schlesinger also established a liaison with the Sun Day board of directors and his Washington office maintains a full literature table for the Sun Day propaganda.

Until the energy secretary retracts his official endorsement of Sun Day, the fact remains that a cabinet-level official is supporting terrorism as a means of imposing the zero-growth energy program he has failed to ram through Congress in the past year.

AFL-CIO to Campaign for Clinch River Breeder

Sources in the United Steelworkers of America union report that the AFL-CIO, the nation's largest trade union federation, has formed an energy committee to mobilize support for a congressional override of an expected presidential veto of full funding for the Clinch River breeder project. The move comes as a result of pressure within the AFL-CIO, primarily from the building trades and steel unions to go with the breeder.

Who Are the Controllers Behind

Next to Energy Secretary Schlesinger in importance in supporting Sun Day from inside the government is the three-member Council on Environmental Quality.

The council is headed by Charles Warren, a former member of the California state assembly who introduced all of the environmental proposals of Gov. Jerry Brown into the legislature. In a major article for the Friends of the Earth newspaper, *Not Man Apart*, in May 1976, Warren wrote:

....Analysts of future events have tended to divide into two groups: The Malthusians and the Cornucopians....The Malthusians argue that the sources of the world are finite, and that continued growth will eventually threaten the resource supply available for future generations; that the driving mechanism behind resource exhaustion is increased population in conjunction with increasing per capita requirements. Therefore, they conclude some form of population control is essential....I come down on the side of the Malthusians.

Working with Charles Warren on the council are Gus Speth, former international projects coordinator for the Natural Resources Defense Council who specialized in anti-nuclear operations, and Gerald O. Barney, an administrator of the Rockefeller Brother's Fund. Under fund sponsorship, Barney headed the *Unfinished Agenda* task force, a group representing every environmentalist organization in the U.S. that published a consensus report on environmental policy for the U.S. by the same name. "*The Unfinished Agenda* is the Carter energy program," Barney told a reporter last summer.

This trio is preparing a major pro-

solar policy statement timed for release before Sun Day.

The Private Controllers

Outside the government, the solar campaign is being directed by the same intelligence think tanks that financed and controlled the European antinuclear violence last year in France and West Germany. Central in the structure of control is the Aspen Institute for Humanistic Studies, which is responsible for the creation and training of much of the international environmentalist movement, including the Friends of the Earth, the International Institute for Environment and Development (based in London), the United Nations Environment Program, and Earth Day, the 1970 prototype for Sun Day. Earth Day was used as the kick-off point for virtually the entire environmental movement in the U.S.

Some of the groundwork for Sun Day was laid in August 1977 at one of typical seminars through which the antitechnology, Malthusian ideas are transmitted to an often unsuspecting group of participants. At that time Aspen sponsored four weeks of workshop seminars on energy alternatives, around the themes of "institutional and technical barriers to change," and "energy crisis implications for governments." The workshops dealt with the problems of conservation, extracting clean fuels from coal, and solar technology and in the words of Aspen's energy specialist Dana Orwick, were "designed to educate public figures" from trade unions, Congress, and corporations.

The operations center for implementing the unpublished plans and campaigns mapped out last summer is Solar Action, a newly formed group whose board of directors is composed of leading environmentalist leaders, some top labor officials, and elected officials. These include David Brower, the founder of Friends of the Earth;

Sun Day ?

Michael McCloskey, head of the Sierra Club; Alan McGowan, director of the Scientists Institute for Public Information, an antiscience propaganda center founded by environmentalist Barry Commoner; William Winpisinger, head of the International Association of Machinists; Douglas Fraser, president of the United Auto Workers and a trainee of the Aspen Institute; Wilson Clark, solar energy advisor to California Governor Brown; Congressmen James Jeffords (R-Vt.) and Richard Ottinger (D-NY); John A. Harris IV from the zero-growth Club of Rome; and Denis Hayes, from the Worldwatch Institute, a Malthusian organization that is a leading supporter of environmental terror tactics and economic warfare.

To build up Sun Day participation, Solar Action has commissioned the full activation of the "Woodstock Nation" zombie drug culture, via *High Times* magazine, a nationwide drug publication that provides the latest tips on drug running, new drugs, and the counterculture.

After May, Solar Action will consolidate a series of permanent antitechnology institutions. Most prominent of these is a national energy coalition organized out of the Midwest Academy in Chicago. The academy is a local community control training school directly linked to the Institute for Policy Studies, the umbrella group that has spawned the bulk of the antinuclear environmentalists and terrorists.

The national energy coalition, whose sponsors say it is designed to provide the image of a mass-based grassroots institution that will "have enough muscle to influence legislation on national energy policies," will be chaired by IAM head Winpisinger. It has already received \$15,000 in seed money from the Ottinger Foundation.

—Stuart Pettingell

The Sun Day Bankroll

According to the Sun Day national office, the most extensive single funder of the multimillion dollar event is the Department of Energy under James Schlesinger. (Despite this fact, many environmentalists criticize the secretary for being "pronuclear.")

Schlesinger's office is underwriting the entirety of the public service advertising for Sun Day on radio and television — an amount that is unspecified.

In addition, the department has given \$180,000 to the national Sun Day office to pull together a state-by-state evaluation on the use of solar energy. The study will include both a review of resources available in each state and the "barriers" to the solar projects.

Local offices of the department have funded state and city Sun Day events, in amounts that are unspecified.

Sun Day's national office has stated that the rest of the funding for the event has come in amounts of about \$10,000 from private foundations and think tanks that fund and control most of the environmentalist activities. Among these are the Stern Fund, the Ottinger Foundation, and the Field Foundation.

Teller: Fusion Hybrid by 1988

Noted nuclear physicist Edward Teller told an audience at the Nuclear Engineering Department at Purdue University April 11 that the fusion-fission hybrid is closer to being implemented en masse than the fast breeder reactor. "You can't imagine how close we are; within 10 years the hybrid can be as widespread in use as the light water reactor is today," Teller said.

Teller called the worst "energy hazard" today the danger of World War III: "Poverty leads to despair, despair to hatred, and hatred to war. I have accused others of scaring people but I have seen World War I and World War II and I am scared of World War III. We cannot abdicate our responsibility for the development of the Less Developed Countries."

It is not true that the rich get richer and the poor get poorer, he said. The use and export of more advanced technology by industrialized nations have actually made the Less Developed Countries richer, in-

creasing their energy consumption fivefold.

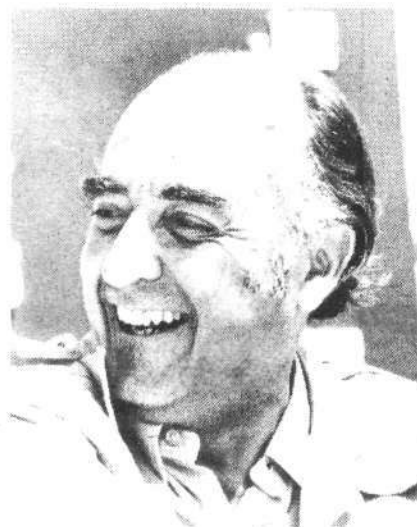
Teller criticized the environmentalists, in particular Ralph Nader, Barry Commoner, and James Schlesinger for chipping away at the American tradition of energy growth and high technology. Ralph Nader put seat belts in cars, Teller said, but that was the "first and only good thing" he has ever done.

As for the bugbear of nuclear safety, Teller said: "It never fails that when I give a speech on nuclear energy there is at least one person who asks, 'What if the plant explodes?' and I always answer that it would take the repeal of the laws of physics to have one explode. Then the same person invariably asks, 'Yes, but what if it explodes?'"

Schlesinger was the only secretary of defense to support the counterforce doctrine against the Soviets, and now he's in the energy department with similarly incompetent ideas," Teller said.

Mexico to Use Gas Revenues for Industrial Growth

Mexican President
Jose Lopez Portillo



In a series of recent speeches, Mexican President Jose Lopez Portillo and his top ministers have announced an aggressive development policy for investing the nation's growing surplus revenues from gas and oil exploitation into industrial projects that will further increase Mexico's productive capacity. "Mexico is fortunately entering a stage which in the near future will allow us to have the resources to increase our resources," the president said March 31 in Chihuahua.

This program for expanded production has been made possible by the phenomenal growth of Mexico's oil industry. The recently released report of the state oil company, Pemex, stated that the country's proven petroleum reserves had jumped from 11 billion barrels last year to 16 billion barrels this year, while the probable and potential reserves are now calculated at 120 billion barrels. The growth of the industry is so rapid that Pemex expects to reach its 1982 output goal by 1980: 2.25 million barrels a day, of which 1.1 million barrels are slated for export.

Mexico must exploit these resources, Lopez told a group of industrialists in the northern state of Coahuila, so that industrialists can plan "large development projects with ambition and vision." The guiding principle is to use energy resources for the kind of industrial development, particularly capital goods, that will

benefit all the population and "pay old debt... of social justice," Lopez said.

Lopez has made it clear that the next phase of energy development must be nuclear power, but to date the government has not defined an immediate crash program to reach this next phase. Congressional hearings are now under way on Mexico's nuclear policy.

Schlesinger Interferes

The major attack on the Lopez development program has come from U.S. Energy Secretary James Schlesinger, who has personally tried to sabotage both Mexico's nuclear power program and its gas exports. Earlier this year Schlesinger intervened to halt a Pemex sale of natural gas to the U.S., thereby cutting off export revenue for Mexico

and badly needed energy supplies for the U.S. More recently, Schlesinger announced that he would withhold Mexico's supply of uranium scheduled for use in the nuclear plant Laguna Verde, which comes on line in 1982, until Mexico meets his so-called safety conditions.

The Lopez government has not directly attacked Schlesinger's anti-nuclear policy, but the government's attitude is reflected in Mexico's press. Mexico has no intention of linking its energy development to "package deals" on issues such as the question of undocumented alien workers, wrote the editorial page editor of the Mexican daily *El Dia*, Jorge Aymami. These are "conjunctural issues" that should not lead us "to mortgage our energy wealth... The question of nuclear energy is simply not negotiable."

Velikhov: Joint U.S.-Soviet Fusion Work

Dr. E.P. Velikhov, the head of the Soviet fusion program, is quietly circulating proposals within the U.S. Department of Energy to vastly expand U.S.-Soviet fusion cooperation. Velikhov, in Washington for an April meeting of the Joint U.S.-Soviet Committee for Scientific and Technological Cooperation, pointed out in private discussions that the world's fusion effort could be dramatically accelerated and its cost decreased if both nations jointly designed and built a demonstration fusion reactor to come on line by the early 1980s.

Velikhov suggested the construction of a prototype commercial reactor, possibly in a third country — Japan, Finland, or East Germany.

Brazil-West Germany Nuclear Deal Jeopardized

Although West Germany and Brazil reaffirmed their nuclear cooperation agreement in a joint communique issued in March, internal developments in Brazil, backed up by a faction in the U.S. National Security Council, now threaten to sabotage the deal.

During Brazilian President Ernesto Geisel's five-day visit to West Germany he signed a reaffirmation of the multimillion dollar nuclear deal with Chancellor Helmut Schmidt as well as agreements with the West German nuclear industry. However, Geisel's chosen successor, General Jose Figueiredo, the chief of the Brazilian National Intelligence Service, decided at the last minute not to accompany Geisel. Figueiredo's absence is viewed as a severe blow to the cooperative development program since most of the fission and reprocessing plant construction under the deal would begin after Figueiredo assumes the presidency in 1979. Furthermore, the snub is seen as a clear sign that the president-designate opposes nuclear power.

The content of the joint agreements are extremely positive in their orientation toward development as the key to world peace. As the joint communique stated, both nations "attach great importance to extension and intensification of economic, industrial, scientific, and technological cooperation which is the keystone of relations between the two countries."

During Geisel's visit, the two nations reconfirmed their original 1975 nuclear trade agreement, despite heavy-handed U.S. pressure to modify it, and Geisel signed a new agreement between the Brazilian Atomic Energy Commission and the Karlsruhe Nuclear Research Center that sets the stage for cooperation in nuclear reactor safety, protection from radiation, and the disposal of nuclear waste.

Reliable Washington sources report that a faction close to U.S. national security advisor Zbigniew Brzezinski is behind the recent opposition in Brazil to the nuclear development program. According to these sources, Robert Pastor, chief Latin American advisor for the National Security Council, has boasted that the council intended to use Brazilian dissidents to phase out the nuclear deal during Figueiredo's term, which begins next year.

Shortly after the Pastor statements, Jose Goldemberg, the head of the Brazilian Physicists Society, charged that lack of safeguards in the planned reactor construction will inevitably result in "a repetition of the catastrophe of Hiroshima." The Goldemberg remarks followed an equally spectacular newspaper leak of what were allegedly secret documents of the National Intelligence Service on

71 fires and accidents at the construction site of Brazil's first nuclear reactor, Angra I, being built by Westinghouse. Indications are that presidential designate F. Guereido, head of the intelligence service, had a hand in leaking the documents to the daily *O Estado do Sao Paulo*. Figueiredo has met several times with Goldemberg.

Ironically, the Brzezinski-led sabotage of Brazil's nuclear development program uses as a cover the unscientific argument that commercial nuclear reactors mean nuclear weapons "proliferation" which means war. At the same time, his program for Brazil is one of military confrontation, pushing Brazil along with South Africa into a South Atlantic Treaty Organization that can defend the Atlantic against a presumed threat from the Soviet Union.

—D. Goldberg



Brazilian Foreign Minister Azerado da Silveira [l] and West German Foreign Minister Genscher signing the nuclear deal.

The Industrial Development Of Southern Africa

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Colombia To Exploit Uranium, Nuclear Power

"Within a period of six years Colombia will have its first nuclear energy plant to deal with the country's growing demand for energy and to substitute for sources of energy that are running out," the Colombian Minister of Mines and Energy told last month's founding meeting of Coluranie, the Colombian Uranium Company. The state company will be in charge of studying, prospecting, exploring, and exploiting Colombia's rich uranium reserves.

Mines and Energy Minister Eduardo Gaitan Duran has recently signed a series of agreements with France, Spain, and West Germany to exploit the country's uranium reserves. The mountainous Andean country, which has large known uranium reserves in its eastern range, declared more than 80 percent of national territory as a special reserve zone for uranium exploration.

The Schlesinger Opposition

To counter Colombia's push to develop high technology and train workers for the nuclear industry, U.S. Energy Secretary James Schlesinger sent department undersecretary Dr. Fredric I. Ordway to the March 6 conference sponsored by the Colombo-American Institute in Bogota. Ordway pushed the necessity for underdeveloped nations to use solar, wind, and wave energy as alternatives to nuclear energy and told the conference that Colombia needed these "appropriate" technologies as well as conservation since nuclear



Eduardo Gaitan Duran

energy was "not feasible until the year 2020."

The Fusion Energy Foundation representative at the conference put forward a program for the immediate construction of three nuclear power plants, one on the Atlantic coast, one in the Valle de Cauca, and one in the Llanos Orientales region.

Colombia Daily Endorses Fusion

The leading Colombian daily *El Tiempo* strongly endorsed the struggle to commercially produce unlimited energy through the fusion process in an editorial April 3. Labeling recent breakthroughs in plasma technology a significant advance for science and for humanity, *El Tiempo* wrote: "Achievements like that of the conquest of space through spaceships and satellites, which will permit the domination of the solar system; the genetic manipulations that will transform the functions and forms of organisms; thermonuclear fusion that will definitively resolve the energy problem... will bring this century to a close on a golden note, defining in a decisive way the destiny of man."

Parliament OKs Windscale Reprocessing Plant

The British House of Commons gave the government a resounding three to one endorsement March 23 for the construction of a new 1,280 ton spent nuclear fuel reprocessing plant at Windscale. The 186 to 56 vote followed a three hour parliamentary debate on the development of the project and culminated a 100-day public inquiry into Windscale.

Last month Justice Parker released an official report on the results of the inquiry giving unequivocal approval to the development of the reprocessing facility. The Parker Report drew the wrath of the Friends of the Earth and other antinuclear groups who had demanded and then prolonged the inquiry. Reportedly the Friends group alone spent \$2.5 million to provide testimony on the alleged proliferation and environmental dangers of a reprocessing facility.

Parker dismissed the environmentalist arguments stating that "a country which depends for its nuclear reactor fuel supplies on imports, is in a vulnerable position both financially and politically." Parker also noted the "plain financial advantage" to be derived from the British construction of the Windscale facility.

France is currently the only country that has given a full go-ahead to commercial reprocessing at its Le Hague facility, and the British government's decision to go with Windscale is clearly a political and financial lever to wield against French domination of a growing multibillion dollar international reprocessing market. Japan has signed a several billion dollar reprocessing agreement with France and has been negotiating a similar accord with Britain pending outcome of the Windscale inquiry.

Howls from the U.S.

The response of the Carter Administration to Windscale has been muted howls of protest. The U.S. so far has implemented the policy recommendations of the Ford

Foundation and the MITRE thinktank calling on countries to abandon development of reprocessing and fast breeder reactors for what are alleged to be the special susceptibility of such plants to weapons proliferation.

Senators Percy, Glenn, and Ribicoff, sponsors of the Nuclear Nonproliferation Act of 1978, wrote a letter to President Carter protesting the British decision, while Joseph Nye, a major participant in the Ford-MITRE study before he became undersecretary of state for non-proliferation matters, sent a formal letter of protest to British Foreign Secretary David Owen.

In his remarks to Parliament before its vote, Owen wryly took note of the U.S. protest: "As one who, as the House knows, supports the United States on many issues, I am not afraid openly to acknowledge the fact when, on some grounds, I think it has been wrong." Owen added that Britain agrees with the U.S. aim of limiting international spread of reprocessing plants, but believes that "we can best achieve this by offering other non-nuclear weapon states the services of the new plant at Windscale."

Regardless of the political motivation behind the British government's

decision to go ahead with Windscale, the Parker report is a useful counter-attack on the destructive U.S. policy of halting its own reprocessing and breeder development. Parker tears apart the arguments of the environmentalists, pointing out a number of factual "untruths" put forward by the antinuclear groups and rejecting their claims on the basis of extensive scientific evidence.

Arguments calling plutonium "the most dangerous substance known to man, a Faustian bargain with the devil" are pure "emotive nonsense," Parker stated. Plutonium is *not* highly radioactive and it is not true that its only two uses are making bombs or making commercial electricity; Pu 238 is used in the body as power source for heart pacemakers, Parker pointed out.

As for the greenie scare story that a leak of plutonium would be a "unique disaster", Parker said the damage done by breaking open a chlorine tanker, to take one example, would be far more damaging. Although plutonium has been produced and moved around the world for more than 25 years, he said, there has never been any known terrorist attempt.

— W. Engdahl



The Windscale plant in Cumbria: Parliament says yes.

Special Report

Upgrade The U.S. Breeder Program

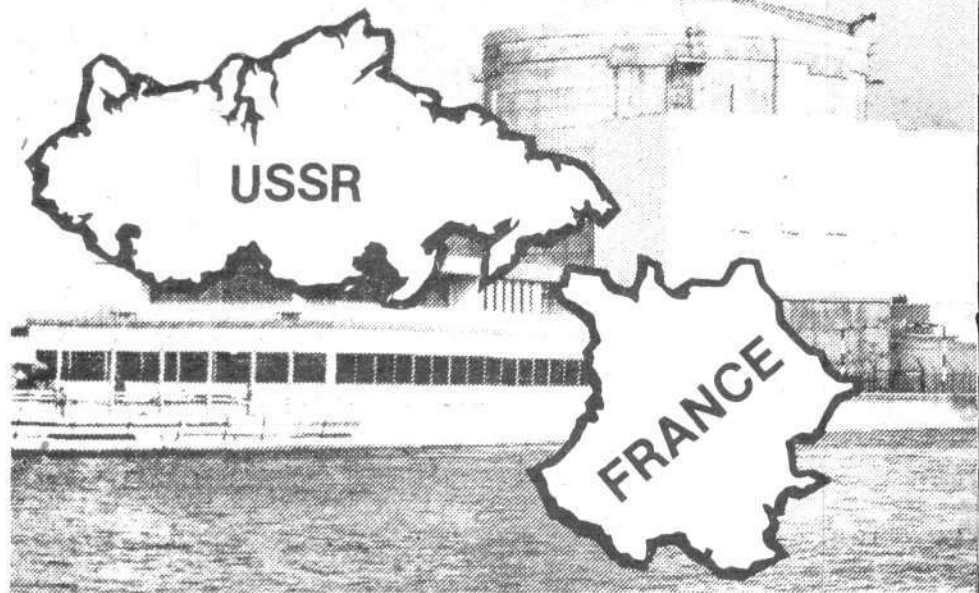
FEF Policy Statement On Clinch River

The energy policy of the Fusion Energy Foundation specifies an immediate crash program in thermonuclear research and development plus full use of the most advanced fission technologies to ensure adequate energy resources to take us to a fusion-based economy in the 1990s. This policy statement on the U.S. fast breeder program was prepared by FEF nuclear engineer Jon Gilbertson and was circulated on Capitol Hill in early April.

Introduction

An old proverb goes, "When you're given only two choices, always take the third." That is what Congress and the administration must do to solve the crisis of the U.S. breeder reactor program. This crisis is now focused on the decision of whether to go ahead with or terminate the Clinch River Breeder Reactor Program.

The Fusion Energy Foundation has drafted this policy statement for immediate enactment and implementation by Congress and the administration. It is designed to save the nation's future nuclear capabilities by breaking the deadlock on the breeder issue. The essential policy criteria upon which it is based are as follows:



(1) The U.S. will not have adequate energy supplies in the near future and cannot realize the necessary economic benefits of large-scale nuclear exports, unless research programs achieve solutions closing the nuclear fuel cycle with rapid development of fuel reprocessing (by 1980) and a commercial plutonium breeder reactor (by the late 1980s).

(2) As a result of past delays in the U.S. program and vigorous efforts by other nations, which have moved ahead of the U.S., the Clinch River project has to be upgraded or superseded with more advanced technology if the U.S. is to regain a leading position in nuclear technology.

(3) The upgrade policy must be implemented *immediately*. U.S. breeder efforts must not be "studied" to death under the rubric of environmental, strategic, or other cautions. The available options are well known, and final policy can be effectively determined in a few months.

(4) It is critical to keep the entire Clinch River staff (as well as staff from all other major nuclear projects) intact while upgrading is underway.

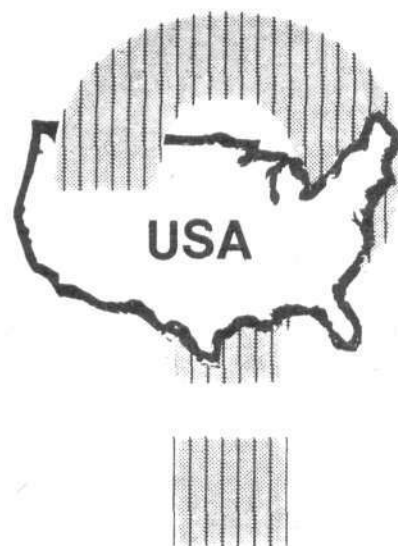
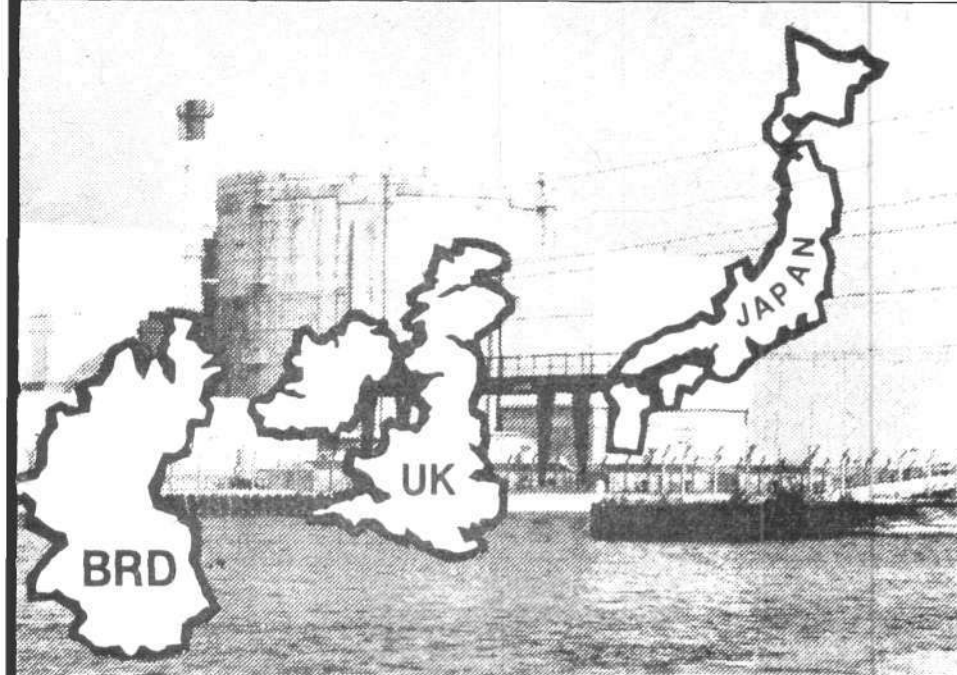
(5) The upgrading, by incorporating "proliferation-proof" processes and consolidating cooperation among the nuclear powers, can better achieve the goal of secure fuel supplies for all nations while further minimizing the already small possibility of diversion of

nuclear reactor material to weaponry.

Over the past two years, the U.S. fast breeder program has deliberately been thrown into a state of disarray by the Schlesinger forces in the administration and President Carter's susceptibility to their zero-growth programs. It is high time for Congress to make a reassessment of the situation and get this country back on the track of development and world technological leadership. To do this, it is necessary first to review the history of the U.S. Liquid Metal Fast Breeder Reactor (LMFBR) program over the past 10 years relative to the rest of the world.

The early planning stages of the Clinch River project were initiated in 1968-69, at a time when most other leading nuclear nations were either planning or just beginning construction of similar prototype demonstration plants. Prior to this time, the United States had built and operated four different fast-breeder-related test reactors of relatively small size. This gave the U.S. an undisputed world lead in LMFBR development. That process began in the early 1950s with the 0.2 MWe Experimental Breeder Reactor-1 (EBR-1), followed in succession by EBR-2 (20 MWe), the Enrico Fermi Fast Breeder Reactor (66 MWe), and the Southwest Experimental Fast Oxide Reactor (20 MWe), all three coming into operation in the late 1960s.

Also in the mid-1960s, the design of



a large fast reactor fuel test facility (FFTF-400 MWt) was initiated, with construction beginning in 1970. This reactor, after many delays, is now expected to begin operations next year. In the late 1960s, when Clinch River was conceived, the U.S. was without a doubt leading the world in this advanced technology and was in an excellent position to maintain that lead.

In the 1970-1972 period the Clinch River program was put together as a joint government-utility industry project with official joint venture agreements signed in 1972. By the end of 1972, Westinghouse had been chosen as the prime reactor contractor with Burns and Roe, Inc., the architect-engineer for the project. Final reactor design started at that time. The next four years saw a series of licensing-related delays that essentially prevented the initiation of any serious construction. The past two years have been a nightmare of administration sabotage. The Clinch River project is now on the verge of destruction and the U.S. LMFBR program is falling farther and farther behind the rest of the world.

Foreign Breeder Programs

In the same 10-year period all other leading nuclear nations have taken on aggressive fast breeder development programs. At least three nations have surpassed the U.S. while two more threaten to do so in the near future.

France, the United Kingdom, and the Soviet Union, already have 250-350 MWe prototype LMFBRs in operation, which are similar in size to the Clinch River plant. Some of these reactors have been operating for several years; the French Phenix achieved full power in 1974, over four years ago. The Soviet BN-350 finally achieved full power in mid-1976 after a few years of reduced power operation because of steam generator problems, while the British PFR reached full power operation in early 1977. The design for the French, British, and Soviet LMFBR plants had to be reworked in several problem areas, particularly the intermediate heat exchangers and steam generator, but now these three plants are working well, and a wealth of valuable design information and maintenance experience has been gained which will make all future designs that much better.

As would be expected, the Europeans also have a commitment to commercial size LMFBRs and are aggressively pursuing the design and construction of these plants. The first commercial plant, the Soviet Union's BN-600, is scheduled for start-up this year while construction on the larger 1,200 MWe French Super-Phenix plant started in 1976 and is scheduled for a 1982 start-up. France has now scheduled the start of construction of two additional Super-Phenix type LMFBRs of a 1,500 MWe size for 1980. The British CFR-1, a 1,300 MWe plant, is

on the drawing boards and waiting for a go-ahead on construction that is expected this year.

