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No limits to growth

Kennedy's national commitment to an advanced science policy through the Apollo program lives on in breakthroughs with the repaired Hubble telescope and in fusion energy. Carol White reports.

What better way to commemorate the legacy of the John F. Kennedy years, than the confluence of positive scientific events which have come as 1993 draws to a close. First and foremost, there is the successful servicing of the Hubble telescope, with the clearer vision promised by the repaired instrument. Then there are advancements in pursuit of controlling the energy of the nucleus, both at Princeton University with the Tokamak Fusion Test Reactor (TFTR), and from a number of laboratories as reported at the Fourth International Conference on Cold Fusion.

Twenty-five years ago, the giant step from the Earth to the Moon had yet to be taken; the task to be accomplished was still enormous. No one at that time could possibly have doubted that a successful Moon landing would rank as a historical achievement not only of the United States, but of mankind. No one would have doubted that, with such an achievement, we would be moving into the 21st century with the assurance that there are indeed, no limits to growth. Surely—although the Apollo program was run by a civilian agency, the National Space and Aeronautics Administration (NASA)—the capability to land Americans on the Moon had obvious national security implications, especially in the wake of the Soviet Sputnik launch. Just as surely—for John F. Kennedy and most Americans at that time—to reach for the stars was to follow man's destiny and, in the words of the psalm, to seek to understand God's word, written in the sky.

Sadly, with the murder of President Kennedy there began a highly successful 30-year-long attack on the notion of the necessity for scientific and technological progress. In place of a confident search for technological solutions to the problem of expanding our energy base and controlling pollution, the cultural paradigm was shifted to portray science and technology as inimical to the biosphere.

The Kennedy administration reversed the economic stagnation of the Eisenhower years, and thus provided the context for the enormous boost to productivity brought about by technological spinoffs from the Apollo program, such as the development of advanced computers and the associated developments of the semiconductor industry, as well as in many other areas—not least of which are advances in medicine. Thus it was a unique moment in U.S. postwar history; nonetheless, President Eisenhower had foreshadowed the accomplishment of the Kennedy years by his Atoms for Peace policy.

In 1953, after the Soviets tested a hydrogen bomb, Eisenhower proposed that an International Atomic Energy Agency be set up under the aegis of the United Nations. Its mandate would be "to provide abundant electrical energy in the power-starved areas of the world. Thus the contributing powers would be dedicating some of their strength to serve the needs rather than the fears of mankind." The United States was prepared, the President said in a speech delivered at the United Nations, "to devote its entire heart and mind to find the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life."

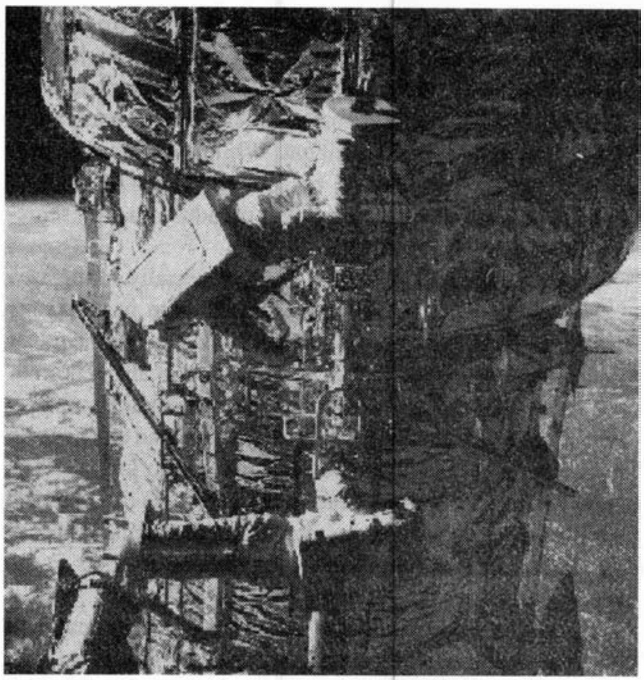
At that time, Eisenhower had hoped for the development of electricity too cheap to meter, which would provide energy for the industrialization of the Third World. He wished to build transoceanic canals and artificial harbors, which would be blasted out by detonating bombs. This program was later to be known as Operation Plowshare. He also expected that the knowledge that would be gained through controlling nuclear energy would lead to enormous strides in medicine and the solution to the world's fertilizer problems. That this was no empty vision is amply testified to by the success of the nuclear industry, notwithstanding the devastating and continued attack which it faces from malthusian forces who do not wish to see Eisenhower's dream realized.

The same spirit of technological and political optimism was again manifest in President Reagan's March 23, 1983 Strategic Defense Initiative (SDI) proposal, when he vowed to substitute a policy of mutually assured survival for Henry Kissinger's MAD doctrine of mutually assured destruction, in order to be an absolute barrier to a third, nuclear world war. It is also in sharp contrast to the looting of the International Monetary Fund and World Bank which is now being enforced on other nations by the United States government, in alliance with the British.

Hubble: A window on the universe

In the weeks leading up to the launch of the Space Shuttle Endeavour, the international media focused upon the mission to service and repair the Hubble telescope. A do-or-die climate for NASA was being orchestrated, under circumstances in which there was no guarantee of success for the mission: Any space walk is a difficult venture, and this mission, in particular, was extraordinarily difficult, as planned; its signal success, therefore, is doubly welcome. In all, five space walks, over 35 hours' duration, were accomplished by the Dec. 12 landing date. While an important aspect of the mission has been the correction of the telescope's focusing, it is important to note that two of three gyroscope pairs which are used to stabilize the Hubble telescope were also replaced by the astronauts. Such wear and tear on the apparatus was to be expected, but it testifies to the good judgment used in planning just such shuttle servicing missions as the Endeavour flight, in the original conception of the space telescope design, which took into account the role of the shuttle. Similarly, the telescope's solar panels were redesigned to deal with the problem of space jitter which emerged.

The first pictures from the refurbished telescope should be available by the first week in February, and we will know by mid-March if all aspects of the instrument are performing properly. The well-publicized spherical aberration in Hubble's primary mirror was corrected twice: once for the light received in the Wide Field and Planetary Camera (the new, more advanced Wide Field and Planetary Camera installed early Dec. 7 is