Surpassing The U.S.

West Germany and Japan both have a very active prototype demonstration plant project and also will probably surpass the United States if the U.S. program is not quickly moved forward. The German SNR-300 is well into the late stages of construction and is scheduled for start-up in 1980. Japan last initiated construction of its 300 MWe Monju reactor which should achieve start-up in 1985. Both countries, of course, have commercial-size reactors planned to come on-line in the late 1980s.

It should be emphasized that these countries are committed to fuel reprocessing and therefore, an economic and efficient closed fuel cycle. The fast breeder, as all these governments know, is an essential part of this closed cycle. These governments therefore see the recent "antiproliferation" actions of the U.S. as preposterous and stupid.

The plutonium to start up the first generation fast breeders must come from the spent fuel rods of the light water fission reactors via the fuel reprocessing plants. Therefore, a parallel commitment to develop such commercial facilities is an absolute requirement well understood by these nations. For example, the government of Great Britain has recently decided

to greatly expand its Windscale reprocessing plant so that the plant can handle not only its own spent fuel but a portion of the rest of the world's fuel as well. France has similar reprocessing capabilities and is now expanding its La Hague facility. Japan just committed itself to a second reprocessing plant, this one a 1,500 metric ton/year unit, which is large enough to service nearly 40 light water reactors of 1,000 MWe each. The Soviet Union has similar capabilities and West Germany is committed to constructing them in the future.

To indicate the confidence these countries have in their breeder programs, the latest estimates of number of commercial breeders to be installed by the year 2000 are: France, 15; Germany, 7; and the United Kingdom, 8. Several of these breeders, especially for France, are expected to be export sales.

Where Is the United States?

What is the situation in the United States? Almost two years ago, all funds for commercial breeder design studies were canceled by the administration, bringing to a halt the joint ERDA-Electric Power Research Institute projects that were then in progress. This terminated all commercial-oriented LMFBR design activity for the major reactor manufacturers in this country. After 30 years of LMFBR development in the United States, we now have no plans for its commercial introduction — while the rest of the world moves quickly forward!

The decimation of the breeder proper of course is an objective that has been stated several times by the Department of Energy head, James Schlesinger. In his proposal March 17, which has now been adopted into a legislative amendment by Rep. Walter Flowers, chairman of the subcommittee on fossil and nuclear fuels, Schlesinger calls for the termination of Clinch River while pursuing design studies on alternate breeder concepts of a larger size. He clearly states that "It is premature to commit to build such a facility; but intensified studies and design efforts will give the base program the direction needed to

maintain a strong breeder option."

At this late date calling the breeder an option is like saying that producing food in the U.S. in the 1980s is optional.

Schlesinger's March 17 statement is almost identical with similar policy statements that passed my desk 15 years ago at General Electric when serious work on commercial breeders was beginning in this country. At that time the second round of 1,000 MWe commercial LMFBR design studies was just getting underway, involving all the major U.S. reactor manufacturers. Schlesinger's policy takes the U.S. back to ground zero again with no energy commitment to the future.

What the U.S. Must Do

Congress has only two choices before it at this time. It can move immediately into the construction of the Clinch River Breeder Reactor while simultaneously developing a commercial design of the 1,000-1,500 MWe size for a commitment to construction in the early 1980s; or redesign the Clinch River Breeder Reactor into a more updated and larger plant based on the experience gained in the foreign breeder programs as well as in the United States, with a firm commitment to begin construction of this plant in one to two years after preliminary designs are completed. This plant would be a near-commercial size demonstration plant and therefore would bypass the smaller 300-400 MWe prototype reactors such as Phenix, BN-350, and PFR which are already operating.

Both options require that Congress break the stalemate on spent nuclear fuel reprocessing and make a firm commitment to move forward with the Barnwell, S.C. reprocessing facility as well as others.

The first option is straightforward and consists simply of implementing and accelerating the already existing Clinch River Breeder program for a 1984-1985 start-up date. However, this must be further tied to a firm commitment and schedule for development of a commercial sized LMFBR. Design studies of this commercial plant should commence immediately in fiscal year 1979 with a

target date for beginning of construction in 1984 at the latest. This will enable factoring into the design the information and experience gained from the first two years of Clinch River operation. This commercial demonstration plant will also take into account all the design and operating knowledge accumulated in the foreign breeder programs. Such a plant will be essentially an American-designed and developed breeder and would come on line in the 1990-1991 period.

The second option is a bit more tricky and more of an economic risk than the first; however, in the long run it may cost less and provide a commercial LMFBR sooner. It is generally well known among knowledgeable people in the nuclear industry that because of the six to eight year delay in the Clinch River program and the rapid acceleration of foreign breeder programs, Clinch River is a somewhat outdated design and in some respects does not now represent what is thought to be prototypical of a commercial plant. For example, its breeding ratio is too low, its doubling time too high, and its steam generators are outmoded. All of these factors tend to reduce its economic incentive and benefits if commercial reactor criteria are applied as the basis for judgment. However, a prototype LMFBR should not be judged only by its economic characteristics. One of the most important purposes of such plants is to prove that safety requirements can be met and that it can operate successfully at high load factors. Clinch River was designed with these criteria in mind, as were the other prototype plants that are now in operation. None of these reactors produces electrical power at competitive prices. This job is left up to the more advanced and larger commercial varieties.

An American Super-Phenix

However, with this in mind, and the fact that LMFBR technology has advanced considerably since the Clinch River project was initiated in 1972, it may be appropriate to start with a new design and go directly to a

near-commercial size fast breeder in the 650-900 MWe range. This plant, called here the Commercial Demonstration Breeder Reactor, would be built on the Clinch River site and would rely heavily on the experience gained from the foreign prototype breeder designs and operating experience as well as the up-to-date information from the U.S. program. In fact, this plant is likely to be an American version of the French Super-Phenix reactor — a plant for which at least two U.S. reactor manufacturers have been attempting to obtain licensing arrangements for over the past four years.

This, or some similarly conceived reactor, could be designed within a one to two year period and be ready for construction no later than mid-1980 given the appropriate U.S. commitments and foreign agreements. The plant could then be in operation by 1987 at the latest — two to three years later than Clinch River is expected on line according to the current schedule. Most of the Clinch River reactor components should be completed and tested in the sodium test facilities in order to gain this valuable test data, while the rest of the Clinch River design team should remain intact and be put to work on this new project.

This plant will depend on working out the appropriate information exchange programs with France, the Soviet Union, or Britain. In addition, licensing arrangements between these countries and the U.S. reactor manufacturers will have to be completed. As for the nation-to-nation technical exchange agreements, this should present no problem since several similar arrangements have already been signed. In 1977, the Soviet Union and France, and France and West Germany signed such agreements. Prior to that, France had entered into agreements on Super-Phenix with a consortium of European countries including Italy, Belgium, Switzerland, and West Germany. Such arrangements with the U.S. should include our offering of information on fusion and fusion-fission research since the U.S. is far ahead of Europe in these areas.

The plant described here will be a more efficient, optimized breeder than Clinch River and therefore more economical per megawatt of power produced. It does potentially run a greater financial risk (if it fails) since it is larger by two times than Clinch River and therefore has a higher total cost. However, reliance on foreign experience can reduce that risk considerably since the safety and most of the operating risks have already been resolved in their prototype plants.

Fuel Reprocessing

Finally, as part of its nuclear package, Congress must move forward the development and construction of fuel reprocessing plants in the U.S. and complete the job of closing the fuel cycle. Preliminary results from the International Nuclear Fuel Cycle Evaluation, a 44-nation, two-year study started in 1977 upon President Carter's request, have already confirmed that the study will come out with a firm recommendation for the uranium-plutonium fuel cycle. It is imperative that Congress do its part by giving the green light and funding for construction of national and international Purex reprocessing centers for light water reactor fuel such as the Barnwell facility. Furthermore, the development of CIVEX reprocessing

facilities for fast breeder fuel should be immediately initiated so that they are available when breeders begin coming on line in significant numbers. The CIVEX facility is essentially "proliferation-proof." It therefore can be readily exported to any country that needs a facility or can be built as international centers.

The U.S. needs *no more alternative study contracts!* LMFBRs have been studied nearly to death in the U.S. and Schlesinger is planning to complete the job. The thorium cycle is not an alternative to the uranium cycle. It instead must be developed in series with and as an integral part of the uranium cycle. Plutonium-fueled fast breeder reactors are the only economically feasible method to bring the thorium cycle into existence.

Congress have all the answers and ammunition needed to justify a total U.S. commitment to nuclear power and the fast breeder reactor. A revived awareness of the direct connection between energy, nuclear power, U.S. exports, and our economy is becoming evident publicly in the recent statements of some administration members. It is now time to make this awareness concrete by supporting a fast breeder program similar to that outlined here. The world is asking for the U.S. to act quickly.

Read the Historic Argument That Won the Supreme Court Case for Nuclear Power!

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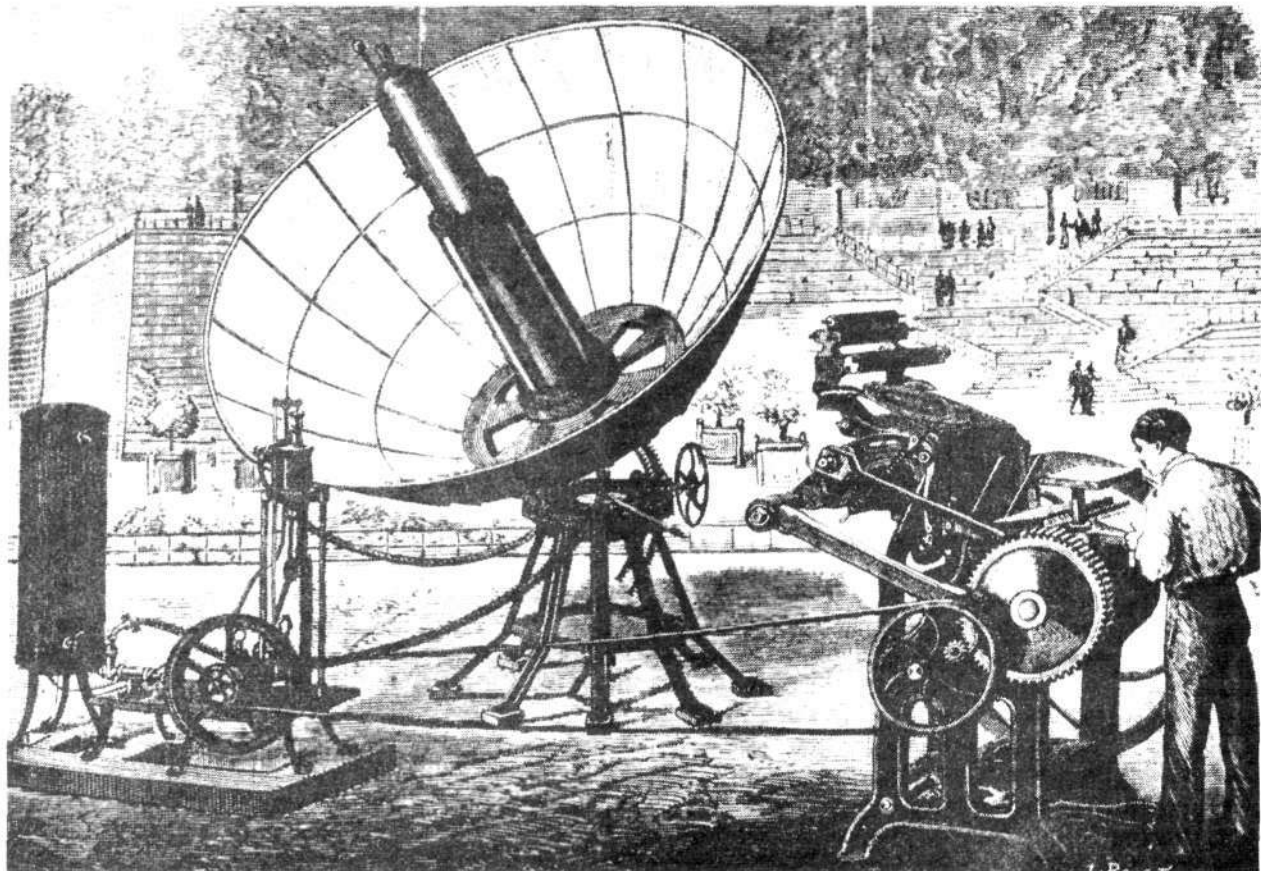
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A solar printing press, circa 1878

Solar Energy Is a Hoax

by Eric Lerner

ALTHOUGH THE ZERO-GROWTH environmentalists have concocted a litany of sun worship to convince red-blooded Americans that they will like returning to the happy, quiet life our ancestors enjoyed in the Age of Firewood, the plain fact is that solar energy is a fraud. It is the most impracticable and expensive method of energy-generation known.

Let's look at the basic assertion of the sun-worshippers — that solar energy is "cheap" or even "free" energy.

The cost of any energy source depends fundamentally on the energy density of that source. That is, the more energy that passes through a given collecting surface per unit of time, the less material, labor, and capital will be needed to collect a given amount of energy.

Solar energy is so expensive because it is so very diffuse, requiring vast amounts of material and labor for its collection.

On earth, the average available solar energy amounts to 200 watts per square meter. By comparison, the energy density in a conventional fossil fuel generator is 10 million watts per square meter or 50,000 times more. The energy density of nuclear energy, both fission and fusion, is still higher.

Typical prosolar "science" articles such as physicist Frank Von Hippel's in the *Bulletin of Atomic Scientists** carefully avoid exactly this crucial point. This is scarcely surprising since solar energy is in fact at least 10 times as costly as any other energy source.

Let's take as an example a solar energy collector capable of supplying New York City with the 10,000 megawatts of electrical demand it now requires.

Using the most efficient designs (which focus sunlight from thousands of huge mirrors on a boiler to generate electricity), maximum conversion efficiencies of 30 percent could be achieved, or 60 watts of produced power for every square meter of mirror. For 10,000 megawatts, 160 square kilometers of mirrors would be required. Including access roads and other space, a total of about 320 square kilometers or 130 square miles (more than one-third the total area of New York City) would have to be used for this glass pyramid! Approximately 4 million tons of glass, steel, and concrete would be consumed in its construction and more than 1 million man-years of labor would be required. The *minimum* capital requirements would be \$100 billion. By comparison, nuclear energy for all of New York City's electricity supply would cost less than \$10 billion. If we went whole hog and attempted to convert the U.S. totally to solar energy, as Von Hippel suggests, the result would be even more economically fantastic.

The Poverty of Barry Commoner

The chief guru of the sun worshippers, Dr. Barry Commoner, has perpetuated the lie that solar energy is cheap in his very unscientific book, *The Poverty of Power* ** which serves as the environmentalist bible. As a brief review of Commoner's assertions will show, this guru is either a charlatan or a conscious liar; there is no other way to explain his erroneous views.

To take just two examples, Commoner asserts that solar energy is more efficient than nuclear power and that it will create more jobs.

Commoner begins with the question of efficiency and immediately makes total hash out of physics. The basis of our scientific knowledge of energy, he says, is the famous Second Law Of Thermodynamics. According to this law, the universe is running down, increasing disorder and entropy. Every time we use energy, we reduce its ability to do work. Therefore, Commoner sagely concludes, we must use as little as possible, and use energy as efficiently as possible.

But we have not understood how to measure efficiency in a way consistent with the famous Second Law. We need a new measure of efficiency — Second Law efficiency. Using this wonderful new measure of efficiency, Commoner arrives at a most astonishing conclusion — the closer the temperature of the source of energy is to the temperature of the end use of energy, the more efficient is the use of energy. Therefore, Commoner scientifically concludes, it is highly inefficient to use a fission reactor, or even worse a fusion reactor, to produce energy at thousands or even millions of degrees, when that energy goes only to let's say, heat a house at a few tens of degrees. All those degrees will be wasted! However, it is highly efficient to use solar energy, which arrives at the earth very diffusely and at low temperature, to do the same task.

Dr. Barry Commoner

Thus, Commoner science tells us that solar energy is cheaper and more efficient than nasty, dirty radioactive nuclear power.

The actual efficiency of any energy system is just the opposite of Commoner's wonderful new "Second Law efficiency." The *higher* the temperature of the source of energy, relative to the surrounding environment, the greater the efficiency of energy production and use, regardless of the eventual end use temperature. The reader can test this concept by imagining the energy required to heat the water for his shower, if the flame heating it were only a few degrees above the temperature desired, as compared with the quick heating of a boiler flame. Evidently in the first case it would be a long wait for a shower — most of the heat would be wasted heating the environment — while in the other case the water would be quickly heated with little heat wasted.

Thus, solar energy, with its low temperatures cannot reach much above 20 percent efficiency (at best), while fission operating at thousands of degrees can reach up to 50

*Frank Von Hippel. "Toward a Solar Civilization." *Bulletin of Atomic Scientists* (October 1977).

** Barry Commoner. *The Poverty of Power*. (New York: Bantam 1976).



\$100 BILLION INVESTMENT IN SOLAR VS HARD TECHNOLOGIES

Solar Plan	Solar Heating	Solar-Electric
Investment	\$50 billion	\$50 billion
Jobs Input	4,000,000	500,000
Replacement Energy	2.5 MBDE	10 GW
Net Energy Growth	-2.1 MBDE	-5 GW
Percent Energy Growth	-6	-2
Net New Jobs	-4.2 million	

Hard Technology Plan	Fossil	Nuclear
Investment	\$50 billion	\$50 billion
Jobs Input	150,000	240,000
Replacement Energy	2.5 MBDE	10 GW
Net Energy Growth	6.5 MBDE	50 GW
Percent Energy Growth	18	18
Net New Jobs	7.2 million	

MBDE—million barrels per day equivalent
 GW—gigawatts electricity



A solar society is not a sunny future. As the table shows, a \$100 billion investment in solar technologies would take away both jobs and energy. Left: Environmentalists are teaching these Nile Valley villagers how to enjoy a solar campfire instead of modern technology.

percent efficiency, and fusion operating at tens of millions of degrees can potentially reach 90-95 percent efficiency.

Commoner and Cheops

Commoner also raises at length a favorite argument of the solar advocates: Solar energy has a low labor productivity and is labor intensive, and the more labor intensive a technology is, the more employment is created. Commoner goes even further to say that the basic reason for our present economic crisis, with its mass unemployment and shortages of capital, is *too much technology*.

The fact is that any program to "create jobs" by lowering labor productivity will necessarily lower per capita consumption at the same time, bringing it back to and below the levels of the last depression. *What creates jobs is the supplying of more energy for the faster growth rates required by an expanding economy.*

We apply the basic measure of *self-expansion*: the question is how many workers are used to create how much energy, which in turn creates how many new jobs? The better energy source is one that has the highest job reproduction.

If mere job creation were the aim, then why not go whole hog and simply build regular, old-fashioned stone pyramids, rather than Commoner's glass ones for solar energy? Pyramids have an even more labor-intensive ratio of jobs per unit of energy produced — they produce no energy at all! And what, after all, is basically wrong with building pyramids today? The exact same thing that was wrong with them when some early Barry Commoner first suggested the idea to Cheops. They divert essential labor from the *reproduction and expansion* of the society to non-

productive waste, thus destroying the ability of the population to survive.

Just as the building of the original pyramids diverted work from maintenance of irrigation infrastructure and led to the inevitable collapse of food production and population, so the building of solar pyramids would divert resources from the maintenance and expansion of our real energy supplies, leading to a similar but more rapid collapse of American society.

In short, solar energy represents a program for *negative reproduction* — a shrinking, not a growing economy. If we compare two overall investment programs, one for \$100 billion a year in solar technology, another for the same amount in fossil and nuclear fuels, the point is summarized neatly (see table). If we invest this money in hard technology and cheap energy, we not only maintain our energy supplies, but make them grow at 18 percent a year. The new factories that can run on that energy will employ in a single year more than 7 million new workers, enough to nearly wipe out the unemployment problem. And these are real jobs, jobs producing for the Third World and the advanced countries, making more goods and services, fueling a boom that can raise the entire world population to U.S. standards of living in a decade.

But if we invest the same money, and a *10 times larger work force in solar*, we will not even get enough energy out to maintain our present supplies. The resulting energy shortage would in a year create an increase in unemployment of 4 million workers. Solar energy is a prescription for instant depression.

Since anyone who can add and subtract will not buy the feasibility of solar energy on earth, sun worshippers have

also developed the "high technology" variant of solar in space. Two former physicists, Dr. Philip Glaser and Dr. Gerald K. O'Neill have been thumping for this particular fantasy for the last two years.

The theory here is that solar energy in space is about eight times more intense than on earth because of the absence of cloud cover, night, and atmospheric absorption. Therefore, presumably, it would be cheaper. The only problem is getting the collectors out there.

Glaser takes the direct approach, suggesting that solar power stations be launched directly into orbit from earth to then beam the energy back in the form of microwaves. The economics of this scheme, however, are actually worse than the economics of earth-based solar energy.

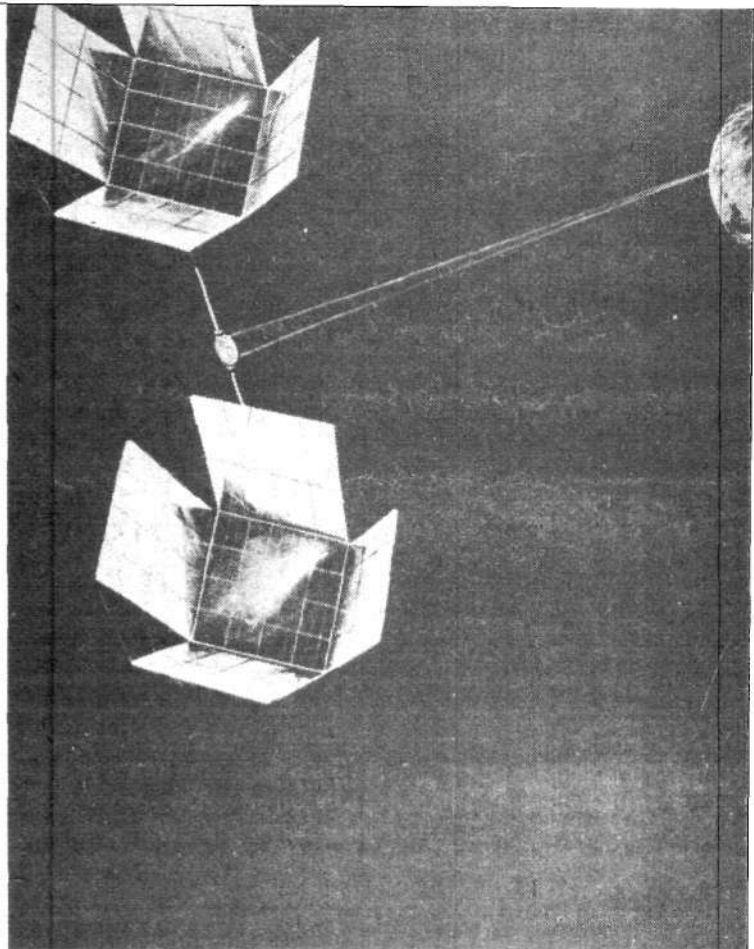
O'Neill recognizes the shortcomings of his colleague's scheme and has therefore proposed an even more ambitious one in his book, *The High Frontier*.^{*} O'Neill wants to build the solar power stations in space colonies orbiting around the earth, thus saving the cost of blasting them up there. According to O'Neill, we first should spend \$100 billion to set up a small mining operation on the moon that would send raw materials to a point in space equidistant from the earth and moon, where a huge space satellite housing 10,000 people would be constructed. These industrious people, equipped with hyperautomated technology would be expected to build one 10,000 megawatt solar station for earth use each year and to double the size of their lunar base. By doubling every year, within 20 to 30 years of the start of the program, the U.S. would be wholly solar-powered.

O'Neill arrives at the astonishing conclusion that the energy thereby produced would be cheaper than that produced by current methods, because only the first \$100 billion would be invested; after this the colonies would be wholly self-sufficient. O'Neill is able to arrive at this preposterous conclusion because he assumes practically total automation of the space colonies. Human labor is allocated only for building of new colonies and the solar power station, and even this is assumed to be efficient and productive. Naturally, if virtually unlimited productivity is assumed, any contraption produced under those ideal conditions, no matter how inefficient, would be very cheap.

Pie in the Sky

There are a few problems with O'Neill's assumption. First, there is the fact that no conceivable combination of foreseeable automation technologies could make a community of as few as 10,000 or even 10 million people, self-sufficient at anywhere near a modern standard of living, let alone the technological level of a space colony. An enormously more complex division of labor involving billions of people would be required.

But, for the sake of argument, let us assume that such wonderful automation could be developed in the immediate future. It still remains paradoxical why O'Neill chooses to use these production technologies to make solar space stations. Current fusion reactor designs have energy densities of about 75 kilowatts per ton, five times that of



A drawing of solar cell power stations. Dr. Glaser's "cheap solar energy" space project would cost about \$2 trillion a year, about twice the cost of a similar monstrosity on earth.

solar generators, and thus would be five times cheaper to make in space. Ordinary fission reactors have energy densities as high as 200 kilowatts per ton and would be cheaper still. And advanced fusion systems might well have energy densities as high as 10,000 kilowatts per ton and would be far cheaper still. O'Neill could much improve the economics of this scheme if he used hyperautomation to produce orbiting fission or fusion plants rather than solar plants.

But why stop here? Why not bring his wonderful automated colony down to earth and use it to build fusion and fission reactors here? That would save the \$100 billion investment in lunar mining and get the whole thing done a lot faster and a lot cheaper.

Eric Lerner is director of physics research for the Fusion Energy Foundation.

This article was adapted from features by the author that appeared in New Solidarity newspaper Nov. 22, 1977 and Feb. 28, 1978.

^{*}Gerald K. O'Neill *The High Frontier: Human Colonies in Space*. (New York: Morrow, 1977).



To the Editor:

It has been my misfortune to receive the December-January issue of *Fusion*. Contained therein is a hysterical diatribe from Carol White. I find this type of journalism offensive, and totally out of keeping with any pretense of objectivity, essential in a "scientific" journal. I am unable to lend support to this type of propaganda, and wish my subscription terminated.

M.Minks
Department of Biological Sciences,
State University of New York at Albany
February 6, 1978

Science Is Politics

by Carol White

Editor's Note

This article by Carol White is an extended reply to the letter to the editor from Dr. M. Minks, which is reprinted above. White's original article, "The Royal Society," appeared in *Fusion* magazine in the Dec.-Jan. 1977-1978 issue. The editors encourage further comments from readers on this and on other issues raised in the magazine.

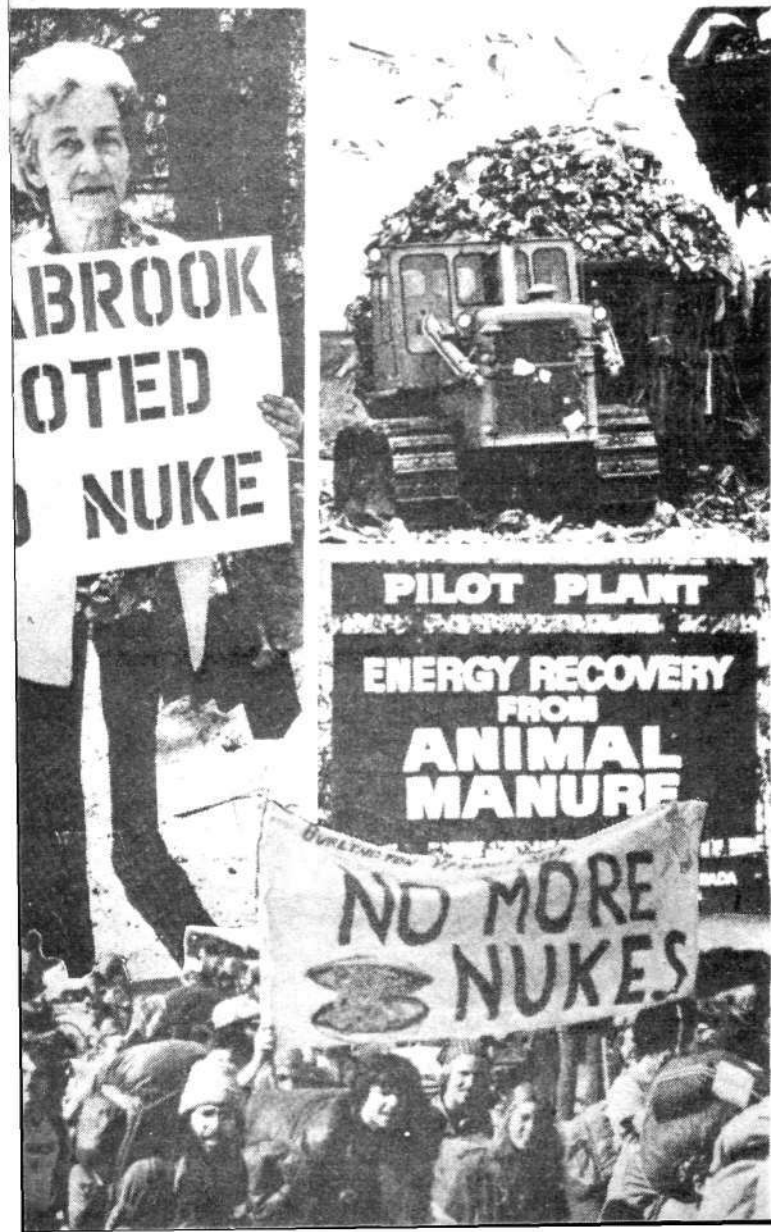
Dear Dr. Minks:

Your letter is worthy of reply for precisely those reasons that made my original article on the Royal Society so objectionable to you.

You are angry, in fact enraged. My article appears to scream at you. "A hysterical diatribe," you write, and then you retaliate, at least in your imagination, by fastidiously tearing it to bits and then flushing it away, along with *Fusion* magazine to boot.

I shall reply to your assertion that my exposure of the hoax of Isaac Newton is propaganda and not documented fact, but first we must clear a few things out of the way.

You are angry. I do not deprecate that anger out of hand. After all, you did subscribe to *Fusion* magazine, which suggests at least some previous acquaintance with its contents. You had probably read the editorial statement in the October-November 1977 issue, "The Antiscience



Mob," where the editors state that they intend to counter the attacks on science. To quote from the editorial:

The current attacks on science occur at another critical point when humanity is faced with a choice between continued progress or economic and political collapse. Once again financier interests, grouped around slogans like "too much technology," are out to destroy the practice of advanced science as well as the very idea of progress.

That stated editorial policy, along with the extraordinarily exciting general coverage of advanced technologies and research at the frontiers of biology and plasma physics, must have influenced your purchase of a subscription in the first place. Yet, now you feel betrayed.

I suggest that you bought *Fusion* because you are a scientist and a teacher; that you are appalled and dismayed at the calculated attack upon science by succubi such as PIRG (the Public Interest Research Group) and similar Naderite institutions that are now contaminating our campuses and our national life. You must look with horror at newspaper headlines that insinuate to the gullible that a human male infant was produced from the cell on a man's arm, headlines that are used as a pretext to justify the cutoff of funds for necessary research in the areas of recombinant DNA and cancer-related changes in physiology.

That's why you feel betrayed. Because you regard the Naderite scum as *political* intruders in the properly *objective* domain of pure science. "Science is objective; keep politics out." This is your defense against the environmentalist scum.

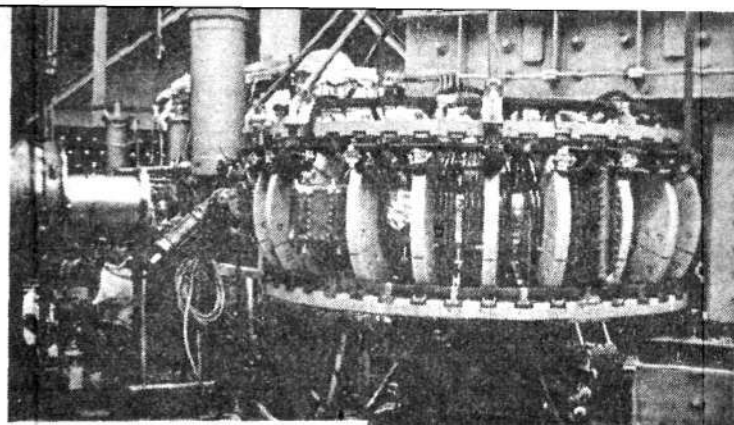
But it won't work, precisely because the environmentalist movement was profiled to play on just these prejudices about so-called objectivity that were drummed into scientists like you in a previous period: "Hypothesis non tingo."

As early as the post-World War I days, Bertrand Russell was seeking to enrage the war-weary population against the alleged *immorality* of the practice of pure science. Who was responsible for World War I? According to the lying Russell it was the scientists who made weapons technology possible.

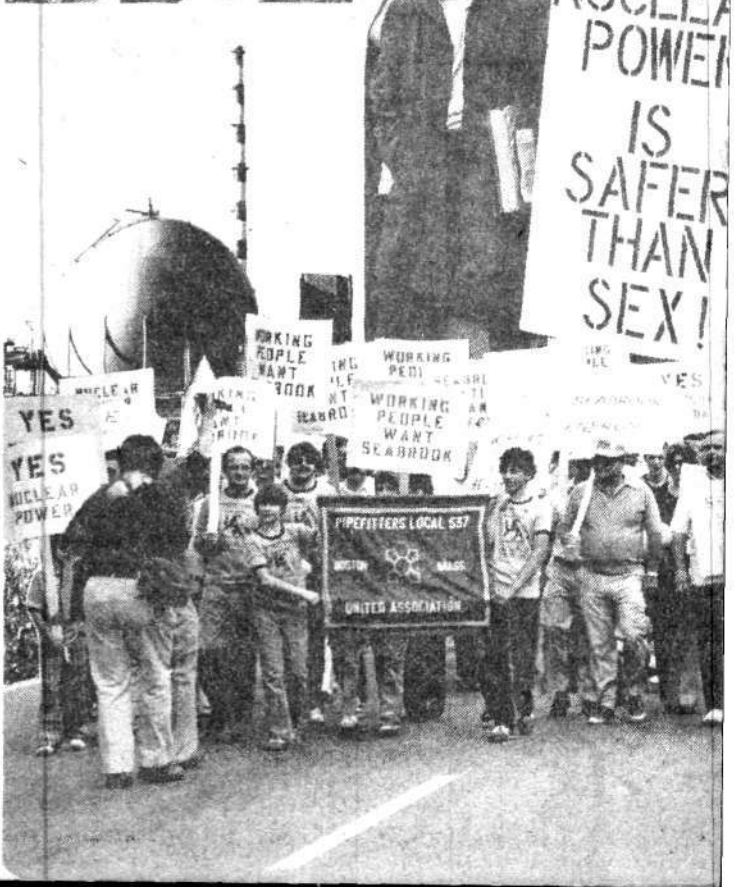
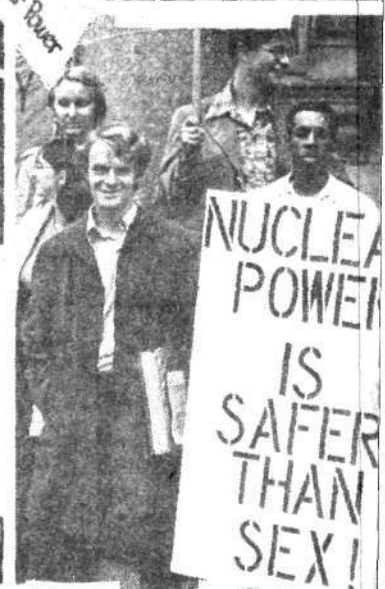
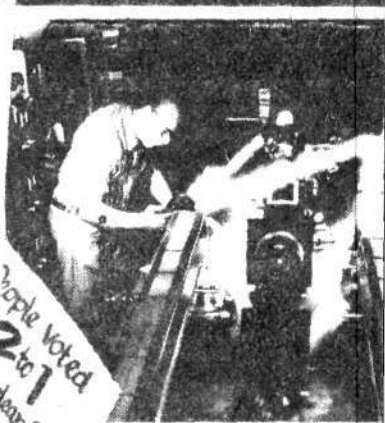
No! Laying claim to the proper objectivity of scientists will not rid us of the parasites who are trying to destroy our nation by obliterating our constitutional commitment to science and progress. Only the most spirited frontal assault on these liars can rout the antiscience mob once and for all.

The Dividing Line

Let's get something straight. Science in its essence is politics. From as far back as we can trace human history there have been two factions: one a humanist faction, city builders who understood that only by continually expanding scientific and technologic capability could they preserve the human race, and at the same time create the basis for expanded human population potential; the other, a collection of oligarchic families concerned primarily to



CRABHELLS
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PROVIDE
ENERGY



maintain their pretensions to political power no matter what the cost to the subject populations whom they sought to control.

This is the dividing line that defines real politics. Of course, many people don't understand it. Therefore, they are frequently duped and fooled and led to act against their own best interest and that of their family and their nation.

Every scientist is a humanist; not every inhabitant of a laboratory, but every real scientist. His daily practice is precisely directed to the expansion of human population potential.

The oligarch, on the contrary, sees mankind as a formless mass that must be controlled and manipulated to serve his species interest. Therefore, a scientist must be anathema to an oligarch; the scientist is the living instantiation that man is not an animal to be herded.

The self-identity of a practicing scientist who locates his sense of accomplishment in his ability to expand the domain of human practical experience is the secular counterpart of the religious notion of the soul. The true Christian knows that man is divine only when he strives to bring his fellow man out of the muck of dumb animal existence. Remember, Christ was a doctor.

The individual who locates the core of his existence as existence for humanity inherently is scientifically oriented. He naturally will tend to subsume his particular area of inquiry within a unified field conception. He will find the notion of a self-developing universe congenial. His own creative practice will be the final unassailable proof of the capacity of that process of self-development.

Aha! you say. That shows that White is hysterical. Doesn't she know that almost every reputable scientist today rejects the possibility of a unified field theory because of the quantum paradoxes?

Just so! That's why it was absolutely necessary that I write the article, "The Royal Society." Countless generations of scientists have been disoriented deliberately by their political enemies, the oligarchs.

Even an avowedly fascist oligarchy needs scientists, so long as it maintains any military pretensions. But it cannot afford scientists who freely reflect upon their own practice to draw the appropriate antifascist conclusions. Depending upon circumstances, an oligarchic tendency that has won political power will control scientific output, allowing more or less money for research and development, more or less for basic education.

It will not — and cannot — however, allow humanist epistemology to exist. Therefore Aristotle's attack upon the Platonic academy. Therefore Newton's attack on Leibniz. (It is not accidental that Newton, who repudiated all hypothesis, gratuitously insisted on the real existence of Aristotle's center of the universe).

To read Newton's *The Mathematical Principles of Natural Philosophy** invokes the incredulity of Marlowe's Dr. Faustus when he saw Helen of Troy: "Is this the face that sank a thousand ships?"

We are demanded to believe that Newton — not Kepler, the discoverer of the laws of elliptical planetary orbits,

but Newton—established the basis for a lawfully ordered picture of the physical universe. We must believe that or...we are called hysterical.

That's your word, Dr. Minks, but it is also the principal feature of every authoritative treatment of the great Sir Isaac.

The Truth About Sir Isaac Newton

The truth is that Newton's major accomplishment was not even the establishment of an inverse square gravitational law. Such law was an obvious extrapolation from Kepler's laws, as Hooke, among others, pointed out.

Newton's accomplishment was to situate that law within the same corpuscular setting as his theory of light and that of his mentor, Robert Boyle. Not only is the apple as a whole attracted to the earth according to the inverse square law, but so are its core and its pips, viewed individually. In other words, Newton extended the Archimedean treatment of center-of-gravity, which was a principle feature of the work of Galileo, Stevins, Pascal, et al. to the case of planetary motion. His purpose was to justify the anti-Archimedean, Aristotelian notion that the primary existent is not the universe as a whole, the particle and the field viewed as a collectivity, but *the particle as such, in contrast to the field*.

That the apple as a whole falls to earth is merely the happy outcome of the tendencies of its composite atoms to fall. In other words, as Hobbes would say, the apple itself is only a *Phantasm*. I shall demonstrate that this is not a mere quibble by quoting at length from the *Principles*.

The purpose of the publication of the *Principles* was not the useful but secondary center-of-gravity calculations of Book I, and certainly not the contents of Book II, an embarrassing collection of erroneous formulations on fluid dynamics. It was written for its attack in Book III on the humanist scientific networks, whose leading members were Leibniz, Huyghens, and the Bernoullis. Simply amalgamate the antiscientific world view of the factional allies of Hobbes, Locke, and Newton and the following world picture emerges: Only motion and extension are primary qualities. Sight, sound, and tactile qualities are only apparent attributes of an object; but we know objects only as they are sensibly apparent to us. Therefore, we do not know objects.

In other words: It's OK to be a scientist as long as you admit that you cannot really be a scientist since you cannot know anything about the world. Or, as it is often put, "You think because you're a scientist you are specially qualified to urge a fusion-oriented energy policy. Watch it, buddy! Don't get too big for your britches."

To quote from Sir Isaac in Book III of the *Principles*:

In the preceding books I have laid down the principles of philosophy; principles not philosophical, but mathematical....It remains that, from the same principles, I now demonstrate the frame of the System of the World....For since the qualities of bodies are only known to us by experiments, we are to hold for universal all such as are not liable to

diminution, can never be quite taken away. We are certainly not to relinquish the evidence of experiments for the sake of dreams and vain fictions of our own devising; nor are we to recede from the analogy of Nature, which uses to be simple, and always consonant to itself. We no other way know the extension of bodies than by our senses, nor do these reach it in all bodies; but because we perceive extension in all that are sensible, therefore we ascribe it universally to all others also. That abundance of bodies are hard, we learn by experience; and because the hardness of the whole arises from the hardness of the parts, we therefore justly infer the hardness of the undivided particles not only of the bodies we feel but of all others. That all bodies are impenetrable, we gather not from reason, but from sensation.**

The bodies which we handle we find impenetrable, and thence conclude impenetrability to be an universal property of all bodies whatsoever. That all bodies are movable, and endowed with certain powers (which we call the *vires inertiae*) of preserving in their motion, or in their rest, we only infer from the like properties observed in the bodies which we have seen. The extension, hardness, impenetrability, mobility, and *vires inertiae* of the whole, result from the extension, hardness, and *vires inertiae* of the parts; and thence we conclude the least particles of all bodies to be also all extended, and hard and impenetrable, and movable, and endowed with their own proper *vires inertiae*. And this is the foundation of all philosophy [emphasis added]....

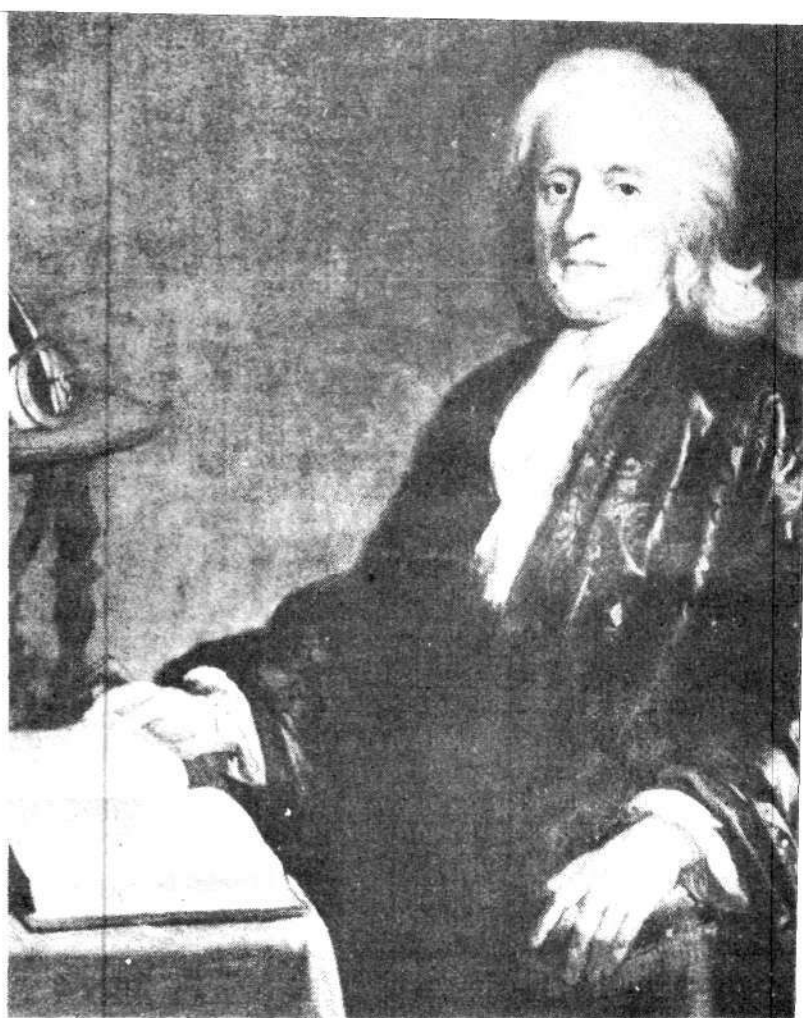
In experimental philosophy we are to look upon propositions collected by general induction from phenomena as accurately or very nearly true notwithstanding any contrary hypothesis that may be imagined, till such times as other phenomena occur, by which they may either be made more accurate, or liable to exceptions. This rule we must follow, that the argument of induction may not be evaded by hypothesis.

Newton's Credible Threat

The duplicity of Newton is documented even by staunch Newtonian defenders like I. Bernard Cohen.† The operation is akin to the stance of the schoolyard bully and his "credible threat." My bluff worked before, the bully says, and you better believe it will keep on working; that is, until a small but tough kid unexpectedly introduces the toe of reality into the back end of the bully's blubber.

Is Newton's ethos that of the bully, the credible threat? Look at the ethics he projects onto God. Newton ends the *Principles* with the famous General Scholium, from which I quote:

This most beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent and powerful



Sir Isaac Newton: "Hypothesis non fingo."

Being.... This Being governs all things, not as the soul of the world, but as Lord over all; and on account of his dominion he is wont to be called *Lord God*...‡ or *Universal Ruler*, for *God* is a relative word, and has a respect to servants; and *Deity* is the dominion of *God* not over his own body, as those imagine who fancy *God* to be the soul of the world, but over servants. But a being, however perfect, without dominion cannot be said to be *Lord God*; for we say, my *God*, your *God*, the *God* of *Israel*, the *God* of *Gods*, and *Lord* of *Lords*; but we do not say my *Eternal*, your *Eternal*, the *Eternal* of *Israel*, the *Eternal* of *Gods*; we do not say, my *Infinite*, or my *Perfect*: these are titles which have no respect to servants.

* Sir Isaac Newton, *The Mathematical Principles of Natural Philosophy*. (New York: The New York Philosophical Society, 1964).

**N.B.: Not reason, but dumb sense certainty is the foundation of Newton's epistemology.

† I. Bernard Cohen, *Franklin and Newton*. (Cambridge, Mass: Harvard University Press, 1964).

‡ Omitted here is the Greek etymology.

Can you deny, Dr. Minks, that this is the credo of a house servant to the British oligarchy and the House of Orange, then monarch? Can you deny the snide pleasure which Sir Isaac took from his jibe at Leibniz: "We do not say my perfect."

What do you, heir to Ben Franklin, say to this man who demands of you the mentality of a servant to the British monarchy? Don't you, with us, recognize the divinity of a scientist who, like Leibniz, struggles for perfection in this world as the surrogate for an omnipotent God, who expresses both his potency and his goodness in wilful intervention to achieve transfinitely greater levels of perfection within and for the evolving universe?

Perhaps you draw back at another implication of my article: With the scientific worldview so viciously under attack by environmentalists, can we afford to undermine the authority of science by attacking the great Newton? Even if Newton perpetrated a hoax on the credulous of his day isn't it better to maintain a myth of his greatness?

No! Science is not a body of facts, nor a housewife's card file of successful recipes. Science is the practice of a body of men who are continuously refining and amplifying a body of hypotheses that they test both for internal consistency and for applicability to emerging technology. Science is the offspring from the mind of the scientist. There is no way to educate a next generation of scientists to the critically necessary task of realizing the potential of a fusion-based technology while deliberately dulling and befuddling their critical capacity with what are no less than lies.

Occultism Versus Field Theory

Newton's apologists claim that Newton actually had a field theory and that only his epigones believed in action-at-a-distance. However, a serious look at Newton's *Opticks* show that his so-called field theory is simply an occultist device.

Newton had various alchemical references to a "field" in his works in the guise of an ether, or, as in the Scholium, to an all-pervasive spirit. This spirit was the *deus ex machina* that might be substituted if people accepted Leibniz's complaint that "action-at-a-distance" re-introduced Aristotelian occultism back into physics.

By deliberately rejecting a vortical representation of particle-field relations along with Descartes's admittedly wrong approximations, Newton denied the possibility of a coherent view of the universe that did not refer in some fashion or another, of necessity, to occult forces. Although he denied any metaphysical notion of action-at-a-distance ("I don't hypothesize"), action-at-a-distance in either the large or the small is the only logical inference of his theory.

Both Huyghens and Leibniz were as critical of Descartes's cosmological theories as was Newton; nonetheless they recognized the necessity of a first order approximation to field theory by exactly the fluid dynamic treatment that Newton rejected. This was, in fact, the immediate next step to field theory as it emerged from the work of Euler, LaPlace, LaGrange, and Poisson.



Like the alchemists he and his Royal Society friends developing universe. Above, *The Alchemist* by Peter

In an intended popular scientific book he worked on in the early 1680s, Leibniz succinctly formulated this approach to unified theory, "All things seem in fact to be fluid but merely variously folded into each other without a break in the continuity."*

It was precisely this commitment of Leibniz and Descartes to a notion of a field that implies perfection and a self-developing universe that Newton opposed.

The Case of Benjamin Franklin

One of the nastiest jobs of Newtonian propaganda in recent years is I. Bernard Cohen's distorted treatment of Benjamin Franklin in his book *Franklin and Newton*.

Is this an unduly harsh characterization? At least Cohen resurrects Franklin's importance as a scientist. Isn't his comparison of Franklin to Newton merely a means to establish Franklin's own credentials? A myth if you like, but well meant.

No. For that to be the case we could reasonably expect Cohen to establish the colonial American backdrop to Franklin's work. However, this would have necessitated referencing Franklin's immediate scientific mentor, James Logan, the American agent for the Penn family. Obviously for Cohen this would have opened an ugly can of worms, for Logan maintained close touch with the Leyden Leibnizian scientific circles and he was on particularly poor



admired, Newton denied the possibility of a coherent, self-
Bruegel the Elder, circa 1558.

terms with Newton's protege, Edmund Halley. Significantly, Logan's work was not published by the Royal Society. It was solicited by the Dutch scientific circles that were associated with Huygens, who was Dutch, as well as with Leibniz and broader humanist networks, no doubt reaching to Spinoza. This was not the Royal Society crowd.

Logan did not present himself as a follower of either Huygens or Leibniz, although he definitely rejected Newton's ludicrous corpuscular theory, as did Franklin. He was an independent cuss, the sort who studied the calculus in his 50s and taught himself Arabic at the age of 70. In fact, in his calculus work Logan discovered that one of Newton's proofs in his 1676 letter to Henry Oldenburg was not only incomplete but also incompetent or deliberately deceitful. Logan showed that the letter, which was alleged by the Royal Society to have suggested the idea of the differential calculus to Leibniz, presented a supposedly convergent series that was actually divergent. Logan also openly expressed his disgust at the campaign waged by the Royal Society to vilify Leibniz and aggrandize Newton, a campaign that went to the absurd lengths of falsifying a portrait of Newton at the age of 70 to make him appear 30.

With his broad circle of continental contacts and fellow-American talented amateur scientists, Logan created the scientific culture in Philadelphia that encouraged Franklin

to research electricity. One has only to compare the obsequious tone with which the English scientist Thomas Young felt it necessary to preface accounts of his discoveries of the wave nature of light in 1803** to render them credible to the Royal Society (Young goes so far as to misrepresent Newton's corpuscular view of light) with the entirely different atmosphere of the colonies as it is reflected in the Franklin-Logan correspondence.

Franklin and the Royal Society

Although Franklin saw himself by-and-large as a Newtonian, nonetheless he was moved to write the following in a 1752 letter to a New York associate Cadwallader Colden: "it is very curious but I must confess I am in the dark about Light. I am not satisfied with the doctrine that supposes particles of matter, called light, continually driven off from the sun's surface, with a swiftness so prodigious."

Franklin then goes on to develop Huyghens's argument against Newton's theory:

Must not the smallest particle conceivable, have with such a motion, a force exceeding that of a 24 pounder, discharged from a cannon? Must not the sun diminish exceedingly by such a waste of matter; and the planets, instead of drawing nearer to him as some have feared, recede to greater distances through the lessened attraction. Yet these particles, with this amazing motion, will not drive before them, or remove, the least and lightest dust they meet with....

Lastly, Franklin reflects on the atmosphere created around the Royal Society:

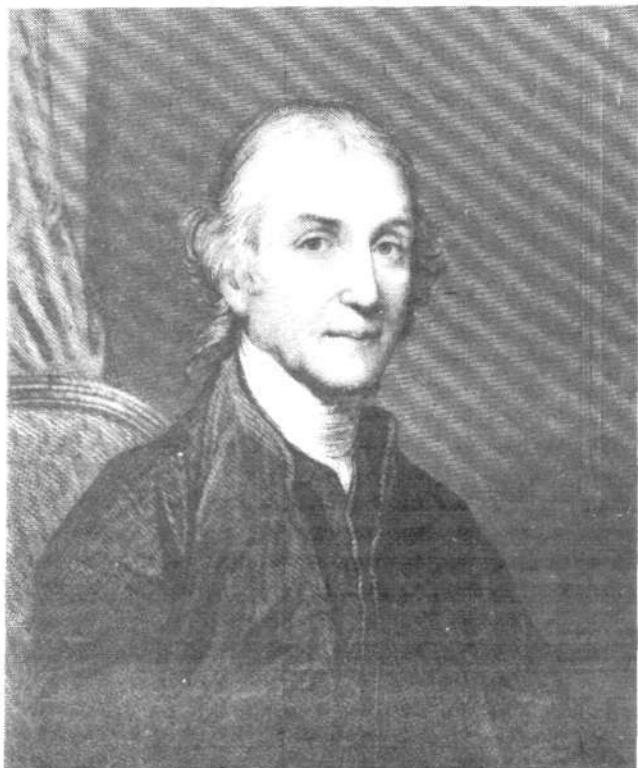
It is well we are not, as poor Galileo was, subject to the *Inquisition for Philosophical Heresy*. My whispers against the orthodox doctrine, in private letters, would be dangerous; but your writing and printing would be highly criminal. As it is, you must expect some censure, but one Heretic will surely excuse another.

Colden had a theory of the origins of the gravitational field that he claimed did not controvert Newton's results, but merely amended them. Needless to say his work was printed only in continental Europe.

It would be a mistake to say that Logan or Colden or Franklin had systematic criticism of Newton or the Royal Society. To the contrary, they seemed to feel most sharply that the society overlooked American work. Colden expressed typical colonial gripes such as: they're so snotty they'd overlook Newton if he were not praised by foreigners.

* Leroy E. Loemker, ed. *Leibniz: Philosophic Papers and Letters*. (Chicago: University of Chicago Press, 1956).

** In *The Wave Theory of Light* ed. Henry Crew. (New York: American Book Co., 1968).



"Every scientist is a humanist; not every inhabitant of a laboratory, but every real scientist. His daily practice is precisely directed to the expansion of human population potential." Above: Joseph Priestley [J] and Cadwallader Colden, both part of Franklin's humanist network.

The point is that the Americans smelled a rat and they didn't accept the self-censorship, the acquiescence to bureaucratic control, the obsequiousness to the Great Man, all of which were requisites if one was to be accepted by the Royal Society. True, Franklin and Mather before him had gained admission to the society. But Franklin thought the recognition belated and grudging, and accorded only after he had achieved a significant measure of foreign recognition through Logan and the continental networks of his London friend Peter Collinson.

Cohen's Fraud

It is possible to judge Franklin's one-fluid theory of electricity as superficially akin to Newton's emanating spirit mentioned in the Scholium, although this begs the whole quality of his work; but it is not possible to call Franklin a Newtonian without stooping to ridiculous lengths.

Poor Richard would have smiled at Cohen's justification of exactly this characterization:

The key figure in the production of the Newtonian science of electricity was Benjamin Franklin, and the very act of placing together the names of Franklin and Newton indicates — as we have seen earlier — the need for revision of some commonly held notions about what a Newtonian science might be. If we take the *Principia* of Newton as our exclusive model of Newtonian science, then Franklin's elec-

trical theory can in no sense be considered Newtonian, despite Franklin's obvious adherence to the program of inquiry and speculation set forth in Newton's other works. Even in the late 18th century, Franklin was attacked for having departed from the strict method of geometrical deduction of the *Principia*; "Hypothesis non fingo." We will have to turn to other writings of Newton that Franklin read, and that were studied so extensively by the experimental scientists of the 18th century, in order to discover how the nonmathematical Franklin, with his expressed weakness for framing hypotheses, could possibly have been a Newtonian scientist....

There can be no question about the choice of Benjamin Franklin as the major investigator to be considered as a speculative Newtonian experimental scientist, once we have adopted electricity as the science to provide a cross-section of 18th-century physical thought. No one would who makes even a superficial examination of the literature of electricity during the 18th century can escape the recognition of the commanding role of Franklin after the mid-century and the eventual universal adoption of the concepts and even the language that he introduced into electricity for the first time.

This is conscious fraud by Cohen. The other work by Newton, his *Opticks*, contains the corpuscular theory of

light with which Franklin explicitly disagreed. So Cohen is really saying that any competent scientist who achieves international recognition is by definition a Newtonian. Rule Britannia!

Everything else aside, it is exactly Franklin's disagreement on the importance of hypothesis that defines him as a humanist opponent to Newton, whether or not he fully understood this. The following is just one statement of the spirit that imbues Franklin's correspondence:

I can not forbear venturing some few conjectures on this occasion: they are what occur to me at present, and though future discoveries should prove them not wholly right, yet they may in the meantime be of some use, by stirring up the curious to make more experiments, and occasion more exact disquisitions.

A discovery is not to be hoarded as a possession but is to be joyously shared with the scientific community. It is not an object but a stimulus to push fellow scientists to further creative activity. It is a glorious offering to the human race.

Poor Newton with his cryptograms and presumptions! Think how horrible if Newton actually did come to recognize the importance of the differential calculus at the same time Leibniz did (by no means a likely presumption) and then simply hid it spitefully, except for esoteric cryptographic references to fluxes and fluxions.

Franklin's Discoveries

It is ironic that Franklin coined the term electrostatics to describe the fact that when a Leyden jar (a condenser) is charged, an equivalent but oppositely signed charge will be accumulated on each plate; that is, a zero net balance of charge will be maintained. This "static" law of conservation of charge summarized more than 20 years of observation by Franklin and others of the effects of transient currents. The significance of the Leyden jar was that the act of grounding it allowed charge to be accumulated. This vastly expanded the scale of possible experiments.

The English experimenter Watson also discovered the relationship of positive to negative charge. In fact, both he and Franklin independently conducted the famous experiment that featured two individuals standing on insulated wax blocks, one of whom is charged by frictional contact with a "rubber" that is then discharged upon the other. This results in their ability to create sparking by touching a third person, so long as they have not touched each other first.

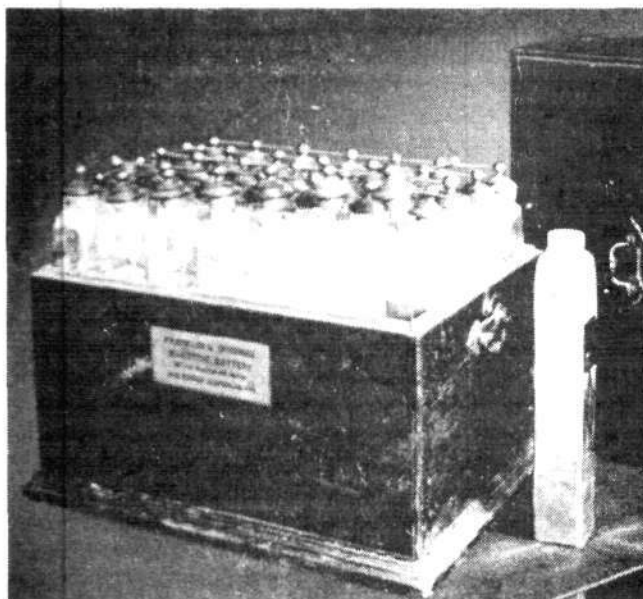
Franklin's unique discovery was to understand that when a Leyden jar or condenser was discharged through a person holding both plates, a current passed through the individual. The generalization of this point of view to the biosphere allowed Franklin to conjecture that the discharge of lightning, also a transient current with effects, was similar to that of the shock experienced by the person holding a Leyden jar so as to close a circuit or to the visible spark that easily could be created by forcing the charge to leap across an air gap.

Franklin's original hypothesis about lightning, later amended in detail, envisaged a system that depended upon clouds being charged by contact with the ocean, discharging in a chain reaction after hitting obstructions like mountains. He conceptualized lightning as part of a complex weather cycle in which the transient electrical current was related to wind currents and to the absorption and release of water in the atmosphere. In order of conception, this is very like Leibniz and Huyghens's higher-order vortices.

The experimenters of this period actually worked with fluorescent light effects, which they achieved by rubbing partially evacuated glass globes. One such experiment created sufficient light so that in an otherwise darkened room letters could be read from a distance of 10 feet. The claim that James Clark Maxwell discovered 100 years later that electricity produces radiation is patently absurd.

The implications of electricity for chemical theory were appreciated fully by Franklin's English protégé, Joseph Priestley. It is astounding, therefore, that the chemical battery, which allowed a continuous current to be maintained, was discovered only in 1800 after a lapse of more than 50 years from Franklin's initial work. Only then was it possible to systematically observe the magnetic correlates of electric current flow.

Such a lag can be accounted for only by the political demands upon Franklin and the vicious attacks to which Priestley was subject, during which his laboratory was twice destroyed and he was driven out of Britain. True, both men were ostensibly attacked for their commitment



Franklin's "battery" of Leyden jars. Franklin was able to accumulate a large charge by connecting the jars to one another in series, rather than grounding each one directly. Franklin's use of an initial static charge to charge all the jars demonstrated dynamic current flow and allowed him to observe the phenomenon of electrical resistance.

to the American revolution rather than their work directly within the field of science. But can the two be separated? The same quality of mind, the same humanist commitment determined both their scientific and their political commitments.

And we can identify just such a joint humanist commitment in every great scientist of the past. Not only Leibniz but Galileo, Kepler, Bruno, Cusa, Roger Bacon, Archimedes, Plato. How can a dedicated scientist not be passionately committed to solving all the questions that determine the survival of humanity? How can a scientist today not be the dedicated enemy of every environmentalist and zero growther?

Ironically, the subject of electrostatics is taught today from the standpoint of the further refinements of the theory by Charles Coulomb, who perfected the method of electrical measurement by his design of the torsion balance. In itself this is by no means inadmissible. Coulomb's work, like that of Lazare Carnot and his son Sadi, reflected the rich Colbertian tradition of the French scientific community, exemplified in the ranks of military engineers and later given expression in the Ecole Polytechnique. Throughout his career Coulomb was concerned to unify an engineering standpoint with mathematical physics in order to study real systems. While Lazare Carnot studied how mechanical systems retain potential energy — leading finally to the work of his son Sadi on the efficiency of steam engines — Coulomb studied energy loss through friction.

These men were associated with Franklin when he lived in Paris at the time of the American Revolution, where he as well as they were members of the French Academy of Sciences. It is of course the case that these scientists over-



"Benjamin Franklin was not really a great scientist. He was a great man, a true humanist. Therefore he was a scientist."

shadowed Franklin as mathematical physicists, but this is not at issue.

In the typical physics textbook, Coulomb's work of refining electrical measurement, and thus laying the groundwork for the further development of potential theory is abstracted out of its real emergence from the study of transient currents by Franklin and others. Electrostatics is presented as the study of the relationship of fixed charged objects. It is then treated as logically prior to the study of electrodynamics. The real distinction between Franklin's electrostatic studies and later work in electrodynamics — which resulted from his inability to produce continuous rather than transient current and, therefore, to observe electromagnetic effects — is obscured in order to assert the primacy of a particle conception and to situate electricity within Newtonian corpuscular physics.

Benjamin Franklin was not really a great scientist. He was a great man, a true humanist. Therefore, he was a scientist. He made significant discoveries in a wide variety of fields, not the least important in political economy.

It is not essential that a student of the physical sciences replicate Franklin's experiments, although it is extremely enjoyable. It is absolutely necessary that such a student understand and replicate his way of thought. This is exactly what the typical textbook presentation of electrical theory misses, or worse, distorts. This is exactly what books like Cohen's are deliberately intended to hide.

Franklin's exuberant sense of humor is in no way extraneous to that way of thought.

Kapitza and Franklin

In 1968, a series of essays by the Soviet scientist Dr. Peter Kapitza were collected and translated, including an address given by Kapitza on the occasion of the 250th anniversary of Franklin's birth, Jan. 17, 1956.* Kapitza is uniquely qualified to appreciate Franklin's work, since he has pioneered in the measurement of energy throughput in nonhomogeneous systems.

Kapitza describes Franklin's basic experiment, the one with the men on the wax blocks and asks the question: "How could it happen that Franklin, never before working in physics, living so far away, in a small American town removed from the world's centers of science, a man already well along in years, succeeded within a few years of work in heading an entire discipline of science?"

Kapitza then appropriately locates Franklin's achievements in the political climate of the colonies, but he does not pin down explicitly the colonial rejection of the Royal Society. Kapitza goes on to say:

In the initial stage of the study of electricity it was necessary that such a bold step be made. And Franklin made it. Until Franklin's work made its appearance a large quantity of experimental data had been gathered, but the facts had been separate from one another....I think the explanation lies in the fact that Franklin was the first man to understand the essence of electrical phenomena and therefore discovered the right path for further researches in the

field...Franklin's hypothesis stemmed from the materialistic nature of electricity and simply explained these experiments.

No, not exactly. Despite his horrific religious views, Isaac Newton appropriately lay claim to holding a "materialist" view of natural philosophy. Neither did Benjamin Franklin reject belief in a supreme being.

No, the critical issue was not materialism. Benjamin Franklin was a humanist. In so far as he was a "materialist" it could be only in the sense of his friend and collaborator Joseph Priestley. Priestley claimed to be a materialist, but he taught that matter could not be described as a mere collection of hard balls in motion. It must be conceived as a collective field-particle phenomenon not only that is capable of exhibiting repulsive and attractive forces but that has immanent within it those properties, not yet defined, but nevertheless inherent to the development of human conceptual power. Priestley demanded that man's mind not be read out of the "material universe," as it must be by reductionist corpuscular theories.

Kapitza stresses the importance to Franklin of his acquaintance with foreign scientists and contrasts it with the detrimental isolation of Russian scientists of that same period. He ends his article:

As we study Franklin's life, we understand more and more clearly why there is this universal respect and admiration for this great man, this American gift to humanity.

In our epoch of the rapid growth of the natural sciences we realize that each nation has contributed a great pioneer of science. We gave Lomonosov to mankind; the English brought forth Newton; the Italians contributed Galileo; the Dutch, Huyghens; the French, Descartes; the Germans, Leibniz; and the Americans, Franklin. The accomplishments of these great savants are the pride of all mankind.

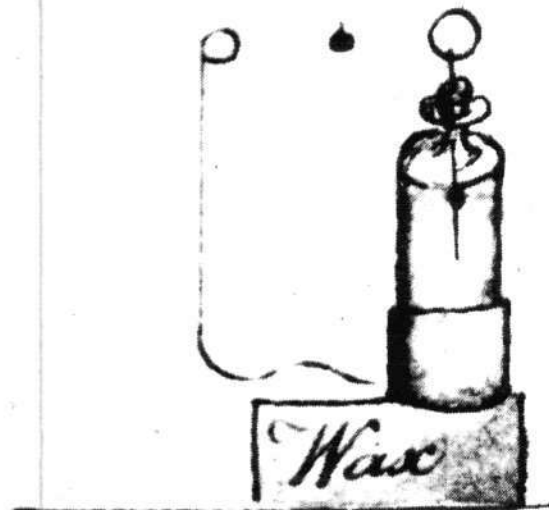
And we the Soviet people are grateful to the American nation that gave and reared for humanity the great Franklin.

That's why I had to write the article that upset you so greatly, Dr. Minks. Because we cannot afford to have great scientists such as Peter Kapitza confusing the evil work of Newton with the humanist traditions bequeathed us by Leibniz, the man Newton tried to extirpate. Not because we need to worry about giving a sentimental accounting to history, but because we must make the Soviets and our own people understand that humanity will not survive if Isaac Newton's view of the world is allowed to prevail.

We must defeat the Royal Society. ❁

Carol White, a former mathematics and philosophy teacher, is a member of the national executive committee of the U.S. Labor Party.

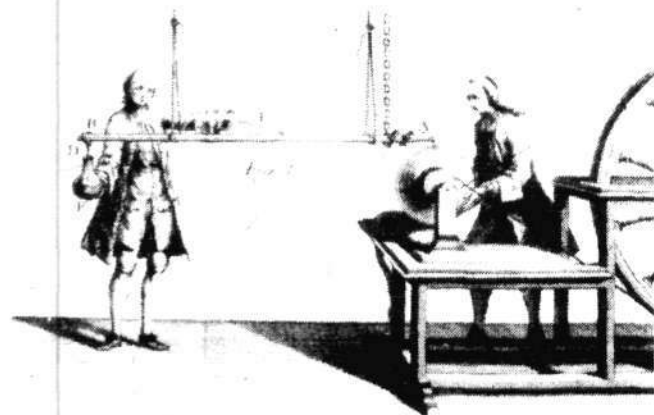
*Peter Kapitza. *On Life and Science*. editor and translator Albert Perry. (New York: The Macmillan Co., 1968).



Above: Franklin devised an apparatus to lengthen the discharge of a Leyden jar [condenser] into a "continuous" transient current. An already charged jar is insulated on a wax block, and a wire is run from the outside plate to a conducting knob placed opposite the knob that is connected to the inside. Since the knobs connect to the inside and outside plates, they are oppositely charged. A ball of cork suspended between the two knobs will be alternately attracted and repelled by each, oscillating until the jar is fully discharged [no potential difference between the plates].

This experiment, which proves that the condenser plates have equal opposite charges, shows Franklin's intention to harness the energy potential of the condenser into a mechanical form or motor to do work.

Below: The iron beam is charged by the electrostatic generator [right] and then charges the Leyden jar grounded in the experimenter's hand. If he touches the beam with his other hand, he will feel a transient current pass across his arms and chest.



Winston Bostick's Approach To the Field-Particle Problem *An Appreciation and Critique*

THE FEATURE ARTICLE in this issue by Professor Winston Bostick of the Stevens Institute of Technology is the second in our series on the frontiers of science.

Many of our readers may wonder what such a "complicated"-looking theoretical article is doing in a popular scientific magazine. The importance of the article is located not in its computational detail, but in Bostick's concrete attempt to solve the fundamental problem of how discrete particles, such as the electron, can exist in a stable state.

As we indicated last month in the introduction to the series, and as Carol White emphasizes in her continuing discussion of science and politics in this issue, the field-particle problem is central to our understanding of how the universe developed and how progress can be sustained in the future. We publish the article here in *Fusion* — despite its somewhat technical aspects — rather than in our companion scientific publication, the *International Journal of Fusion Energy*, because of its contribution to this basic understanding. We hope that our audience will read it in that spirit.

Winston Bostick is one of the most consistent monistic practitioners of physics today. As his researches and the conclusions he has drawn from them* make clear, Bostick has an unusual (these days) unified conception of physical processes, especially plasma processes.

The laudable aspect of his thinking is as follows: (1) the various structures and processes in the physical universe have a common basis, the self-stabilizing or changing

flows of energy in the electromagnetic field, and the field is the primary reality; and (2) force-free vortical structures "whipped up" out of the field and field-particle continua play the critical mediating role in energy flow and containment of physical systems.

In the specific area of plasma physics, Bostick has been a pioneer in pointing out the significance of vortex filaments for plasma processes and of developing the high-resolution diagnostics needed to observe and measure these characteristics.

The vortex filament structures that Bostick has produced and studied in the laboratory ultimately may be the mechanism by which small, efficient fusion reactors are constructed to take full advantage of the tremendous energy density of fusion reactions. This could also permit the use of advanced fuel cycles that produce charged particles — electricity — directly as their output. In addition, plasma vortex and filamentary structures play an essential role in the dynamics of the sun, the galaxies, and even the structuring of the largest expanses of the universe.

For at least the past two decades Bostick also has been convinced that the remarkable self-stabilizing and energy-concentrating properties of filamentary structures could account not only for critical aspects of classical fluid and plasma behavior, but also for the existence of the very singularities in the continuum, the elementary particles.

On this basis Bostick constructed a model of the electron as an electromagnetic field filament. For this work Bostick was awarded first prize in the Gravity Research



Foundation essay contest in 1961. Yet, not one of the leading scientific journals to which Bostick submitted articles based on this approach has published the work.

This discrimination has been a disservice to progress in physics. Bostick's work is valuable from two standpoints. First, it shows that most of the basic properties of the so-called elementary particles and the basic results of quantum mechanics can be accounted for without the complete abandonment of any geometrical representation of the particle-field configuration. Second, it provides a concrete basis for defining the limits of any classical approach — such as Bostick's — to a fundamental solution of the field-particle problem. In particular, Bostick's work helps define the limits of present electromagnetic field theory.

The essential feature of Bostick's approach that makes this possible is his use of limiting configurations of relativistic electromagnetism (the Maxwell-Einstein tradition) to replace the incomprehensible Newtonian and Heisenberg representations of particle dynamics. As Bostick triumphantly notes, the primary attribute of the particle that his model can account for is the particle's existence.

The Starting Point: Electromagnetic Energy

His reasoning and model are the following: The usual attempts to account for the existence of elementary particles "blow up" if the starting point is either classical or quantum theoretical attempts to balance gravitational and

electromagnetic interactions. Either the forces don't balance and the particle blows up, or the particle itself must be a theoretical fiction since it contains infinite self-energy. In contrast, Bostick's starting point is that the only primary reality is propagating electromagnetic energy; mass, charge, and gravitation are derived properties.

According to Bostick's view, once one specifies a particular geometric configuration of electromagnetic fields, the other properties and then the forces to be balanced follow. The mass per unit volume — and thus the gravitational force between any two volumes — is determined by the field energy density in the volume. The charge per unit volume — and thus the electromagnetic force — is determined by the secondary fields that "leak" out of the core filamentary structure. Using this approach and the result from fluid and plasma dynamics that stable filaments can be very small in cross section compared with their major radius, Bostick found that the weak magnetic force could just balance the hundred-million-times-stronger electrical force (in conjunction with centrifugal and gravitational forces) only if the electromagnetic field were compacted into an almost filamentary closed helical structure.

It is striking that this model, which accounts for the stability of the electron, also accounts for its internal

* For a summary of Bostick's research and conclusions, see "The Pinch Effect Revisited" in the *International Journal of Fusion Energy*, Vol. 1, No. 1, March 1977.

angular momentum, its magnetic moment, and wavelike properties in propagation that are otherwise mysteriously attributed to wave mechanics.

Bostick's model also provides an appropriate geometrical picture for why a particle like an electron is not eternal but can be transformed into other forms of energy under certain conditions — such as encountering an anti-electron.

A Critique of Bostick

What does the Bostick paper prove? His "referees" have said that it is not to be taken as more than speculation unless it can provide better values for electronic constants or predict new phenomena. These rules are not outrageous in themselves, but in their discriminatory application.

If such standards were rigorously applied by the theoretical guardians of physics they would have to throw out their own theories as nothing more than "curve fitting" exercises on two counts. First, they cannot account for the essential feature of field-particle self-interaction indicated by the particle's (meta) stability, and second, the errors in the values for any particular property can be made as large

as one wishes by disallowing arbitrary cutoffs in series representation of such values. If Bostick's model is arbitrary, why then accept as "first principles" any of the current, totally incoherent axiomatic bases for physics?

What then is the fundamental problem with Bostick's conception? Let us reemphasize that there is nothing other than prejudice or taste in what now passes for physics to exclude Bostick's conception, in the absence of direct experimental evidence proving otherwise. Although such evidence is available in conclusive form from studies of vortices in various fluids and in the biological domains of genetics and neurophysiology, the issue is more fundamental.

Bostick's model is fundamentally inconsistent with the primary datum of the secularly increased potentiation of the physical universe and the demonstrably negentropic development of the biosphere and of human species existence. His model is based on too simple a notion of nonlinearity. Specifically, the attempt to account for fundamental physical processes by nonlinearity in the form of the self-interaction of any axiomatically postulated field metric ultimately must run into the very Newtonian problem it seeks to avoid: that the universe either is entropic, or, as Leibniz pointed out, would require divine intervention to be periodically wound up.

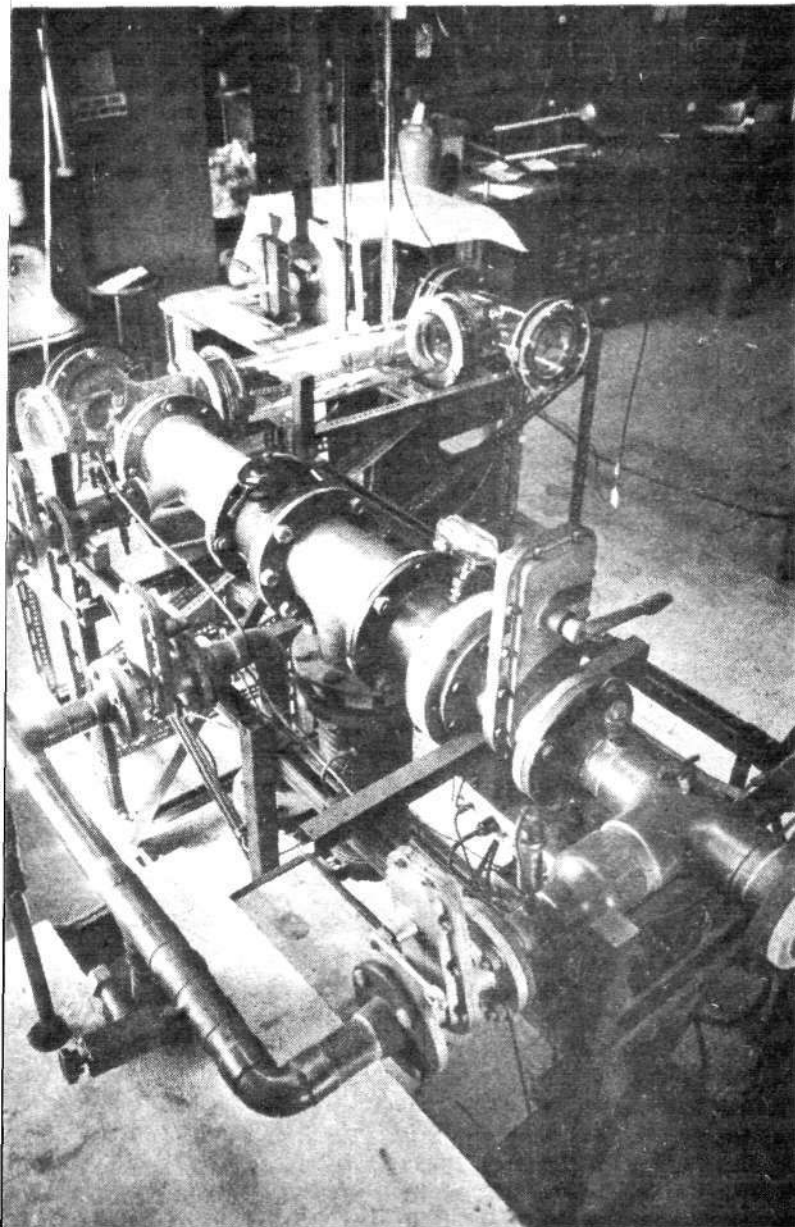
The real universe cannot be built up by compounding of simple stabilities. Bostick's theory cannot account for Bostick!

There are two complementary standpoints from which to pinpoint the problem. In general epistemological terms, the existence of any particularity cannot be an isolated stability, a thing-in-itself; it represents a complex reordering of space that also changes the quality of the field. This self-reflexive aspect of field-particle coupling is amply confirmed, for example, by the Fermi statistics of electrons. Specifically, there is no reason to extend the Maxwell-Einstein field relations or simple non-Euclidean geometry to the very small, or for that matter to any region of relatively high energy density compared with two-body or kinetic energies (for example, fusion-tending plasmas and superfluids). Doing so, as in Bostick's model, results in a very peculiar form of discontinuity, the arbitrary sharp cutoff in the Poynting vector bundle constituting the filamentary vortex ring, even though the physical space of the electron otherwise is assumed to be a linearizable continuum.

This same problem in one form or another is present in the attempts by Davy, then Lord Kelvin, and even later J.J. Thomson to construct vortical atoms from the ether to save the otherwise incoherent field theories of Faraday and

The plasma focus device at Stevens Institute, designed and built by Bostick and his group. Most of the machinery pictured is the vacuum system used to evacuate the plasma chamber and fill it with controlled amounts of deuterium. The plasma focus is contained in the glass "T" in the center of the picture.

Photo by Ulanowsky



Maxwell. This was also one of the nonrigorous aspects of Descartes's system of vortical dynamics that Leibniz rightly criticized for not properly determining the role of singularities.

With respect to the problem of the particle, Bostick would be the first to agree that his researches are not the last word in particle theory. However, they pose the critical issue of the conditions under which the ubiquitous vortex filament and other vortical structures of characteristic energy-diameter ratio are the actual mediators of energy transformation. More important, Bostick's researches concretely pose the problem of when such structures must be replaced by higher-order conceptions (and realities) of singularity and nonlinear dynamics to account for the negentropic development of the physical universe.

The Nonscientist's Roadmap

The Problem Of the Existence Of the Electron

A list of the names of the physicists who have tried to solve the problem of the existence of the electron includes the greatest scientists from the time of Maxwell onward: Thomson, Kelvin, Lorentz, Poincaré, Einstein, Fermi, Weisskopf, Pauli, and Dirac.

All of them recognized that 19th century experimental and theoretical physics had created a beautiful and self-consistent edifice in the theory of the electromagnetic field, or more strictly speaking, the "free field." The Maxwell-Hertz equations from the 1870s give a strikingly coherent theory of a continuous field interacting with itself and the space around it — the electric and magnetic fields and their transport of energy and momentum.

Yet, this theory cannot explain the sources of these fields. In a rigorous sense, in fact, classical electromagnetic theory is a continuum theory only, dealing with the dynamics of fields and not with particles within these fields. This difficulty was recognized early on and took the quite perplexing form of the inability of the theory to explain and, in fact, even to describe the existence of the electron, the fundamental unit of electrical charge and the

source for almost all known electromagnetic phenomena.

At first look, the problem seems to stem from one misleadingly simple fact in classical electrodynamics: that the stability (and hence, existence) of any collection of charge depends on the distribution of that charge so that there is no net force on the object. If there are unbalanced forces within the particle (caused by the particle's self-created fields), then the particle will explode, taking the inquisitive scientist along with it. The electric charge must be arranged so that the particle does not push itself apart.

Maxwell's theory says that the force one charge exerts on another is the sum of the electric force, which is always repulsive, and the magnetic-velocity force, which can be either attractive or repulsive. If we apply this theory to the constituent forces of the electron, then the question is what kind of forces do the different parts of the electron exert on one another? If we assume that the charge in the particle is not moving, then only the electric part remains.

The natural and simplest assumption to make, and the one that has always been made, is that the charge is a *blob of electricity* that is stable in the same way that macroscopic objects seem to be stable. This model assumes that the electron is a little ball of electric charge, with charge arranged in a fixed and stable way. This general idea was quantified and cast in terms of Maxwell's theory starting with Thomson in 1881. The challenge was to come up with a stable microscopic configuration of charge, a task that turned out to be impossible within the context of classical electrodynamics. Why?

The Failures

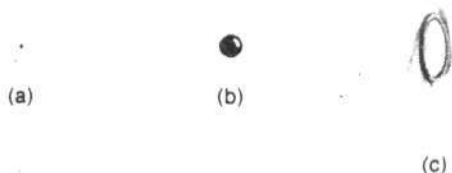
(1) In 1903 and 1904, after the discovery of the electron, Lorentz and Abraham calculated the energy, mass, and size for a charge with the electrical properties of the electron. They came up with a particle that would obey classical equations of motion, based on the assumption that its electromagnetic properties supplied its mass (through mass-energy equivalence). However, the electron's mass calculated in this fashion was bigger by one-third than the mass the electron should have had according to known experimental measurements. (Thomson also found this discrepancy in 1881, in a slightly different context.)

(2) Physicists reasoned that perhaps the difficulty with Lorentz and Abraham's approach was that their solution was only approximate. To make it exact was easy enough; it required letting the size of the electron decrease until it became a point particle. This adjustment, however, resulted in an infinite energy for the particle!

(3) Back at the drawing board, the next step was to make the electron bigger again. However, a finite-size particle could not hold together: the only force operating between the parts of the electron would be the electrostatic force, and no matter how the charge is arranged, the force is repulsive. Hence, such an electron kept blowing itself to bits.

(4) Working in 1906, Poincaré found that he could get a finite particle with the right mass if he introduced a set of phenomenological forces, apart from electromagnetism,

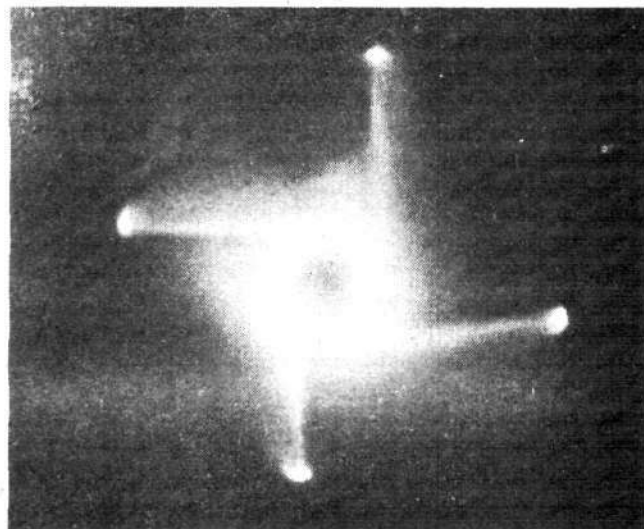
THE EXISTENCE OF THE ELECTRON THREE VIEWS



Imagine an extremely small dot [a], as small as you like but still with finite extent. This is the usual conception of an electron. However, this sort of electron necessarily suffers a violent death—by explosion. The only forces operative in such a point particle are electrostatic, and these forces—no matter how arranged—are repulsive. Thus, the particle is blown to bits. Gravity cannot stabilize such a particle since the gravitational force is roughly 10^{42} times smaller than the electrostatic force, smaller by a ratio of 1 over 10,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000!

A small improvement on the problem is afforded by imagining the electron as a small ball [b], held together by some other force, nonelectromagnetic, that can balance the repulsive electrostatic force. This solution, however, is really a *deus ex machina* since there is no insight into where such other "forces" might come from. Even worse, as soon as one attempts a reasonable mechanical model for such a particle held together by these magical forces, classical mathematical physics shows that the particle cannot be casual. In other words, the equation for motion of a particle stabilized by these required nonelectromagnetic forces can sense forces acting on the particle externally before forces even come in contact with it! This is just one of the serious problems with the "ball particle" construct that scientists attempted to sweep under the rug.

Imagine now a ring of circulating charge as the basic structure of the electron [c]. Bostick shows in detail how such a vortex ring of rapidly moving charge can remain stable because it is able to balance the repulsive electrostatic forces between the like-charged elements of the ring against the magnetic forces created by the circulation of the charged elements. The net result is a dynamically stabilized structure. In addition, this ring shares a number of other properties of the electron that are known experimentally—its spin and its wavelike quantum behavior, for example.



In the mid 1950s, Bostick, then at Lawrence Livermore Laboratory, developed a means of creating stable plasma structures by colliding several [here four] plasma beams. The beams interact and form a rotating plasma structure whose dynamics are governed by a "balancing" of forces similar to his model of the electron.

At right, Bostick and coworker Dr. William Prior at work in their laboratory. Prior has been chiefly responsible for the design and construction of the diagnostics on the Stevens plasma focus.

that would balance the electrostatic repulsion. These forces became known as the *Poincaré stresses*. This electron seemed to be doing fine even though it was not electromagnetic anymore, until one tried to calculate an equation of motion for such a particle. The appropriate equation of motion shows that such an electron balanced with Poincaré stresses will move before a force gets to it; the effect precedes the cause!

Classical electromagnetism is known to fail on other grounds as well. Its modern elaboration, quantum electrodynamics, remedies some of the problems with electrodynamics in the microscopic realm, but fails as badly as classical theories in explaining the stability of the electron. In quantum field theory, the electron *must* be a point particle. But if it is a point particle, then it has not only infinite energy but also infinite mass and charge.

Most physicists agree that the inability to explain the existence of the electron, as evidenced in the problems noted above, shows that electrodynamics is inadequate in both its classical and quantum form. As Bostick's article shows, however, the situation is not so simple. There is no doubt on many grounds that electrodynamics is wrong, but the failure of the above attempts to describe the electron is not evidence of the overall failure of electrodynamic theory. Bostick is able to show that a more sophisticated dynamic or process conception of what a particle really is allows even classical electrodynamics to describe some singular properties in thermodynamics, like the electron.



Photo by Ulanowsky

In other words, with a more rigorous epistemological approach, one can salvage some important results from classical electromagnetic theory.

The issue is as follows: The static assumptions of Lorentz neglect to ask the central question: What is a particle? As Bostick demonstrates, once the answer to this question is understood, then we can try to build a model of it. A particle is not a blob! A model that begins with the blob assumption is doomed to suffer the electrostatic explosion of its constituents.

As future articles in this *Fusion* series will elaborate, the particle represents a much more complex and interesting object whose most immediate characteristic Bostick has identified: It is not statically stable.

The real problem with describing a particle's existence is not stability but what Bostick calls its energy storage. This concept pervades Bostick's approach and is the key to understanding where Bostick differs from the past attempts at solving the problem of the electron. The electron is not a little ball; it is a dynamic mechanism for energy storage, and so, it turns out, is every other "stable" entity. Reflection on this idea shows that energy is never stored in little balls but always by some highly interacting, dynamic structure.

This fundamentally different outlook immediately bears fruit when applied to the problem of the existence of the electron, even if within the framework of classical electrodynamics. As noted above, Maxwell's equations state that

the force inside the electron consists of two parts — one static (electric) and the other dependent on the velocity of the internal parts of the electron. Given an understanding of the dynamic nature of stability and energy concentration, what could be more natural than to try to balance these two forces off against one another. The only way this is possible is through the *self-structured* arrangement of that energy. Bostick has designed a microscopic analogue of plasma and fluid vortices and used this vortex as the ordered structure through which the electric and magnetic forces can be dynamically balanced to give "stability."

As a not-so-minor side attraction of Bostick's model, the spin, magnetic moment, and some quantum features of the electron also become explicable! Because Bostick's electron is not a simple clump, it can sustain a concentration of energy in a mathematically consistent way, and this dynamic energy concentration can give rise to electrical and gravitational properties experimentally associated with the electron. Bostick's vortex is, of course, not without its own ad hoc assumptions and epistemological difficulties, but the striking point that he demonstrates is that even a simple appreciation of the actual quality of a physical singularity — *that it is not a static lump* — already contains within it a tremendous rich body of physics. ❁

—Dr. Steven Bardwell and Dr. Morris Levitt

Toward Understanding The Nature of Fusion Energy

by Dr. Winston H. Bostick

IN THE EXOTHERMIC fusion reactions $d(d,n) He^4$ and $d(d,p) H^3$, which yield net energy of $Q \cong 3.27$ Mev and 4.04 Mev, respectively, in the form of kinetic energy of the reaction products, an amount of mass, m , is annihilated according to the famous Einstein formula $mc^2 = Q$. The Einstein relation is so universal and all inclusive and so beautifully derived from basic, philosophical principles that, for many readers of the fusion scene, it is the last and only word that need be spoken concerning the nature of fusion energy.

However, if one wishes to inquire more in detail concerning the origin of this mass loss when two deuterium nuclei interact, one must face that as-yet-poorly-charted sea of strong, short-range interactions in nuclei and the very nature of the elementary particles themselves. Such a confrontation thus far has caused a crisis among the professional elementary particle physicists. Consequently, the understanding of the nature of the particles has seemed hopelessly beyond the grasp of an otherwise informed laity of plasma physicists, engineers, metallurgists, chemists, and people professionally and generally interested in fusion energy.

It would be considered an impudent act indeed if, for example, a plasma physicist were to attempt to elucidate the nature of this fusion energy by bringing the concept of the elementary particle down to earth in dynamical and determinist terms that the layman could picture in his mind. Such

Winston H. Bostick has been George Meade Bond Professor of Physics at Stevens Institute of Technology since 1956, and for 12 years he headed the Stevens Department of Physics. He has written more than 90 scientific papers, mostly on plasma physics, including an article for *Scientific American* and contributions to *Colliers Encyclopedia* and *Encyclopedia Americana*. Bostick is a member of the initiating editorial board of the *FEF's International Journal of Fusion Energy*.

an impudent Promethean attempt certainly would draw the wrath of the Olympian elementary particle theoreticians. The Olympian theoreticians all have been well indoctrinated in the concepts and catechism of quantum mechanics, which is, among other things, a kind of scientific equivalent of "women's lib." These Olympians are wont quite naturally to characterize as crackpot any paper on the nature of elementary particles that harks back to the old-fashioned, classical, dynamical, pre-lib virtues of equilibrium and stability. But, it is just these classical concepts of equilibrium and stability, so useful in fluid mechanics and plasma physics, that the author proposes to employ in drawing a portrait of an elementary particle, namely, the electron, the simplest of all elementary particles. The author proposes to elucidate in some detail the nature of the mass energy of the electron.

The audacity to commit this monumental impudence is supported within the author's mind by the knowledge that our Founding Fathers (and also Clemenceau) firmly believed "war is too important to be left entirely to the generals." And the author also is aware that the organic gardening and natural food movements are evidence that some people believe that health is too important to be left entirely to the professionals of the American Medical Association, U.S. Department of Agriculture, U.S. Food and Drug Administration, U.S. Public Health Service, and the food-processing conglomerates. The concept of energy storage in the elementary particle is perhaps too important to be left exclusively to the elementary particle theoretician. Thus emboldened, the author launches this heresy that flies in the face of quantum electrodynamics, whose spectacular numerical victories are celebrated widely by the Olympian theoreticians.

The author has been admonished by his professional friends that if his portrait of the electron could but bring forward some feature not heretofore calculated sufficiently accurately by Dirac or quantum electrodynamics, then per-

haps the Olympians would be less hostile. The portrait, alas, predicts spin $\frac{1}{2}$ for the electron—no more accurately than Dirac. The portrait, alas, predicts the $(1 + \alpha/2\pi - \dots)$ corrections to the magnetic moment of the electron more crudely than quantum electrodynamics.

Other professional friends have given the advice that if these ideas only could be formulated in the ultra-sophisticated language of the elementary particle theoretician, then perhaps the Olympians would listen more patiently. But again, alas, the author's humble talents can provide only a simple, unembroidered presentation.

In the existential sense, however, the author's portraiture has a triumph: the portrait can account for the *existence* of the electron by arguments involving the concept of equilibrium, and there are no embarrassing self-energy infinities. The point-charge particle of quantum electrodynamics, on the other hand, cannot exist, it will blow itself apart with very large (if not infinite) energy. And the author submits that existence is a property of the electron that cannot be overlooked; existence is really as important as some of the other properties of the electron that have been calculated so accurately by quantum electrodynamics. Furthermore, the author's portrait shows that the DeBroglie waves for the electron are a *necessity* (not an *ad hoc* attachment) if the electron is to exist as an *equilibrium* configuration. The author's portraiture also shows that vortices (and their accompanying inertial waves) in fluid mechanics provide complete macroscopic analogues to DeBroglie waves, $m = m_0(1 - \beta^2)^{-1/2}$, $E = h\nu$, and the photon.

This particular publication, *Fusion*, has editors who are self-confessedly interested in self-ordered phenomena. The author, therefore, takes the opportunity to put forth in these pages his ideas that have been brewing for the last 23 years.

We thus begin the brush strokes for the portrait of energy storage in an electron.

A Rationale Via Plasma Physics

The concentrated plasma nodules (ion density $n \cong 10^{21} \text{ cm}^{-3}$, $B \cong 6 \times 10^6$ gauss) that are produced in the plasma focus (Bostick 1972) are force-free toroidal circulation cells, spontaneously formed out of a much less dense continuous medium of plasma and magnetic field ($n \cong 10^{16} \text{ cm}^{-3}$, $B \cong 10^3$ gauss). The minimum dimensions of these structures are about 0.1 mm (the diameter of the "channel"), and they are formed out of a pinched column that has a diameter of about 4 mm. The spontaneous formation of these energy-concentrated small (yet macroscopic) plasma structures not only should give food for thought to scientific bureaucrats of the U.S. Controlled Thermonuclear Research program (now called Magnetic Fusion Energy) who have stated that the research phase of the U.S. CTR is to be considered as completed; it should also stimulate the intellectual world at large to contemplate a possible analogue blueprint for the concentrated storage of energy in the elementary particle.

The Elastic Flywheel Model

In considering a model for the energy storage in a particle like the electron, let us contemplate first the storage of both kinetic energy $\frac{1}{2}m_0v^2$ and elastic potential energy $\frac{1}{2}k(2\pi R)^2$

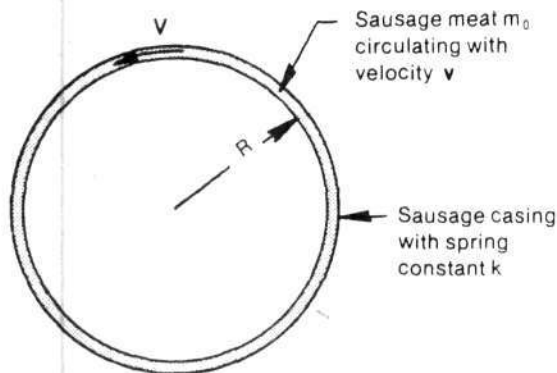
in the rim of a perfectly elastic flywheel (Figure 1) where m_0 is the mass of the rim and k is the elastic spring constant of the rim. It can be shown easily that for an equilibrium radius, $\frac{1}{2}m_0v^2 = \frac{1}{2}k(2\pi R)^2$; that is, the virial theorem holds.

The elastic rim on the elastic flywheel could be visualized as a toroidal, massless elastic sausage casing with a spring constant k , in which the sausage meat of mass m_0 circulates without friction with a velocity v . We will assume that the initial radius $R_0 = 0$.

An interesting case evolves in the relativistic gedanken experiment where the velocity of the sausage meat v approaches the speed of light c . Then the kinetic energy $mc^2 - m_0c^2$ approaches mc^2 where $m = \gamma m_0$, $\gamma = \sqrt{1 - \beta^2}$, $\beta = v/c$, $\gamma \gg 1$, and $\frac{1}{2}k(2\pi R)^2$, the elastic potential energy, still equals the kinetic energy. The total energy then approaches $2mc^2$. If the observer picks up the torus and weighs it on the scale, he will record a weight of $2m$. If his physics teacher asks him to compute the angular momentum of such an effective relativistic mass $2m$ traveling at the speed $v \rightarrow c$ at a radius R , he will say that the angular momentum (or spin) s is equal to $2m c R$. However, we know that he is wrong because the elastic potential energy that contributes to the total energy does not contribute to the spin. We know, therefore, that the spin is only $m c R$, not $2m c R$, and we could say, therefore, that the spin is $\frac{1}{2}$, that is, just one-half of what one naively would expect. The elastic containing force enables equilibrium to be attained (that is, it holds the torus together) and causes the spin to be half.

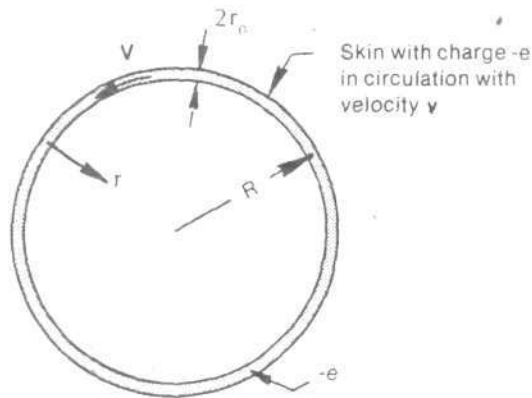
Let us now construct the electromagnetic counterpart of the mechanical meat-sausage-casing flywheel of Figure 1.

Figure 1
PERFECTLY ELASTIC FLYWHEEL



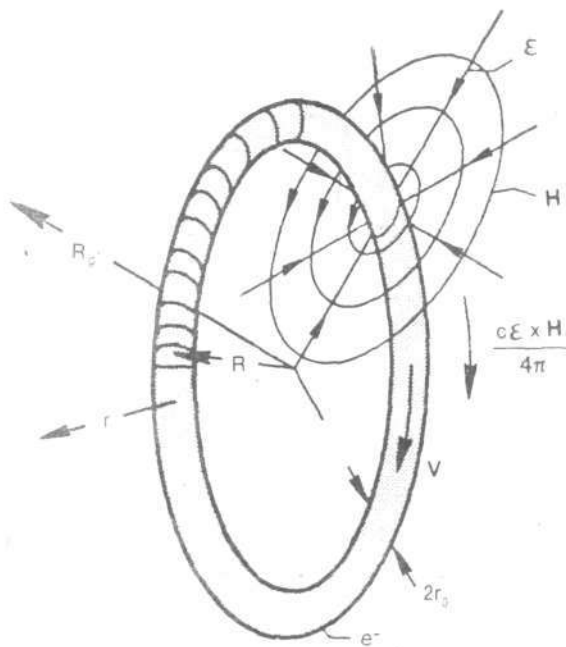
By balancing its kinetic energy of rotation [$\frac{1}{2}m_0v^2$] against its potential energy [$\frac{1}{2}k[2\pi R]^2$ —in the casing], this flywheel is a model for more complex forms of energy storage in dynamic equilibrium.

Figure 2
ELECTROMAGNETIC FLYWHEEL



The electromagnetic analog of an elastic flywheel supports itself in a dynamic equilibrium by balancing its energy content in the electric field $[\epsilon]$ and the magnetic field H —see Figure 3.

Figure 3
ELECTROMAGNETIC FLYWHEEL
WITH ϵ AND H VECTORS



The stability of this flywheel is due to the interaction of the fields it creates.

Suppose the toroidal sausage casing consists of a massless superconductor (thin toroidal shell) that has a linear spring constant k . We charge the casing uniformly with a massless charge $-e$ that circulates with a velocity $v = c$ in the toroidal direction. The concept of the charge and its circulation are involved merely to generate the electric field ϵ and magnetic field H in the region $r_0 < r \ll R$ in Figures 2 and 3. The energy and angular momentum are stored in these vectors and (largely) in this space (Bostick 1958 and 1961).

The total electromagnetic energy E for $r_0 \ll R$ is given approximately by

$$E \cong 2\pi R \int_{r_0}^R \frac{(\epsilon^2 + H^2)}{8\pi} \cdot 2\pi r dr = \frac{e^2}{\pi R} \ln \left(\frac{R}{r_0} \right) \cong mc^2$$

where $\epsilon = H = e/\pi R$ cgs.

It is crucial that the charge e circulate at $v = c$ so that ϵ , which tends to explode the channel by increasing r_0 , is perfectly balanced by H , which tends to compress the channel about r_0 .

The Poynting vector $c\epsilon \times H/4\pi$ carries the angular momentum or spin, and this spin is given by

$$2\pi R \cdot R \int_{r_0}^R \frac{(\epsilon \times H)}{4\pi c} \cdot 2\pi r dr \cong \frac{e^2}{\pi c} \ln \left(\frac{R}{r_0} \right) = mRc.$$

The elastic potential energy $\frac{1}{2}k(2\pi R)^2$ stored in the elastic casing is equal to the electromagnetic energy E , so the total energy stored in the ring is $2mc^2 = m_1c^2$, and the mass of the ring, if weighed on a scale, is $m_1 = 2m = 2E^2/c$. However, the angular momentum or spin is mRc and not $2mRc$ ($=m_1Rc$), and hence the spin can be said to be $\frac{1}{2}$.

Energy Stored in the Electron's Rest Mass Considered As Energy Stored In an Electromagnetic Flywheel

The ultimate example in high-density electromagnetic energy storage is the elementary particle, for example, the electron. This section shows how the model of Figures 2 and 3, when given the appropriate microscopic dimensions for the electron, accounts for the electron's rest energy, the spin $\hbar/2$, the "double" magnetism, and the anomalous gyromagnetic ratio $\cong e/2m_e c \cdot 2(1 + \alpha/2\pi)$ where $\alpha = e^2/\hbar c = 1/137$.

If we set the spin of the torus of Figure 3 equal to the spin of the electron, $\hbar/2$, where $\hbar = h/2\pi$ and h is Planck's constant, $\hbar/2 = e^2/\pi c \cdot \ln(R/r_0) = \text{spin}$. Here $e^2/\hbar c = \pi/2 / \ln(R/r_0) = 1/137 = \alpha$, the fine structure constant. The charge $-e$ is now the electron's charge.

If the monopole electric energy, ΔE , in the spherical region (see Figure 3) of radius $R_0 \geq 2\pi R$ is added to $2E$ to obtain the new total energy, $E_1 \cong 2(E + \Delta E)$, the new total mass $m_1 = 2(E + \Delta E)/c^2$, where $\Delta E \cong e^2/4\pi R$, and thus

$$m_1 \cong \frac{2e^2}{\pi R c^2} \ln \left(\frac{R}{r_0} \right) \left(1 + \frac{1}{4 \ln(R/r_0)} \right) = 2m \left(1 + \frac{\alpha}{2\pi} \right)$$

Since the magnetic field falls off as a dipole field in the region $R_g \geq 2\pi R$, this ΔE makes essentially no contribution to the spin, although it does contribute to the total energy and hence to the total mass m_1 . That is, in the region $R_g \geq 2\pi R$, the Poynting vector vanishes.

The current in the torus is $e/2\pi R$ and the magnetic moment of the torus is $\mu = \pi R^2 i = eR/2$ (cgs). The magnetic moment for the electron can be written as $\mu_e = e\hbar k'/2m_e c$ where k' is a constant $\cong 1$, now to be evaluated in terms of the torus. If we put μ for the torus equal to μ_e and $m_1 = m_e$, the electron mass,

$$\frac{e\hbar k'}{2m_1 c} \cong \frac{e\hbar k'}{2 \cdot 2m(1 + \alpha/2\pi)} = \frac{eR}{2}$$

$$R = \hbar k'/2m \left(1 + \frac{\alpha}{2\pi}\right) c$$

and $\frac{\hbar}{2} = mRc = m\hbar k'c/2m \left(1 + \frac{\alpha}{2\pi}\right) c$

and $k' \cong 1 + \frac{\alpha}{2\pi}$.

Thus the gyromagnetic ratio for the torus is given by

$$g = \mu/s = \frac{e\hbar k'}{2m_1 c} / \hbar/2 \cong \frac{2e}{2m_1 c} \left(1 + \frac{\alpha}{2\pi}\right)$$

which is of the same form as that for the second order correction for the electron. In determining $\Delta E = e^2/4\pi R$, the region $R_g \geq 2\pi R$ (see Figure 3) was obviously very roughly estimated. For the torus $\alpha = \pi/2/\ln(R/r_0)$ and $R \cong \hbar/m_1 c = \lambda_c/2\pi$ where λ_c is the Compton wavelength of the electron.

The electron model of Figure 3 also exhibits quantization of magnetic flux Θ : For the torus of core radius r_0 and large radius R

$$\begin{aligned} \Theta &\cong 2\pi R \int_{r_0}^R H dr = 2\pi R_0 \int_{r_0}^R \frac{e dr}{\pi r R} \cong 2e \ln \left(\frac{R}{r_0} \right) \\ &= \frac{\pi \hbar c}{e} = \pi \text{ fluxons} \end{aligned}$$

since $e^2/\hbar c = \pi/2/\ln \left(\frac{R}{r_0} \right)$ and one fluxon $= \frac{\hbar c}{e}$

Thus the energy storage in the model of Figure 3 becomes a high-fidelity analogue of the electron itself.

We now address ourselves to the construction of a "sausage casing" that can have a tensile strength in the toroidal direction.* Considering a charged toroidal thread of the same general form as Figure 3, where the large radius is R_g the small radius r_{0g} and the charge $-e$ is circulating with $v = c$. The values of r_{0g} considered here are much smaller than r_0 .

$$\epsilon = H = e/\pi r_g R_g \text{ for } r_{0g} < r_g < R_g$$

The electromagnetic-field-energy of this torus is

$$E_f \cong \frac{e^2}{\pi R_g} \ln \left(\frac{R_g}{r_{0g}} \right); \ln \left(\frac{R_g}{r_{0g}} \right) \gg 1.$$

The energy density ${}_d E_f$ of this electromagnetic field is

$${}_d E_f = \frac{1}{8\pi} (\epsilon^2 + H^2) = \frac{1}{4\pi} \frac{e^2}{\pi^2 R_g^2 r_g^2}$$

The mass density ρ associated with this electromagnetic field is

$$\rho(r_g) = \frac{1}{4\pi c^2} \cdot \frac{e^2}{\pi^2 R_g^2 r_g^2}$$

By Gauss's theorem the gravitational field f_g associated with this spatial distribution of e can be calculated thus:

$$2\pi r_g f_g = 4\pi G \int_{r_{0g}}^{r_g} 2\pi r_g \rho dr_g$$

$$\text{or } f_g = \frac{e^2 G}{\pi^2 c^2 R_g^2 r_g} \ln \left(\frac{r_g}{r_{0g}} \right)$$

The energy density ${}_d E_g$ associated with this gravitational field is

$${}_d E_g = \frac{-f_g^2}{8\pi G} = \frac{-G}{8\pi} \cdot \frac{e^4}{\pi^4 c^4 R_g^4 r_g^2} \ln^2 \left(\frac{r_g}{r_{0g}} \right)$$

The total energy E_g in this spatial distribution of ${}_d E_g$ is

$$\begin{aligned} E_g &= -2\pi R_g \int_{r_{0g}}^{R_g} {}_d E_g 2\pi r_g dr_g \\ &= -2\pi R_g \int_{r_{0g}}^{R_g} \frac{2\pi G e^4 \ln^2(r_g/r_{0g}) dr_g}{8\pi \cdot \pi^4 c^4 R_g^4 r_g} \\ E_g &= -\frac{G e^4}{6\pi^3 c^4 R_g^3} \ln^3 \left(\frac{R_g}{r_{0g}} \right) \end{aligned}$$

Overall equilibrium between the expanding forces in the filamentary direction due to E_f and the contracting forces in the filamentary direction due to E_g occurs when $|E_g| = |E_f|$, or

$$\frac{e^2}{\pi R_g} \ln \left(\frac{R_g}{r_{0g}} \right) = \frac{G e^4}{6\pi^3 c^4 R_g^3} \ln^3 \left(\frac{R_g}{r_{0g}} \right)$$

which gives

$$\ln \left(\frac{R_g}{r_{0g}} \right) = \frac{6^{1/2} \pi c^2 R_g}{e G^{1/2}}$$

* See Bostick 1961. There are some mistakes in reasoning in the 1961 piece that the author has corrected in this presentation.

On the other hand local equilibrium in force density will occur at the value of r_k where $|E_r| = |E_k|$ or

$$\frac{e^2}{4\pi^3 R_k^2 r_k^2} = \frac{Ge^4}{8\pi^5 c^4 R_k^4 r_k^2} \ln^2 \left(\frac{r_k}{r_{0k}} \right)$$

or where

$$\ln \left(\frac{r_k}{r_{0k}} \right) = \frac{2^{1/2} \pi c^2 R_k}{eG^{1/2}}$$

This particular value of r_k is thus given by

$$\ln \left(\frac{R_k}{r_k} \right) = 3^{1/2}$$

or

$$\frac{R_k}{r_k} \cong 6.9$$

A plot of $|E_r|$ and $|E_k|$ as a function of $\ln(R_k/r_{0k})$ would look something like Figure 4 (not to scale) where it can be seen that

$$|E_r| > |E_k| \text{ for } \ln \left(\frac{r_k}{r_{0k}} \right) < \frac{2^{1/2} \pi c^2 R_k}{eG^{1/2}}$$

and

$$|E_r| < |E_k| \text{ for } \ln \left(\frac{r_k}{r_{0k}} \right) > \frac{2^{1/2} \pi c^2 R_k}{eG^{1/2}}$$

The overall gravitationally equilibrated filament, therefore, will behave like a rubber rod inserted through the hole in a rubber hose; the rod is under compression and the hose is under tension. If the rod is free to twist inside the hose the ensemble will assume a helical configuration as shown in the photograph in Figure 5. Thus, we can expect this massless, ($E_k = -E_r$) gravitationally equilibrated fiber to assume a helical configuration as shown in Figures 6 and 7. The locus of this fiber becomes the torus of small radius r_0 , and the net velocity c of the charge $-e$ in the toroidal direction (for the torus of Figures 3, 6, and 7) is the resultant of the circulation velocity of c along the helical gravitationally equilibrated fiber and the local normal velocity of this helical fiber on the surface torus of small radius r_0 . The helical fiber thus becomes the *massless* helical spring ("sausage casing") with the spring constant k to give equilibrium to the torus of Figure 3 against expansions of R , to make the total mass $m_T \cong 2m$, and give spin $1/2$. Now

$$\begin{aligned} E_r = |E_k| &= \frac{e^2}{\pi R_k} \ln \left(\frac{R_k}{r_{0k}} \right) \\ &= \frac{e^2}{\pi R_k} \cdot \frac{6^{1/2} \pi c^2 R_k}{eG^{1/2}} = \frac{6^{1/2} e c^2}{G^{1/2}} \end{aligned}$$

$$\begin{aligned} E_r = |E_k| &= 2.7 \times 10^{15} \text{ ergs} \\ &= 1.7 \times 10^{27} \text{ eV} \cong 3 \times 10^{21} \end{aligned}$$

electron masses, which is large but not infinite, and $E_r + E_k = 0$, so that these two giants are exactly in balance. The value of

$$\ln(R_k/r_{0k}) = 1.2 \times 10^{17}$$

and if we take R_k to be equal to R , the Compton wavelength divided by 2π , r_{0k} is much smaller than r_0 and can provide essentially a skinlike charge on the torus of small radius r_0 . The torus of Figure 3 is in neutral equilibrium for perturbations in r_0 because $E = H$. It should, therefore, not be subject to the sausage and kink instabilities of pinch-effect fame.

The tensile stress supplied by the helical gravitationally equilibrated fiber in the form of the spring with the constant k , which equilibrates the torus of Figure 3 in the toroidal direction, is equal to

$$\begin{aligned} \frac{e^2}{\pi R} \left(\ln \frac{R}{r_0} \right) \cdot \frac{1}{2\pi R} &= \frac{m_e c^2}{2} \cdot \frac{1}{2\pi R} \\ &= 1800 \text{ dynes} \cong 2 \text{ grams.} \end{aligned}$$

For a hadron of rest energy $\cong 1.5$ GeV, in comparison with the electron of rest energy 0.51 MeV, the stored energy is greater by 3×10^4 and the value of R is less by a factor 3×10^4 . Therefore corresponding tension for such a hadron is $1.8 \times 10^4 \times 9 \times 10^6 \text{ dynes} = 16 \times 10^9 / 10^9 = 16$ tons. This can be compared with the figure of 13 tons quoted for the tension in the "light-string" model of the hadron (Schwarz 1975).

To determine the stress in terms of force/cm² corresponding to the 2 grams for the electron we note that with

$$\ln \left(\frac{R}{r_0} \right) = 137 \frac{\pi}{2}$$

$$\text{and } R = 3.8 \times 10^{-11} \text{ cm, } R/r_0 = 10^{93}$$

$r_0 = 0.38 \times 10^{-101} \text{ cm}$. We will take an effective area of about $2\pi r_0^2$. The stress is thus about 2×10^{200} metric tons/cm².

For the gravitationally equilibrated fiber of radius r_{0k} whose locus makes the torus of small radius r_0 and whose configuration supplies the spring constant k for the electron, we can calculate the gravitational tension in the fiber necessary to equilibrate the gravitational attractive force (tensile force along the fiber) with explosive electromagnetic force that tends to tear the fiber.

The value of $|E_k| = E_r = ec^2/\sqrt{G} = 2.7 \times 10^{15}$ ergs.

The tension can be roughly computed to be $E_r/2\pi R = 1.2 \times 10^{24} \text{ dynes} = 1.2 \times 10^{16}$ metric tons.

The stress in dynes/cm² or tons/cm² of this gravitationally equilibrated fiber is fantastically large.

The importance of this type of model for elementary particles is beginning to be recognized by the elementary

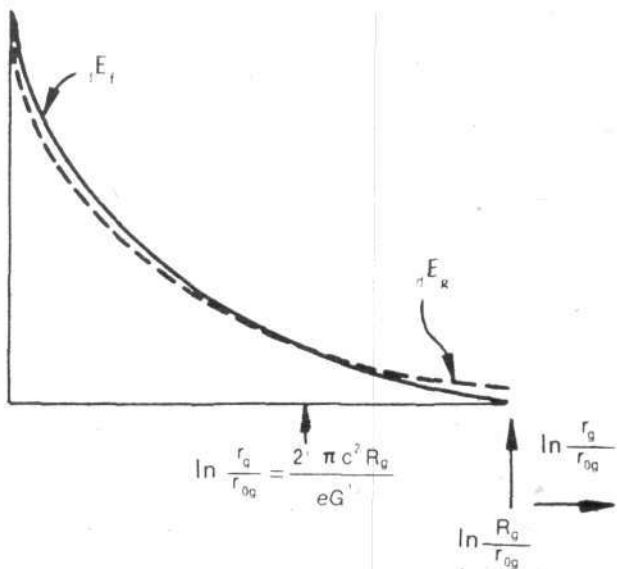


Figure 4

The force density of the contracting forces in charged rotating filament, E_r , and the expanding force density, E_f . These two force densities are plotted against $\ln [r_g/r_{0g}]$, and the equilibrium condition is shown at the point that the two force densities are equal and opposite.

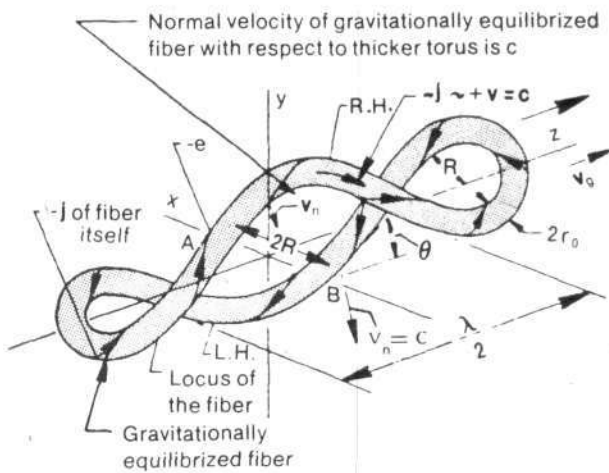


Figure 6

HELICAL TWISTING OF A GRAVITATIONALLY STABILIZED CHARGE FILAMENT

From the constructions shown, the quantum mechanical results relating momentum and wavelength follow naturally from the conditions necessary for stable energy storage in the filament.

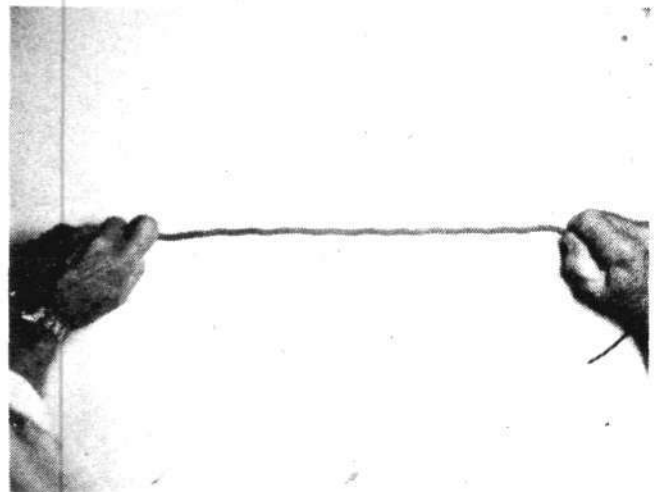


Figure 5

THE HELICAL EQUILIBRIUM CONFIGURATION FORMED BY A RUBBER ROD UNDER LENGTHWISE COMPRESSION INSIDE A RUBBER HOSE UNDER LENGTHWISE TENSION

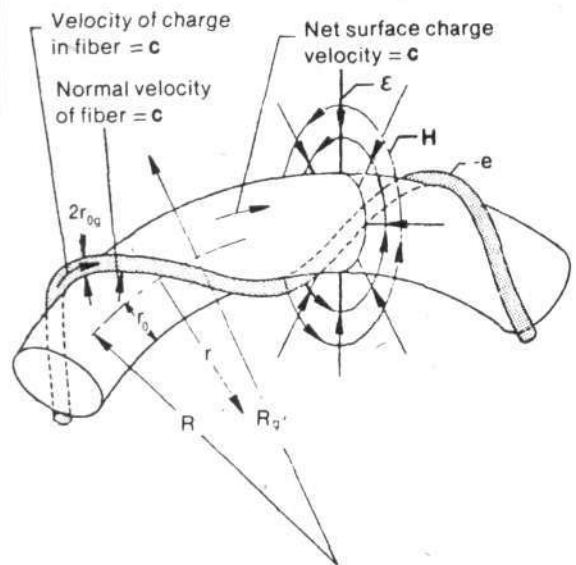


Figure 7

DETAIL SHOWING THE WAY IN WHICH THE GRAVITATIONALLY EQUILIBRATED, CHARGED FIBER PRODUCES THE SURFACE CHARGE AND CURRENT FOR THE TORUS OF SMALL RADIUS r_0

particle physicists who are now using models based on the "theory of light strings" to describe hadrons when they speak of tensions of 13 tons in the strings (Schwarz 1975).

Figure 6 shows how the toroidal electromagnetic flywheel of Figure 3 becomes the two-wave functions ψ and ψ^* (for a free particle) with the appropriate deBroglie wavelength as it moves with a group velocity v_g with respect to the observer. (See Appendix A.) Here it can be easily shown that $v_g \cdot v_p = c^2$, where v_p is the phase velocity, since $v_g = c \sin \theta$ and $v_p = c/\sin \theta$. (See Figure 6.)

The crucial point here is that the normal velocities v_n of the toroidal filament of radius r_0 must be equal to c in order for the configuration to be an equilibrium configuration. (See Appendix A.)

An electromagnetic wave in a wave-guide is functionally very similar to this model of an electron moving with a group velocity $v_g = c \sin \theta$ and a phase velocity $v_p = c/\sin \theta$ where in the wave-guide the angle θ is the angle between the reflecting walls and the wave front.

There are also models for energy storage in the photon and neutrinos, particles of "zero rest mass" (Bostick, unpublished work). Figure 8 is a model of the storage of energy in a right-hand circularly polarized photon. (See Appendix C.) The basic difference between particles of finite rest mass and zero rest mass is this: Particles of finite rest mass have their charged filaments and Poynting vectors circulating at the speed of light in a toruslike structure (Figures 3, 6, and 7). Particles of zero rest mass have their filaments and Poynting vectors projected, like arrows, rectilinearly at the speed of light (Figure 8).

Indeed photons reflecting back and forth ($\theta = 0 =$ angle between wavefront and walls) between the walls of a cavity or a wave-guide have a "finite rest mass" in the laboratory frame of reference. If these photons now reflect at the angle $\theta > 0$ with respect to the walls of the wave guide, this "rest mass" is transported at a group velocity $v_g = c \sin \theta$, just as with the deBroglie wave and with our electron model of Figure 6.

The proton and mesons, although more complicated than the electron, also can be modeled similarly to the finite-rest-mass electron model of Figures 3, 6, and 7 (Bostick, unpublished work).

The generalization now can be made that all stored energy (including the kinetic energy of macroscopic bodies) is electromagnetic energy, remembering that it has self-gravitational properties. And all macroscopic momentum, angular and linear, is the summation of the Poynting vectors of all the elementary particles making up the macroscopic body.

Even the mysterious short-range, "strong forces" that give rise to the binding energy in the nucleus (and energy production in the stars) can be explained as electromagnetic forces that result from the configuration of telescoped ring-like particles in the nucleus. The author predicts that the unity and consistency of nature eventually will prevail in the minds of man with the recognition that there are no mysterious energies or forces, only electromagnetic fields with self-gravitation. The mysterious nature of the "strong forces" will go the way of the epicycles of Ptolemy and the phlogiston of

the late 18th century.

Einstein (1953) speaks of an averaged "inward pressure" that is equal to one-half the average mass density of the universe and that binds the electromagnetic energy of the particles of finite rest mass into those particles. This averaged inward pressure we now identify with the elastic hoop stress force (sausage casing with spring constant k) formed by the gravitational fiber in the configuration shown in Figures 6 and 7, which is responsible for spin $1/2$.

We can also remind ourselves that the universe as a whole is of such a mass density and radius that the gravitational potential energy of a particle of mass m in the universe is equal to $-mc^2$. Therefore, the universe as a whole has essentially zero net stored energy content, its gravitational energy being equal and opposite to its mass energy: a photon struggling to escape the gravitational field of the universe will be Doppler-shifted down to zero frequency in the attempt.

Finally, in the energy stored in vortices in fluid mechanics it is possible to make a complete macroscopic analogue of the flywheel model of the electron of Figures 3 and 6, and also of the photon of Figure 8 (Bostick, unpublished work).

Consider a vortex produced between the two solid plates, as shown in the idealized velocity profile in Figure 9 where the undisturbed hydrostatic pressure in the liquid is p_0 . Most of the kinetic energy is contained in the irrotational region where $r_1 < r < \infty$ and

$$v = \frac{v_1 r_1}{r} = \frac{\Gamma}{2\pi r}$$

The vortex circulation is $\Gamma = 2\pi v_1 r_1$. The kinetic energy per unit length of the vortex is

$$\begin{aligned} KE &\cong \int_{r_1}^{r_2} 2\pi r \rho v^2 dr = \rho 2\pi \frac{\Gamma^2}{4\pi^2} \int_{r_1}^{r_2} \frac{dr}{r} \\ &= \frac{\rho \Gamma^2}{2\pi} \ln \left(\frac{r_2}{r_1} \right) \end{aligned}$$

The vessel must be terminated at a radius $r_2 < \infty$ if the kinetic energy is to remain finite. The pressure is given by (for $r_1 < r < \infty$)

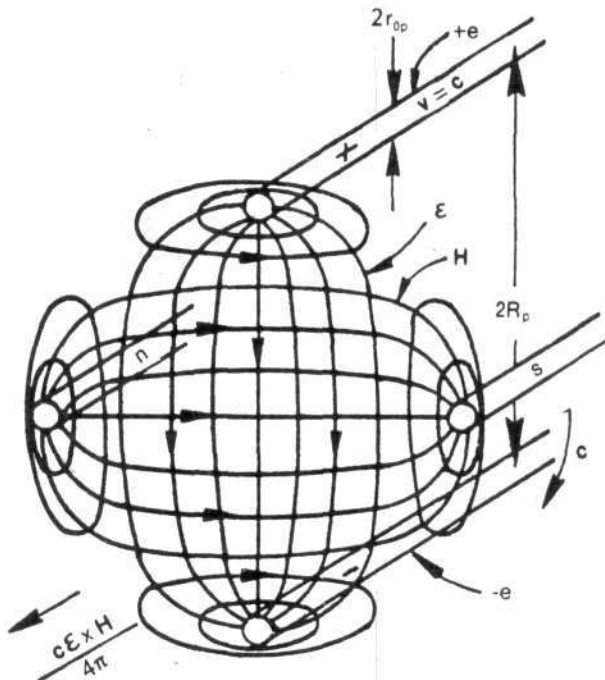
$$dp = -\frac{\rho v^2}{r} dr = -\rho v_1^2 r_1^2 \frac{dr}{r^3}$$

Then,

$$\begin{aligned} p &= p_0 - \int_r^{\infty} \rho v_1^2 r_1^2 \frac{dr}{r^3} \\ &= p_0 - \frac{\rho v_1^2 r_1^2}{2\pi r^2} = p_0 - \frac{\rho v^2}{2} \end{aligned}$$

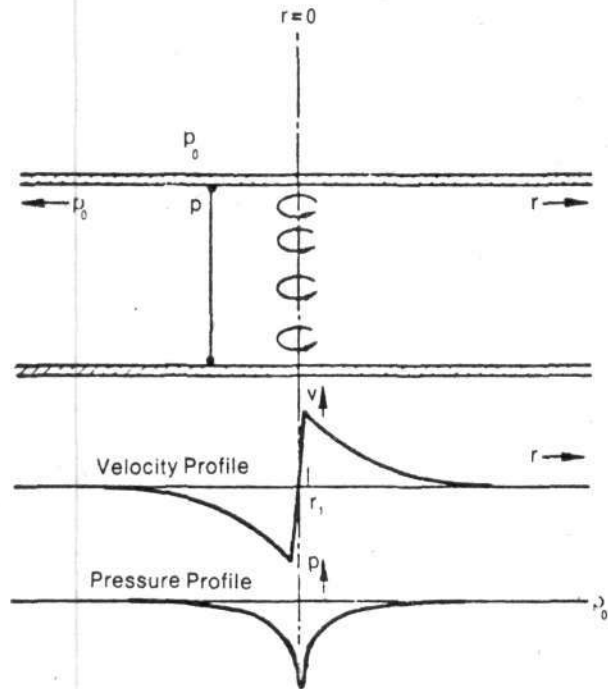
which gives the pressure profile shown in Figure 9. There is a pressure differential $p_0 - p = (\rho v^2/2)$ across each metal plate, which one can consider to be produced by elastic

Figure 8
ENERGY STORAGE IN MODEL OF A RIGHT-HANDED
CIRCULARLY POLARIZED PHOTON



The central distinction between the stabilized filaments in massless particles [like the photon] is that they are rectilinear rather than toroidal.

Figure 9
ENERGY STORAGE
IN A FLUID MECHANICAL VORTEX



The vortex is produced between two parallel plates, about the axis $r=0$.

bands attached to the inner surfaces of the plates. The elastic potential energy in these stretched bands per unit volume is $\rho v^2/2$, which is locally equal to the kinetic energy density.

If we take the rectilinear vortex segment of Figure 9 and permit it to be a torus of rest mass m_{0v} defined as E_{0v}/c_s^2 where E_{0v} is the kinetic energy of rotating fluid in the vortex and c_s is the sound speed, we can construct a macroscopic vortex analogue of the electron model of Figures 3 and 6 complete with deBroglie (inertial) waves, $E = h\nu$, and $m = m_0(1 - \beta^2)^{-1/2}$. We illustrate the beginning of this construction: We can calculate this kinetic energy E_{0v} to be

$$E_{0v} \cong 2\pi^2 \rho v_1^2 r_1^2 R_v \ln \left(\frac{R_v}{r_1} \right) = \frac{\rho \Gamma^2}{2} R_v \ln \left(\frac{R_v}{r_1} \right)$$

where R_v is the large radius of the toroidal vortex and Γ is the vortex circulation. If we now translate the toroidal vortex through the background fluid medium, with a group velocity v_g (with respect to this medium) parallel to the plane of the vortex, the magnus forces will deform the vortex into the shape of Figure 6 and the wave functions ψ and ψ^* generated by the two counterrotating translating helical vortex filaments (which are inertial waves) "swim" upstream

through the background medium. The wave function (see Appendix A) $\psi(z,t) = R_v \cdot \exp[i(\omega t - kz)]A(z,t)$ is the helical centerline of the left-handed helix rotating in the right-handed sense and $\psi^* = R_v \cdot \exp[-i(\omega t - kz)]A(z,t)$ is the centerline of the right-handed helix rotating in the left-handed sense. Both helices are also being translated in the z direction. $A(z,t)$ is the amplitude or the envelope function of the wave packet. These rotating translating helices of Figure 6 should be recognized as inertial waves. $k = 2\pi/\lambda$. The normal velocities v_n shown in Figure 6 are then $v_n = v_1 r_1 / 2R_v$; the phase velocity $v_p = \omega/k = v_n / \sin\theta$; the limiting value for v_n is c_s , the sound speed in the fluid: If v_n were greater than c_s , shock waves would form and dissipate energy. Thus $v_g v_p \leq c_s^2$.

If we recognize from Figure 6 that (for a vortex and the electron model) $\lambda = 2\pi R_v / \tan\theta$, we can write

$$v_g = v_n \sin\theta = \frac{v_1 r_1}{2R_v} \sin\theta$$

$$= \frac{\pi v_1 r_1}{\lambda} \frac{\sin\theta}{\tan\theta}$$

$$\text{or } \lambda = v_1 r_1 \pi \cos\theta / v_g$$

In a gedanken experiment we now make a very special vortex which can execute the waves indicated in Figure 6 in which $v_p \rightarrow c_s$, and which possesses no more than the minimum values of v_1 , r_1 , and R_v to accomplish this. The rest mass of this special vortex we shall now call $m_{0v} = E_{0v}/c_s^2$. Also now $v_g v_p = c_s^2$.

We further define a macroscopic quantum of action h_v as $h_v = m_{0v} v_1 r_1 \pi = m_{0v} R_v c_s 2\pi$.

Then we can write

$$\lambda = \frac{m_{0v} v_1 r_1 \pi \cos\theta}{m_{0v} v_g} = \frac{h_v \cos\theta}{m_{0v} v_g} = \frac{h_v}{m_{0v} v_g / \sqrt{1 - \sin^2\theta}}$$

$$= \frac{h_v}{m_{0v} v_g / \sqrt{1 - \beta_v^2}} = h_v / m_v v_g$$

where

$$m_v = m_{0v} (1 - \beta_v^2)^{-1/2} = \gamma m_{0v}; \quad \beta_v = v_g / c_s$$

The frequency $\nu = \omega/2\pi$ measured by an observer at rest in the background fluid is given by

$$\nu \lambda = v_p = c_s^2 / v_g = c_s^2 m_v \lambda / h_v$$

or

$$h_v \nu = m_v c_s^2, \text{ which equals}$$

the total energy stored in this vortex (of the shape of Figure 6) as it moves with a group velocity v_g with respect to an observer in the frame of the background fluid medium.

Thus, with the definition of $m_{0v} = E_{0v}/c_s^2$ and the knowledge that the vortex will change into the configuration of Figure 6 with the rotating and translating helical wave functions ψ and ψ^* we have derived the most famous of all energy storage formulae, namely, the Planck quantum hypothesis that the energy = $h\nu$ is proportional to the frequency.

It has been shown by Hasimoto that an ideal vortex filament can be expected to support helical waves that act like deBroglie waves because the appropriate equation is a nonlinear Schroedinger-type equation. Hasimoto's discovery adds strength to our prediction that the vortex will "swim upstream" with the deBroglie type waves as indicated in the general configuration of Figure 6.

We have emphasized that the flywheel configuration of Figure 1 at rest can exist as an equilibrium configuration only because of the elastic force constant k that gives rise to a potential energy $\frac{1}{2} k(2\pi R)^2$. Now we must emphasize that the "double helix" right-handed and left-handed configuration of the vortex moving at v_g with respect to the observer in the background medium can be an equilibrium configuration *only if* it swims *flagellatingly* as shown in Figure 6 with the normal velocities $v_n = c_s = v_1 r_1 / 2R_v$. We can also justify the configuration of Figure 6 to represent the free electron moving with v_g with respect to the observer: *Only when* the normal velocities $v_n = c$ will an element of length of the right-handed wave function ψ have its net electric current *perpendicular* to the current of the corre-

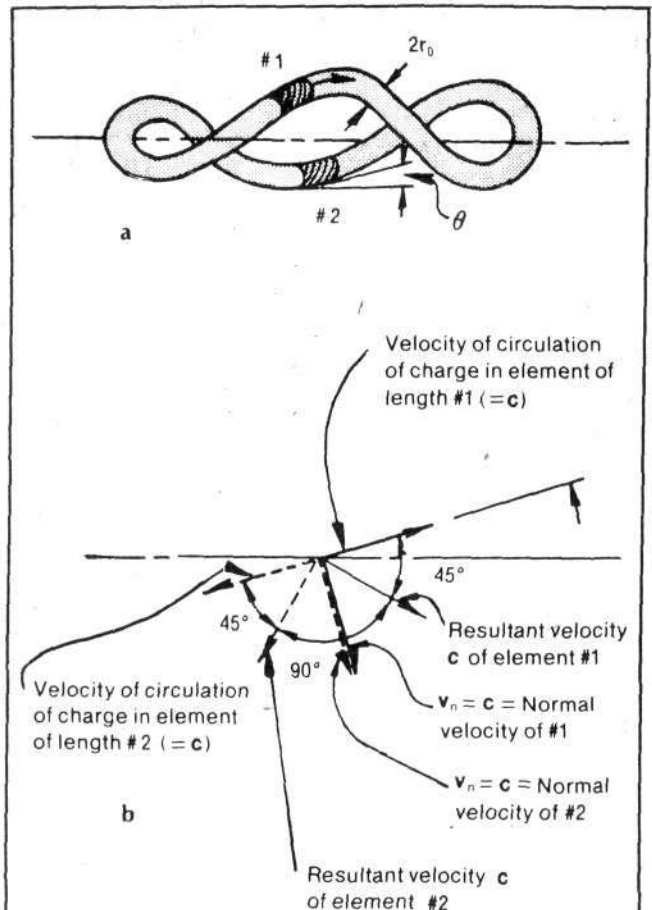


Figure 10
THE FORCE-FREE NATURE
OF THE HELICAL TOROID FILAMENT

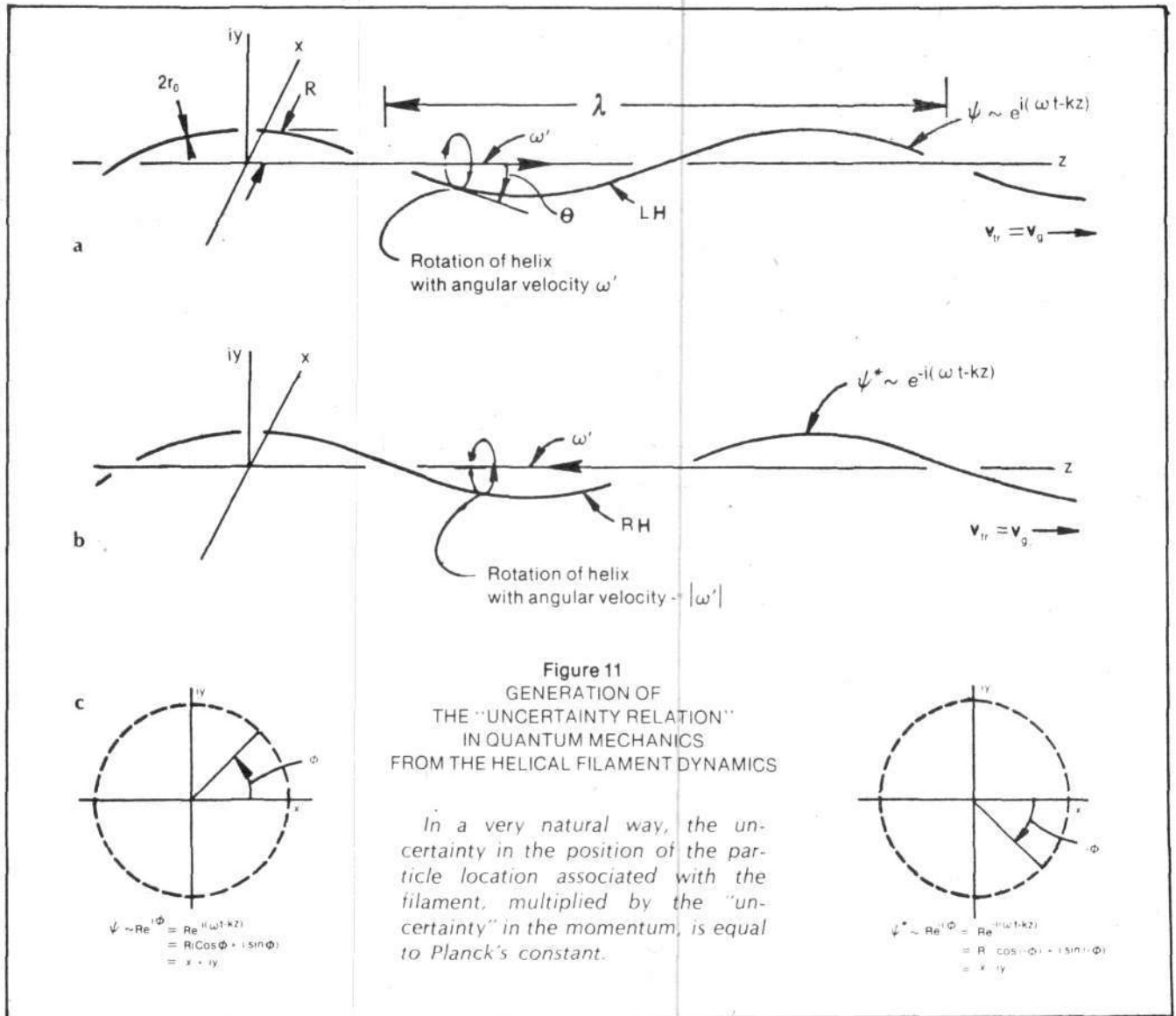
Each segment exerts no force on the other segments of the filament.

sponding element of length of the left-handed wave function ψ^* (see Appendix A); *only thus* can the configuration be an equilibrium one! Otherwise there will be forces that will increase or decrease R in Figure 6. Only equilibrium configurations can hope to have any reality in this world. Hence, for reasons of existence, an electron observed to be traveling with v_g is *obliged* to exhibit functions ψ and ψ^* as shown in Figure 6.

The author can adduce arguments to show that energy stored in such an electron can simultaneously go through *both* slits of a double slit grating (for example) and go to an appropriate spot on the interference pattern (Bostick, unpublished work). It is nice to know that the energy stored in such a model of the electron can be so well trained.

Appendix A

The configuration of Figure 6, as observed in the laboratory frame of reference, is required, when the "electron" is moving with a group velocity v_g as shown, if the



configuration is to be an equilibrium configuration that can endure in the laboratory system. Figure 10a shows two shaded filament segments of the configuration (of Figure 6) which remain at the same distance, $2R$, from one another and hence must be experiencing no net attractive or repulsive force on one another. Figure 10b shows the resultant velocity of the charge of each of these elements of length. Each resultant velocity is the sum of the velocity c of circulation of the charge within the filament and the normal velocity $v_n = c$ of the filament that gives rise to the deBroglie waves. The two resultant velocities of the charges on the two elements of length are perpendicular and, therefore, cannot exert any Lorentz force on one another. The two elements do not repel each other electrically with any net force because of the two normal velocities $v_n = c$.

It is the normal velocity $v_n = c$ everywhere in the two helical configurations that gives rise to the phase velocity $v_p = c/\sin\theta$ and the group velocity $v_g = c \sin\theta$ and to the two

wave functions $\psi \cong \text{Re}^{i(\omega t - kz)}$ and $\psi^* \cong \text{Re}^{-i(\omega t - kz)}$. We choose to let the wave function ψ represent the left-handed helix of Figure 6 in the following manner: a snapshot of ψ at a time t is shown in Figure 11a, where the axis of the LH helix is the z axis and the two axes perpendicular to the z axis are x and iy . Figure 11b is the wave function ψ^* , which is the RH helix.

At a given value of z the wave functions ψ and ψ^* represent the displacements of the tip of the vectors $x \pm iy$ rotating as shown in Figure 11c in time with the frequencies ω and $-\omega$. This rotation of these vectors $x \pm iy$ is the result of a simultaneous translation of the helices of Figures 11a and b in the z direction with a group velocity v_g and a rotation of the helices at angular frequencies of ω' and $-\omega'$ (not to be confused with ω). At a fixed value of time the vectors $x \pm iy$ again rotate as shown in Figure 11c with variations in z , where $k = 2\pi/\lambda$. The simultaneous translation and rotation of the helices is required to produce the normal velocities $v_n = c$ that are required for the continued

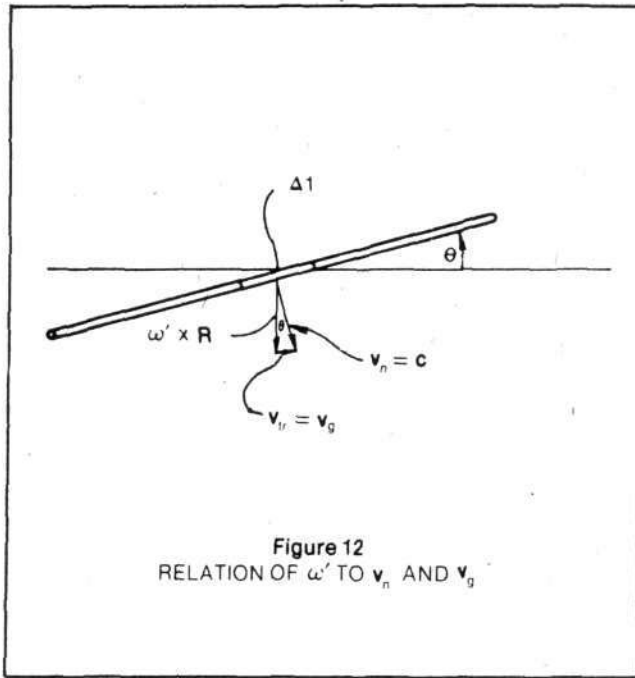


Figure 12
RELATION OF ω' TO v_n AND v_g

equilibrium of the configuration of Figures 6 and 10a. The resultant wave functions ψ and ψ^* based on the motion of these helices then have $v_g = c \sin \theta$, $v = c / \sin \theta$, $v_g v_p = c^2$, and $\omega = v_p k$. The normal velocity $v_n = c$ is made up as shown in Figure 12 as follows:

$$\omega' R = c \cos \theta$$

$$v_n = c = \omega' \times R + v_g$$

$$v_n = \sqrt{(\omega' R)^2 + (v_g)^2}$$

$$v_p = c / \sin \theta = \omega' R / \sin \theta \cos \theta$$

$$= \sqrt{(\omega' R)^2 + (v_g)^2} / \sin \theta$$

For examples:

When $\theta \rightarrow 0$, $\sin \theta \rightarrow 0$, $v_p \rightarrow \infty$,

$$v_g \rightarrow 0; \omega' R = c$$

When: $\theta \rightarrow \frac{\pi}{2}$, $v_p \rightarrow c$, $v_g \rightarrow c$; $\omega' R \rightarrow 0$

When: $\theta = \frac{\pi}{4}$, $v_p = c\sqrt{2}$, $v_g = c/\sqrt{2}$

$$\omega' R = c/\sqrt{2}$$

It is to be emphasized that the frequency of the wave functions ψ and ψ^* observed in the laboratory is ω and that this ω is not to be confused with ω' . It has been noted from Figure 6 that $\lambda = 2\pi R / \tan \theta$.

Now since $v_g = c \sin \theta$ and since $R = \hbar / m_{0e} c$ where m_{0e} is the rest mass of the electron,

$$\lambda = 2\pi R / \tan \theta = 2\pi R \frac{\cos \theta}{\sin \theta} = \frac{2\pi R \sqrt{1 - \sin^2 \theta}}{\sin \theta}$$

$$= \frac{\hbar}{m_{0e} c} \frac{\sqrt{1 - (v_g/c)^2}}{v_g/c}$$

$$= \frac{\hbar}{m_{0e} v_g / \sqrt{1 - (v_g/c)^2}} = \frac{\hbar}{m_e v_g}$$

where $m_e = m_{0e} / \sqrt{1 - \beta^2}$ and $\beta = v_g/c$.

Thus also $v\lambda = v_p = c^2/v_g = c^2 m_e \lambda / \hbar$

or $h\nu = m_e c^2$.

This model of the electron thus, in a sense, comes forth (as did the vortex) with a derivation of the most famous of all energy storage relationships, that is, that the total energy $m_e c^2$ is equal to $h\nu$ where ν is the observed frequency and h is the Planck's constant.

Also from

$$m_e = m_{0e} / \sqrt{1 - \beta^2}$$

$$m_e c^2 = (m_{0e} c^2)^2 + m^2 v_g^2 c^2 = (m_{0e} c^2)^2 + p^2 c^2$$

where $p = mv_g$.

This is essentially a dispersion relation that can be written

$$\hbar^2 \omega^2 = (m_e c^2)^2 = \frac{\hbar^2 c^2}{\lambda_c^2} + \frac{\hbar^2 c^2}{\lambda^2} = \frac{\hbar^2 c^2}{\lambda_c^2} + \frac{\hbar^2 k^2 c^2}{(2\pi)^2}$$

where the Compton wavelength $\lambda_c = \hbar / m_{0e} c$

or $\hbar^2 \omega^2 = \frac{\hbar^2 (2\pi)^2 c^2}{\lambda_c^2} + \hbar^2 k^2 c^2 = \hbar^2 \omega_c^2 + \hbar^2 k^2 c^2$

or $\omega^2 = (2\pi)^2 c^2 / \lambda_c^2 + k^2 c^2 = \omega_c^2 + k^2 c^2$

where $\omega_c = 2\pi c / \lambda_c = c/R$

could be called the Compton frequency of the electron.

The similarity of this dispersion relationship to an electromagnetic wave in a wave-guide where the wave front that moves with the velocity c makes an angle of θ with the wall of the guide is complete: For a wave-guide

$$\omega^2 = \frac{(2\pi)^2 c^2}{\lambda_{c0}^2} + c^2 k_z^2 = \frac{(2\pi)^2 c^2}{\lambda_{c0}^2} + \frac{(2\pi)^2 c^2}{\lambda_{\text{guide}}^2}$$

$$\text{or } \omega^2 = \omega_{c0}^2 + k_z^2 c^2$$

where here λ_{c0} is the cut-off wavelength analogous to $\lambda_c = 2\pi R = h/m_{0e}c$, the Compton wavelength; $\omega_{c0} = 2\pi c/\lambda_{c0}$ is the cut-off frequency; $k_z = 2\pi/\lambda_{\text{guide}}$; λ_{guide} = the waveguide wavelength, analogous to the deBroglie wavelength of the electron. A similar dispersion relationship occurs in the propagation of electromagnetic waves in a medium with free electrons where now the plasma frequency ω_p plays the role of ω_{c0} .

The full wave function is

$$\psi = A(z,t) e^{i(\omega t - k z)}$$

where $A(z,t)$ is an amplitude function that propagates with the group velocity v_g . Then the accepted quantum mechanical probability distribution $\psi \psi^*$ is $A^2(z,t)$, and the "probability" of finding the particle, at a time t , between z_1 and z_2 is

$$\int_{z_1}^{z_2} \psi \psi^* dz,$$

which is the fraction of the configuration of Figure 6 contained between z_1 and z_2 .

With the portrait of Figure 6, the "uncertainty" of location of the "particle" in the z direction, $\Delta z \cong n\lambda$ where n is the number of wavelengths in the train of Figures 6 and 11. The uncertainty of momentum in the z direction, $\Delta p_z \geq (h\nu/c) \frac{1}{2} \pi n$. Thus $\Delta z \Delta p_z \geq (\lambda/2\pi)(h\nu/c) = \hbar$, and Heisenberg's celebrated uncertainty principle is "obeyed."

Appendix B

Now that the model of Figures 3 and 6 has shown itself to be a high-fidelity replica of the electron itself, we ask ourselves the question, "what light can this model shed upon the values of the constants such as c , e , m_e , h , and α ?"

The value of c is that charge circulating velocity which permits equilibrium in the radius r_0 of the torus of Figures 3, 6, and 7; that is, the value that equates the electric field E , which tends to burst r_0 to H , which tends to contract r_0 .

The value of h should be such that the two elements of length diametrically across the torus in Figure 3, a distance of $2R$ apart, can communicate with one another with their fields that are established at the speed of light, in a time approximately $2R/\omega_c$ where ω_c is the Compton frequency,

$$\omega_c = m_{0e} c^2 / \hbar = 2\pi c / \lambda_c$$

That is, $c/\omega_c \cong R = \hbar/m_{0e} c$

and this is true and consistent with the Planck relation that $\hbar\omega_c = m_{0e} c^2$.

This is tantamount to saying that the two shaded elements of Figure 10 (in the configurations of Figures 6 and 10) must be able to communicate with one another across the spacing $2R$ in a time $\cong 2/\omega$ where ω is the frequency observed by the earth frame as the electron (Figures 6 and 10) proceeds with a group velocity v_g with respect to the earth frame. As we have

seen in Appendix A, the transformation from earth frame to electron frame involves the dispersion relation $\omega^2 = \omega_c^2 + k^2 c^2$ that comes from the Einstein relation $m_e = m_{e0} (1 - \beta^2)^{-1/2}$, which we have actually derived in Appendix A with the help of the geometrical relation $\lambda = 2\pi R / \tan\theta$ from Figure 6.

For another particle, the proton for example, m_0 and ω_c are larger and R is smaller and the value of h is consistent with the values of R , m_0 , and ω_c for the proton.

Remarks similar to those made for the electron can be made about the macroscopic quantum of action $h_v = m_{0v} v_1 r_1 \pi$ for the vortex analogue of the electron: The spacing $2R_v$ of two diametrically opposite vortex segments (corresponding to the spacing $2R$ for the electron in Figure 3) must be such that the segments can communicate with one another in a time $\cong 2/\omega_c$ through their velocity fields whose maximum velocity is sound speed c_s . That is $c_s/\omega_c \cong R_v$, where $\omega_c = m_{0v} c_s^2 / \hbar$ and this is true and consistent with the Planck relation that $\hbar v \omega_c = m_{0v} c_s^2$ since $v_n = c_s = v_1 r_1 / 2R_v$.

When the vortex moves in the z direction with a velocity v_g with respect to the earth's frame its shape becomes that of Figure 6 and the dispersion relationships are completely analogous to those for the electron.

We have seen that the value of

$$\alpha = e^2 / \hbar c = \frac{1}{137}$$

is related to the structure of the model by

$$e^2 / \hbar c = \frac{\pi}{2} / \ln(R/r_0)$$

and this is consistent with the spin

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

the rest mass

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

and the gyromagnetic ratio,

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

The value of r_0 (and hence $\ln R/r_0$ and $\alpha = e^2/\hbar c$) very likely depends in some way upon the properties of the gravitationally equilibrated fiber shown in Figures 6 and 7, which acts like a helical spring to produce the spring constant k and the effective surface charge on the torus of Figures 3, 6, and 7.

The analysis of the gravitationally equilibrated fiber presented thus far is manifestly crude. Due to the self-gravitational effects of the concentrated E and H fields surrounding the fiber of radius r_{0a} one would also expect a tendency for the fiber to collapse gravitationally radially along the $-r_a$ directions. The only process that would inhibit

such a collapse would be an angular momentum carried by the Poynting vector circulating with an azimuthal component about the core of the fiber of radius r_{0g} . Perhaps it will be a consideration of these additional refinements ("higher Riemannian manifolds") that will eventually lead to an understanding of why $\alpha = 1/137$ and how e , c , h , G , and m_p come to have the values they are observed to have.

Appendix C

The model of the photon is developed as follows: the toroidal filament of Figures 3, 6, and 7 of the core radius r_0 and charge $-e$, is straightened out into an arrow of core radius r_{0p} , and projected along with three other filaments as shown in Figure 8. The three other filaments are one with a charge of $+e$, and the other two with magnetic charges of north and south poles as shown. The separation of opposite filaments is $2R_p$. The configuration rotates with an angular frequency ω so that the peripheral velocity of each filament is c , as shown in Figure 8. To make the right-hand circularly polarized photon, where $\omega = 2\pi\nu$, $\omega R_p = c$, $\lambda\nu = c$, $\lambda = 2\pi R_p$ and $\nu = c/2\pi R_p$.

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 $E = e/\pi r_p^2$ and the magnetic field H is $H = E$. Then, since there are four filaments, the photon electromagnetic energy is

$$E_p \cong \frac{4 \cdot 2\pi R_p n}{8\pi} \int_{r_{0p}}^{R_p} \frac{2e^2}{\pi^2 r^2 R_p^2 n^2} \cdot 2\pi r dr$$

$$\frac{4e^2}{\pi n R_p} \ln\left(\frac{R_p}{r_{0p}}\right) = \frac{8e^2}{n\lambda} \ln\left(\frac{\lambda}{2\pi r_{0g}}\right)$$

$$= \frac{8e^2\nu}{nc} \ln\left(\frac{R_p}{r_{0p}}\right) = \frac{8h\nu\alpha}{n} \ln\left(\frac{R_p}{r_{0p}}\right)$$

$$= \frac{4h\nu\alpha}{\pi n} \ln\left(\frac{R_p}{r_{0p}}\right) = \frac{4h\nu}{\pi n 137} \ln\left(\frac{R_p}{r_{0p}}\right)$$

The electron model of Figures 3 and 6 and the corresponding vortex model both have come forward, as we have already seen, in a *non-ad hoc* way with the famous Planck *ad hoc* energy storage relationship that $E = h\nu$. Now we see that this model of the photon also comes forward in a *non-ad hoc* way with the relationship that $E_p \cong h\nu$. To make this relationship an equality, so that $E_p = h\nu$, it is necessary that $1/\pi \ln(R_p/r_{0p}) = 137n/4$.

Thus, if the number n of the wavelengths in the wave packet is altered, the value of $\ln(R_p/r_{0p})$ must adjust itself accordingly. The value of R_p remains constant, given by $\lambda = 2\pi R_p$. Thus, it must be r_{0p} that makes the adjustment to preserve $E_p = h\nu$.

The spin of this photon model is given by $(h\nu/c^2) R_p c = \hbar$ which is what it should be. That is, the model portrays a spin 1 photon. A left-handed circularly polarized photon is produced by rotating the filamentary configuration of Figure 8 in the opposite sense.

The attractive force supplying the centripetal acceleration on the negatively charged electrical filament, for example, is supplied by its Coulomb attraction for the positive filament. The magnetic forces due to the oppositely directed currents in these filaments are just balanced out by the magnetic forces due to rotation. The zero resultant of these magnetic forces can be understood in another way by recognizing that an element of length of the positive filament moves perpendicular to the velocity of the corresponding element of length of the negative filament. The electrical Coulomb central force on the negatively charged filament, for example, is given by the electric field from the positive filament at the position of the negative filament. This force is $e^2/2\pi R_p^2 n$ and it produces on the mass

$$E_p/4c^2 = (e^2/\pi n R_p) \ln\left(\frac{R_p}{r_{0p}}\right)$$

a centripetal acceleration $\cong c^2/R_p$. The central attractive force obeys an inverse square law ($\cong 1/R_p^2$) and, therefore, the "orbits" of the filaments of Figure 8 should be Keplerian and hence stable. There is a difficulty with the equilibrium condition, however: If we put

$$\frac{e^2}{2\pi R_p n} = \left(\frac{e^2}{\pi n R_p c^2} \ln\left(\frac{R_p}{r_{0p}}\right) \right) \frac{c^2}{R_p}$$

we are met with the condition $\ln(R_p/r_{0p}) = 1/2$, which is, of course, too low a value for $\ln(R_p/r_{0p})$ and permits no adjustment of r_{0p} .

In this simple calculation the centripetal force $e^2/2\pi R_p n$ has apparently been too small. If we set

$$1/\pi \ln(R_p/r_{0p}) = 137n/4$$

then the necessary centripetal force is

$$\left(\frac{e^2}{\pi n R_p c^2} \ln\left(\frac{R_p}{r_{0p}}\right) \right) \frac{c^2}{R_p} = \frac{e^2}{n R_p c^2} \frac{137n c^2}{4 R_p} = \frac{137e^2}{4 R_p^2}$$

This centripetal force is independent of n , as it should be, is inversely proportional to R_p^2 (for stable Keplerian orbits for the filaments of Figure 8) and it permits an adjustment of r_{0p} with n .

The fluid mechanical model of the photon is represented by four vortices that are spun out by the tips of a four-bladed boat propeller as it proceeds through the water. It can be shown that for this fluid mechanical model of the photon, the Planck-type relationship $E = h\nu$ can again be derived. ☼

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Research

The Current Status of Fusion Research

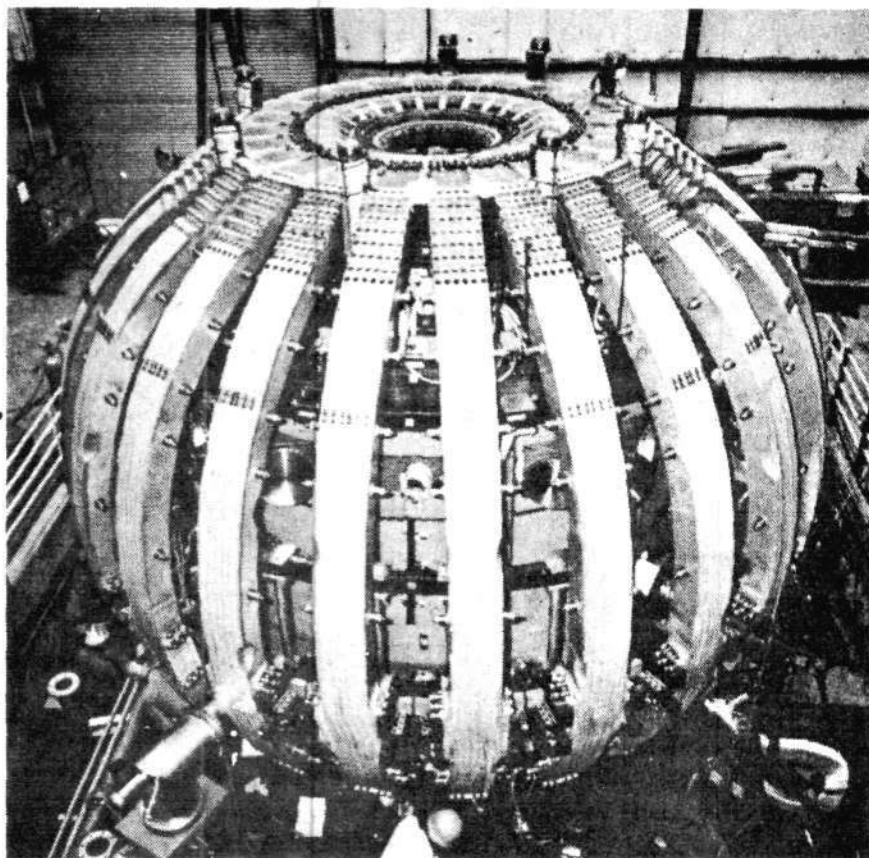
by Charles B. Stevens

In early 1978 the world effort to harness the vast potentials of nuclear fusion reactions stands at the brink of conclusively demonstrating the scientific feasibility and even the economic-technical feasibility of a wide variety of entirely different approaches.

In the opinion of the leading authorities of the world fusion research effort, most recent developments mean that with sufficient resources, fusion researchers could design and construct economical operating fusion electric power station prototypes during the next decade.

Tokamaks

Within the next several months three major new tokamak experiments will be brought on line: The Poloidal Divertor Experiment at Princeton, the Doublet III at General Atomic, and the Alcator C at the Massachusetts Institute of Technology. These experiments, together with further upgrading of the neutral beam heating capacity on the Princeton Large Torus tokamak, will conclusively demonstrate the scientific feasibility of tokamak fusion power plants. But more significantly, these frontier experiments almost certainly will open up entire new possibilities that could greatly accelerate the rate at which a technically feasible power system, especially of the hybrid fusion-fission type, could be developed and demonstrated as economical.



General Atomic's Doublet III, the largest tokamak in the world, went into operation on schedule in March.

It is from this perspective that the authors of the U.S. Department of Energy report, "Fusion Power by Magnetic Confinement Program Plan," (ERDA-76-110, Volumes 1-4) published in July 1976, now believe that they could confidently move up by several years the most optimistic date for initial operation of a tokamak power demonstration plant, given in the study as 1989. Of course, this could be based only on the immediate commencement of a "maximum effective effort," described by the authors as "Logic V funding levels." Sadly, the U.S. fusion effort under the constraints of the Carter Administration is currently following a Logic I, "level of effort" funding path. According to the study and the congressional testimony of the director of U.S. magnetic fusion research, Edwin Kintner, Logic I would not only foreclose on the possibility of ever developing a fusion

power reactor at this level of funding, but would retard any future effort — no matter how large — by from several years to as much as a decade, since a lack of funding is causing the breakup of crucial research teams.

Inertial Confinement

In the case of inertial confinement, there are no studies such as ERDA-76-110 in the public literature. Outline studies, however, have been released. These reports give approximately the same figures and time-spans as developed in ERDA-76-110 for development of tokamak power plant prototypes. For laser pellet fusion power plants, \$15 billion over 15 years would be divided in approximately the same proportions as called for in the studies on magnetic confinement: 10 percent for theoretical research, 10 percent for experiments, 40 percent for development and technology, and 40 percent for construction.

The real giant step for inertial confinement is about to take place: the world's most powerful laser, the 20-beam glass laser at Lawrence Livermore Laboratory in the U.S. (the Shiva), has just finished its initial startup tests and will be delivering its 20 trillion watts of laser light onto micro-sized fusion pellets and other types of more advanced non-symmetrical targets for generating fusion microexplosions.

During 1977 other giant steps were made in electron beam inertial confinement at Sandia Laboratory in New Mexico, but these major breakthroughs were clouded over by security classification and funding cutbacks for the U.S. program.

The two most significant results for laser fusion in 1977 were experiments of N.G. Basov of the Soviet Union and the work of the U.S. Los Alamos Scientific Laboratory on carbon dioxide gas laser systems for pellet fusion. Basov's reported experimental success with "low-power" laser pellet implosions may very well open the road to the type of "high-gain" pellets needed for power plants and simultaneously solve the most serious problem to yet arise in laser fusion research — Brillouin back-scattering of laser light. The successful technical development of high-power carbon dioxide lasers and experiments producing fusion for the first time with this type of laser means, in the words of the Los Alamos laser fusion scientists, that "up to 10 years can be sliced off the time needed to develop actual power plants based on laser fusion."

The General Picture

The two most significant developments for fusion research in general were, first, the emergence of major Japanese effort to realize power plants based on the tokamak in the 1980s, and second, the growing confidence of nuclear engineers that economical and technically feasible reactor systems could be built, both for tokamaks and laser systems.

While the physics of tokamak operation remains far from full comprehension, there is sufficient empirical information to confidently design minimally performing reactor

prototypes with existing state of the art technology. This is the chief conclusion of the joint statements of Velikhov and Kintner, directors of the Soviet and U.S. major fusion programs respectively. Far from being overly optimistic, this perspective is conservative in the extreme.

In fact, experimental results from a half-dozen tokamak and stellarator experiments, but primarily from that small workhorse of the U.S. tokamak effort, the MIT Alcator, indicate both qualitatively and quantitatively that "classical" confinement of plasmas is being achieved.

Stupendous Breakthroughs

Even if only partially true, the achievement of classical confinement is a stupendous breakthrough. Back in the early 1950s, when the first large magnetic fusion research efforts were being initiated, the classical theory of confining a 100 million degree gas in a magnetic trap led many scientists to believe that developing fusion reactors would be scientifically and technologically simple. This was before the host of plasma micro-instabilities and MHD-macro-instabilities were encountered experimentally. Now after 20 years of difficult research, plasmas are no longer unpredictable and anomalous creatures, but can be created and confined to order. Classical confinement is hundreds (if not thousands) of times better than that minimally needed for economical reactors.

In conclusion, high-confidence level tests of scaling of confinement times with size, current, density, temperature, and magneto-hydrodynamics stability have been accomplished, and definitive tests will take place within the next year on the reactors mentioned in the first section. While classical (neoclassical) theory is by no means completely adequate, the behavior of toroidally confined hot plasmas is sufficiently known empirically to extrapolate several different types of plasma regimes needed for power reactor energy production.

As little as a year ago, control of the influx of unwanted types of elements — impurities — into a hydrogen plasma, especially from the wall of

the vacuum chamber, was the chief bugaboo of the magnetic fusion research program. Now, through the success of Taylor's important work at the University of California at Los Angeles, the initial results of the ISX experiment, and the vast improvements in the PLT's operation with increasing temperature levels generated through neutral beam heating, it is apparent that impurity control is rapidly approaching the level of definitive tests.

Plasma beta limits (plasma beta is the ratio of the plasma gas pressure to the pressure exerted by the confining magnetic field) remain the weakest area of tokamak research. For power reactors, minimal betas of 4 percent appear to be certainly attainable. But for really economical units, betas on the order of 10 percent are needed. Great progress has been made in this area through the work of the MHD team at the New York University Courant Mathematical Institute, under the direction of Professor Harold Grad, and through the work of theoreticians at Oak Ridge National Laboratory in Tennessee.

There are dramatic possibilities for greatly enhancing and accelerating the rate at which fusion can be developed as a versatile and cheap energy source through the full utilization of various strategies for fusion-fuel burn dynamics. These possibilities are only beginning to be theoretically examined. A number of interesting studies by J.R. McNalley of Oak Ridge demonstrate that with some hypothetical confinement systems utilizing advanced fusion fuels other than D-T, fusion energy can be produced almost as pure electricity.

In particular, if the next generation of tokamak experiments are successful, it may be possible to bypass the D-T fuel cycle and proceed directly to the D-D cycle, which necessitates much higher ignition temperatures. This could greatly relax the overall engineering demands of a fusion power plant, since tritium would not have to be bred in a blanket surrounding the reactor chamber, and material damage due to the very high-energy (14 MeV) D-T-produced neutron would be avoided.

Clone Story Spurs Attacks on Genetic Research

The sensationalist press treated readers last month to the "true story" of the birth of a child "cloned" from the cells of its father and therefore an exact copy of the father. According to reports of a just-published book, *In His Image: The Cloning of a Man*, an unidentified British laboratory took nonreproductive somatic cells from an elderly man, introduced the nucleus of one cell into the enucleated egg cell of a female, and transplanted this now "fertilized" egg into a surrogate mother who gave birth to a child nine months later.

The author of the book, David Rorvik, claims that the child is a replica of the man whose cell's genes were introduced into the egg cell and whose money was used to pay for the experiment. The hair color, fingerprints, and personality, Rorvik says are in the image of the donor.

While the cloning described is from all indications a hoax, this hoax raised an outcry from the anti-DNA-research crowd that scientists would soon be cloning little Hitlers. Both the sensationalist coverage and the equally hysterical reactions are based on a fundamental misconception. The facts are that a human being is not fixed and determined only by the makeup of his or her genes.

Genes Don't Make the Man

Identical twins, for instance, are actually cloned from a single fertilized egg and share even the same crucial prenatal and postnatal development environment. According to the unscientific theory promoted by the clone baby story, these twins should be exactly alike. Yet, such twins have distinct and unique differences, especially in personality. Genes are not the determinants of human beings!

Not surprisingly, one of the loudest, most virulent attacks on all genetic research following the book's announcement came from Institute for Policy Studies antiscience environmentalist Jeremy Rifkin.* Rifkin's

statement reflects the idiocy of the environmentalists' denial of the human mind: "...molecular knowledge...has given proof to one genetic truth: Life is simply an arrangement of chemicals and biological processes. Nothing more, nothing less."

Rifkin and his cohorts wasted no time after the cloning story to try to shut down all genetic research. "These labs must be shut down — violently, if necessary," one environmentalist said. The Rifkin group accused the government of complicity in "Nazi" research, and filed suit to stop all research in the areas of cloning for any species. This includes farm animals, fertilization studies, genetic screening (which includes

aminocentesis, a commonly used medical procedure to detect severely malformed fetuses), and recombinant DNA. Exactly these research areas, especially recombinant DNA, are the frontiers of biological science and as such hold great promise of breakthroughs that will benefit mankind.

the clone-baby has waned, the overall attack on basic research has not let up. There are no less than four bills under consideration in Congress, which would, in varying degrees of severity, inhibit genetic research and its applications.

— Dr. Richard Pollak

* For more details on Rifkin, see page 59 in the book review section of this issue.

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"Energy and the Economy"

- HENRY MILLS, Indiana State Chairman, NAACP
- O.B. FALLS, President, NucleDyne Corp.; Former Advisor, International Atomic Energy Agency
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The 'Nukes Cause Cancer' Hoax

The latest scare story about nuclear power involves a study in New England allegedly proving that workers in the nuclear industry have a higher incidence of cancer. Publicized by the *Boston Globe* and other media, the study claimed that nuclear workers at the Portsmouth, New Hampshire naval shipyard were dying of cancer at twice the national rate.

A closer look at the so-called study put together by Thomas Najarian of the Boston Veterans Administration Hospital, however, shows it to have no scientific or statistical basis, leaving no doubt that it was intended merely as another rallying point for the northeast environmentalists against nuclear plants.

Najarian began his study by scanning thousands of death certificates in the Massachusetts, New Hampshire, and Maine area,

gathering 1,722 that listed the naval shipyard as the person's place of employment. He then divided the group into cancer and noncancer deaths, and contacted 592 relatives by telephone. On the basis of the relatives' recollection, Najarian then determined if the deceased had job contact with nuclear materials such as those in the Trident submarine.

One can only imagine — Najarian does not say — how the questioning was framed. Were the relatives asked: "We are doing a study to see if your relative died from cancer because of radiation exposure. Do you think he may have been exposed at his job?" How reliable would such answers be?

There is other evidence that Najarian's initial sample was biased. Most Massachusetts death records do not indicate place of employment. Since doctors are becoming more

conscious of the possible connection between cancer and the workplace, it is probable that doctors were more likely to record the employment history of patients who died of cancer.

There were further statistical tricks. After dividing the 592 deaths into nuclear and nonnuclear, Najarian then calculated the percent of deaths within each group due to cancer and compared this percent with the national average. Within the "nuclear group," cancer accounted for 38.4 percent of the deaths, and in the non-nuclear group 21.7 percent. The claim of "more than twice the cancer death rate" was then made by comparing the 38.4 percent to the national average of 18 percent.

This calculation, besides being statistically inaccurate, ignores the important relationship of age distribution to cancer death rates. The percent of deaths due to cancer is twice as high for the age range 65-69 compared to the age range 35-39. Was the age distribution of the naval base workforce the same as the national distribution? Najarian doesn't say.

Also ignored is the question of male versus female death rates; of the 20,000 workers employed at the base at any one time, most are male, and males have a markedly different cancer-age relation compared to females.

The Najarian study came under such heavy fire from scientists and the U.S. Labor Party for its incompetence and obvious political motivation that the Center for Disease Control was called in to do a real study, the results of which are not yet available. The *Boston Globe*, which had highlighted Najarian's results, then ran a series of letters to the editor and interviews with researchers, almost all of which termed the study incompetent and stressed that there is no research showing that low doses of radiation cause cancer.

— Dr. Ned Rosinsky

Computer Helps Develop Cancer Drug

Researchers from the University of California Medical Center have used a computer to produce an anticancer drug that scientists call the most potent cancer killer ever made. Dr. Martin A. Apple, the head of the research team that developed the drug, told an April science seminar sponsored by the American Cancer Society in Houston that the drug, azetomicin, "is probably better than many drugs used clinically now, at least according to our computer projections."

The three-dimensional chemical structure of the drug was designed so that it would bind to individual molecules, called receptors, in the cancer cells. The researchers believe that the length of time the drug stays bound to the receptors increases its effect.

To develop the best molecular structure for such a drug, the research team used a computer program from PROPHET, a nationwide program sponsored by the National Institutes of Health that centralizes chemical and biological data. With PROPHET's information, they simulated molecules on three-dimensional television screens to test for those that would bind most tightly to the DNA (deoxyribonucleic acid, the genetic material) of the cancer cell. The assumption was that such binding would kill or immobilize the cancer cells. Apple pointed out that the use of PROPHET enabled the researchers to do more in an average day than "a year or two of trial and error in the lab.... We can study simulated molecules and alter their structure in minutes and study their effects in minutes."

Books

The Ecologists Versus DNA Research

by Dr. Richard Pollak

Who Should Play God?

by Ted Howard and Jeremy Rifkin.
New York: Dell, 1977, \$1.95.

Although the environmentalists have tried to make the term genetic engineering connote evildoings, its straightforward scientific meaning refers to the directed human control over the genetic makeup and biological processes of the biosphere as a whole. This includes practices that have been ongoing for as long as civilization has existed — the selection of highly productive crop strains, the selective breeding of domesticated animals, and even the taboo against incest.

The most controversial area of genetic engineering is recombinant DNA research, a process of combining the genetic material (DNA) of one organism with that of a second and inserting these "spliced genes" into a host where they will replicate the combined material. Recombinant DNA, on the frontier of biological science, is the chief victim of Ted Howard and Jeremy Rifkin's attack on biological research. They go at their victim from a completely unscientific basis spilling over with rage at science and scientists.

It is essential to understand that the authors are not just enraged "little people" who locate the source of all society's ills in big science and big business. Rifkin is a veteran of what is



Environmentalists hung this banner up at a recent forum on genetic research. Calling the scientists "oppressors," the protestors used mob tactics to break up the meeting.

naively called the left wing in this country, with known ties to the Institute for Policy Studies including antinuclear terrorist Sam Lovejoy. Among Rifkin's credits is that he founded the so-called People's bicentennial Commission that explicitly called for violence in Philadelphia in 1976 to disrupt the celebration of the American Revolution.

Thus the howls of Rifkin and co. in *Who Should Play God?* against scientific research have to be seen as an integral part of the ongoing campaign by Energy Secretary Schlesinger, his Institute shocktroops, and the monetarists in control to shut down progress in this country and substitute austerity, deindustrialization, and conservation.

The danger of these men lies in how successful they are in getting others to adopt their cover story. Although legislation to stop or impede recombinant DNA research has not yet been passed, environmentalists have succeeded via the National Environmental Protection Act in getting an injunction that prohibits an eminent Harvard University researcher from

starting work using recombinant DNA techniques.

The potential benefits of recombinant DNA research are tremendous and, if not stopped by medieval book burners, like Howard and Rifkin, will lead to qualitatively new understandings of the basic physiological processes of life and to increased human control over these processes to meet societal needs.* Although a very new laboratory technique, some of the possibilities of recombinant DNA work have already been realized. For instance, researchers have successfully undertaken the production of the human hormone somatostatin from bacteria, and scientists expect within a year to commercially produce the hormone insulin, a vital drug for diabetics and one which is anticipated to be in short supply in the near future.

Just a little farther into the future,

*For a full discussion of recombinant DNA techniques, its promise and implications, see "Recombinant DNA: The Promise of Genetic Engineering" in *Fusion*, Vol. 1, No. 2 (Oct.-Nov. 1977).

NUCLEAR REACTOR SAFETY

Edited by F. R. FARMER

This monograph falls into three main sections: a discussion of the chemical and physical properties of fission products significant in safety, a discussion of the quantitative approach to reactor safety assessment, and consideration of the specific safety problems inherent in thermal and fast reactors. The book will serve as an introduction to this ever expanding field.

CONTENTS: *H. M. Nicholson*, Introduction. *F. Abbey*, Radioactivity and the Fission Products. *J. R. Beattie*, Radiation Hazards and Environmental Consequences of Reactor Accidents. *G. D. Bell*, The Calculated Risk—A Safety Criterion. *A. Aitken*, Quantitative Approach to Reliability of Control and Instrumentation Systems. *F. M. Davies*, The Reliability of Heat Removal Systems. *R. O'Neil*, The Integrity of Pressure Vessels. *J. H. Bowen*, Thermal Reactor Safety. *H. J. Teague*, Safety of Fast Reactors.

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the ability to biologically produce human substances for both treatment and laboratory experimentation will lead to substantive changes in medical practice. Similarly, the engineering of plant-associated microbes and eventually the plant cells themselves, should herald in qualitative changes in agricultural practices. Even more profound is that the recombinant DNA techniques will mandate fundamental new conceptions concerning the nature of genes, their interactions within the cell, and their relationship to the environment as a whole.

Science As Oppressor

Who Should Play God? is a crude and inflammatory book, directed at those who have a less than positive view of science and technology. Dismissing the idea that science and scientists might have any positive motivation, Howard and Rifkin, locate "eugenics (as) the ideology behind genetic research." In an early chapter they set the tone for the rest of the book by building the case that the racist eugenics movement is the basis of all genetic research. They accomplish this primarily by citing various famous figures who have located societal improvement in selective human breeding. With few exceptions, the cited individuals — such as Darwin's cousin, Sir Francis Galton, Julian Huxley, and racists Arthur Jensen and Richard Herrnstein — all represent the same zero-growth, "small is beautiful" ideas as the authors.

It is just a small leap to their next contention — that contemporary science is meant only to serve the forces of oppression. Liberally quoting from big-name biologists, Howard and Rifkin build a case for the necessary outcome of nothing but evil from science and technology. "...Science is in the hands of the people who run our industries and is being used to exploit and oppress people all over the world and in this country."

And why do people accept this so-called biological accommodation where their beings are manipulated for evil interests? Supposedly because of a "technological seduction," which

comes about as values change. This, in turn, occurs as citizens, overwhelmed by technology-created unresolved societal, environmental, and political problems, turn to more technology to bail out society. "For if the manufactured environment is no longer subject to human intervention, then the other option is to begin changing, for the first time, human biology itself to accommodate the new reality in the outside world."

This sentence summarizes both the assumptions and conclusions of the book; namely, that in a Malthusian world of finite resources it is prohibitive to intervene into nature. Therefore, science must attempt to rescue the corporations and government by altering our physical beings to adjust to the Malthusian situation. Any sane person who reflects briefly on the real history of medical or scientific advances can see the hideousness of the Howard-Rifkin alternative: *The world is running out of firewood? Don't discover the use of coal. Instead, shackle the innovators, reduce the population, and divide up the remaining supplies among a frozen population.*

Not surprisingly, Howard and Rifkin use the tactics that usually accompany a fascist ideology. At a recent U.S. National Academy of Sciences meeting in Washington, D.C., Rifkin led a mob that disrupted the proceedings with chanting and took over the podium until his faction was allowed to "crossexamine" the scientists speaking at the meeting. Unfortunately, the scientists were so intimidated that they became defensive, focusing on the mob's "issues" while the real scientific questions were forgotten. In that sense, Rifkin and his group were successful.

As this incident makes clear, unless the general public and the scientific community come to grips with the political nature of this fight, the Dark Ages fantasies of the environmentalists will become a nightmarish reality.

Richard Pollak is a member of the biological sciences division of the Fusion Energy Foundation.



Ecotopia: Sun Day's Fascist Program

by William Wertz

Ecotopia, by Ernest Callenbach, New York: Bantam Books, 1975, \$1.75.

Ecotopia is a blueprint for an environmentalist coup d'état in the American Northwest. Since the book was published in 1975, Ecotopian groups have been formed and have actively developed strategies for "liberating" the region. These groups see the May 3 Sun Day orgy of environmentalism, which has won the official stamp of approval from Energy Secretary James Schlesinger, as a step in that direction.

In his novel Callenbach portrays the barbaric consequences of environmentalism with far less hypocrisy than his tree-worshipping disciples, who advocate the economics of fascism but deny its necessary genocidal implications. For all its would-be libertarian aura, Callenbach's tract makes it clear that a less-is-more world will lawfully demand the political methods of Hitlerism.

When Washington, Oregon, and northern California secede from the union in 1980, individual income is virtually halved. Callenbach admits that many citizens are thus deprived

of hard-earned comforts, but he offers the consolation that Ecotopian experience is relatively painless compared to that of living on rats and moldy potatoes in Warsaw, Poland during World War II.

This blissful state of affairs is achieved by a policy of forced deindustrialization. The energy-intensive aluminum industry is largely abandoned, aerospace is diversified into mass transit, hydroelectric dams are dynamited to allow recreational boating, lumber exports are prevented by draconian tariffs and agricultural output is drastically reduced by the strict enforcement of irrigation acreage regulations. Medical centers are dissolved, cars are abolished, schools are broken up, and the population is dispersed into the countryside, Cambodia-style, as the existing cities of San Francisco, Oakland, Seattle, and Portland are gradually razed and the land returned to grassland, forests, orchards, and gardens. In the process, the population is reduced by a million and those who survive are employed in labor-intensive work camps.

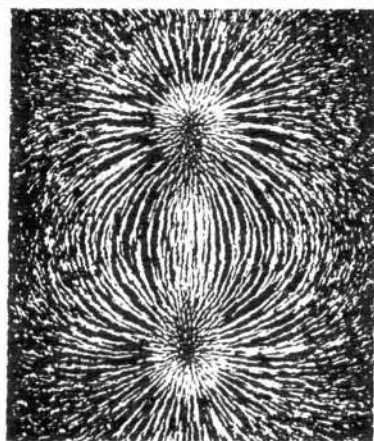
This is only the beginning.

Ecotopians estimate that the proper population size is the number of Indians who inhabited the territory before the Spaniards and Americans came — something less than a million for the whole region, living in thinly scattered bands.

Jungle Tribalism

As the fruits of modern technology are abandoned, the region deliberately is reduced to a state of jungle tribalism. In a horrifying example of British anthropological behavioral modification, the men in Ecotopia by law are forced to participate in Dionysian rites of bloody warfare. Bands of young men dressed in leather jackets and shorts, decorated in designs — some astrological, some totem-animal — and armed with primitive spears, battle one another before a cheering crowd until one side wins by maiming or murdering one of the other side. The victors then engage in an orgy, carrying their women off into the bushes, while the losing side participates in a satanic parody of the crucifixion and resurrection of Jesus Christ.

Given this bestial conception of



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Ecotopia author Ernest Callenbach

man, it should come as no surprise that the racial policy in Ecotopia is apartheid. The environmentalists' fetishist belief in decentralization leads ineluctably to the establishment of semiautonomous city states, or bantustans, in the ghettos of Oakland, San Francisco, and so forth. Order is maintained by drugging the population; marijuana and other drugs are legalized and heroin is taken over as a government monopoly. The residents of "Soul City" who resist are interned in slave-labor prison camps.

A Real Scenario

How then does this paradise on earth come into existence? By a deliberately engineered financial collapse that culminates in terrorist nuclear blackmail against the federal government of the U.S. After having provoked a flight of capital from the region by passing stringent conservation laws, the secessionists supplant the existing local constitutional governments. When the federal government attempts to restore order and put down the fascist coup, the environmentalists threaten to detonate nuclear bombs in New York City, Chicago, and Washington, D.C. Precisely this scenario is now operational in the Northwest, where

environmental terrorists are conspiring openly to establish an Ecotopian "bioregion." In the greater Seattle area, for example, the Ecotopian group was founded in the winter of 1977 as the by-product of a class on Ecotopia offered at the University of Washington Experimental College. The class was led by Bryant Milliman, publisher of the proterrorist *Seattle Sun*, and Jon Alexander, a member of Washpirg (Washington Public Information Research Group), Ralph Nader's local unit of the Red Guard. As in the novel, where the kidnaped hero is finally brainwashed into staying in Ecotopia, members of the Seattle Ecotopian group were reported by an eyewitness to have been recruited from the class by ego-stripping group therapy methods.

Human Recycling?

In May 1977, Callenbach made an organizing appearance at the University of Washington to bolster the troops. Since then the group has issued a series of white papers including one edited by Washpirg's codirector Nicholas Licata and written by Tim Williams. The latter worked closely with Alexander in preparing Washpirg's October 1977 Northwest energy report which, true to Callenbach's own scenario, proposed that the region rely on conservation as an alternative to energy-dense nuclear power. After 20 years solar power will be cost competitive, the report suggests. In the meantime, the region's aluminum industry will be dismantled and the population will be able to enjoy the full benefits of Ecotopian labor policy — perhaps even to the point of human recycling.

Not surprisingly, the Ecotopians and their mind controllers see Sun Day as an ideal organizing opportunity. Throughout the Northwest, Ecotopian groups are organizing for a week-long sun-worshipping celebration from April 29 through May 7. Anyone who doubts the grisly seriousness of their intentions would be well advised to examine Callenbach's book.

William Wertz is the Washington state chairman of the U.S. Labor Party.

FEF News

FEF TO FILE SUIT AGAINST DOE CLASSIFICATION OF RUDAKOV DISCLOSURES

The Fusion Energy Foundation is seeking contributions to file suit against the U.S. Department of Energy for its refusal to release to the FEF material on the Soviet breakthroughs in electron beam and laser fusion research that were reported by Soviet physicist Leonid Rudakov in his visit here in summer 1976.

As *Fusion* magazine has reported, the Soviet government voluntarily declassified information on its breakthroughs in electron beam research and Rudakov presented this material in meetings before U.S. scientists at U.S. fusion research laboratories in June-July 1976. The U.S. government promptly classified the material Rudakov presented.

In response to the FEF's Freedom of Information Act request on the Rudakov files, the Department of Energy released more than 300 pages of heavily deleted material on the Rudakov visit. However, the department withheld numerous other documents in their entirety, including reports by U.S. scientists on Rudakov's presentations and documents that show British government pressure on the U.S. to withhold from the public the Soviet research findings.

The suit charges that the Department of Energy has used classification to prevent public knowledge of the advanced stage of fusion research both in the U.S. and Soviet Union for the purpose of protecting the credibility of the department's no-growth and antinuclear policy. The suit concludes by stressing that the two central issues now before the American public and Congress — energy policy and the deployment of military technology — cannot be intelligently debated without access to the Rudakov disclosures.

BARDWELL AT CLEVELAND FUSION CONFERENCE

Dr. Steven Bardwell, director of plasma physics for the FEF, addressed a group of Cleveland students, faculty and business representatives on the scientific aspects of fusion and the classification procedures that stunt scientific research April 5. The conference on the state of fusion energy was hosted by John Carroll University in Cleveland. Sharing the podium with Bardwell was Reece Roth, a scientist with the National Aeronautics and Space Administration. The speakers fielded questions on why the government is sabotaging fusion research and on the technical aspects of magnetic confinement.

LEVITT ADDRESSES LUTHERAN GROUP

Dr. Morris Levitt, executive director of the FEF spoke at a Special Consultation on Nuclear Energy sponsored by the Division of Church and Society of the Lutheran Church in America in March. Held in Madison, Wis., the consultation was convened in response to the railroading of an antinuclear resolution through the National Council of Churches last year by Dr. Margaret Mead and other zero-growth advocates. In contrast to the meeting of the National Council, the consultation featured several dozen nuclear experts who are church members. Dr. Levitt's talk, "Energy and Natural Law," reviewed the history of energy development in the universe, and how the antinuclear movement would wipe out the essential feature of humanity — its creativity.

FEF MEMBERS MEET

The Fusion Energy Foundation held a membership meeting April 6 in New York City to confirm the organization's board of directors. The FEF also welcomed two new members to its board of trustees, Paul W. Lattimore, mayor of Auburn, N.Y., and Robert Perry, president of the Michigan Banking Association.



Dr. Steven Bardwell

NUCLEAR NEWS FEATURES FEF TRUSTEE

Nuclear News, the magazine of the nuclear industry, featured a short article in its March issue on William Cornelius Hall, president of Chemtree, who was named to the FEF board of trustees in December 1977.

Reprinted below are excerpts from the piece.

Of all the hard-line pronuclear stands adopted by citizens' groups, industry lobbies, and so forth, none currently appears more fiercely supportive than that of the Fusion Energy Foundation (FEF)....

"The one organization that is really influencing the public, in my opinion, is the Fusion Energy Foundation," said Hall in a recent telephone interview. Hall's recruitment may not have been the FEF's only success, but when Hall was named to the FEF board of trustees in December, and agreed to keynote a technical session at an FEF conference in late January, he became the most prominent nuclear industry executive connected with the group.

Chemtree, Hall's company, based in Central Valley, N.Y., manufactures metallic mortars for use in reactor shields....He is the principal force in his company, and usually has little time for outside interests. But he said he is making time for the FEF.

Hall's main concern is to win over the public to nuclear, and he feels that the FEF does a better job of this than does the American Nuclear Society or the Atomic Industrial Forum. "The industry has no clout," he said, adding, "It talks to itself and not to the public." By contrast, he told of a group of FEF members he saw in a Philadelphia train station, contacting passersby.

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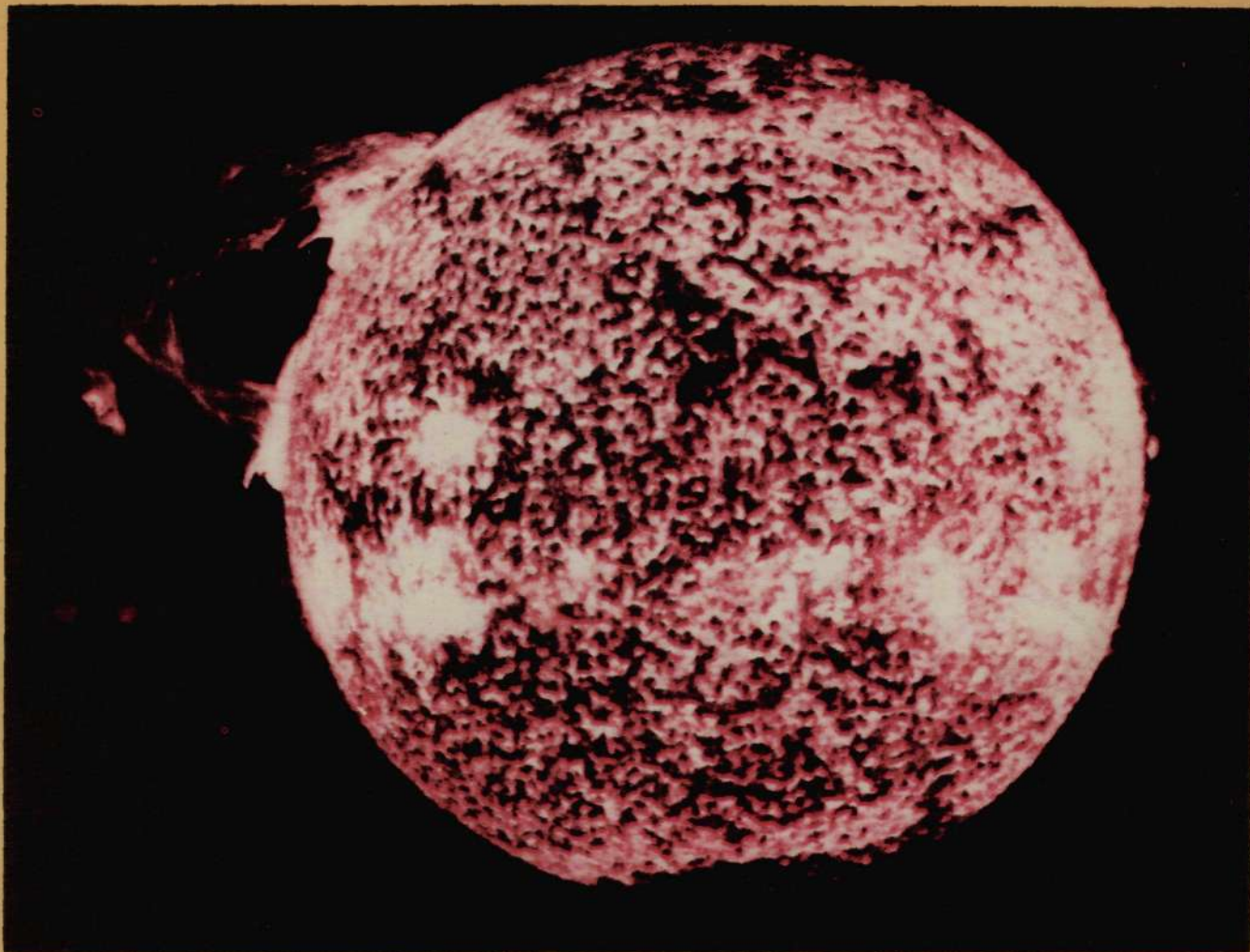
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No More Human Sacrifices

The front cover depicts human sacrifice to the sun as practiced by the Aztecs until the Spanish conquest in 1520. The plan of the modern-day sun worshippers for total dependence on the sun does not call for slicing open chests to pluck out the victim's still-pumping heart as a ritual offering to ensure that the sun will rise. But, if implemented, the Sun Day demands to shut down high-technology industry will claim many more human victims than the tens of thousands sacrificed yearly by the Aztecs.

Mankind's survival depends on using 20th century technology to harness the energy-producing process of the sun here on earth—fusion. With the development of controlled thermonuclear fusion power, man will create virtually unlimited energy, enough to guarantee that there will be no more human sacrifices.

On the back cover is a photograph of the sun and a solar flare, a huge vortical filament of ionized helium generated by the same high-energy processes that must be mastered to make fusion power a reality. Taken in December 1973 by NASA's Skylab 4, the photo shows one of the most spectacular solar flares ever recorded, spanning more than 367,000 miles across the solar surface.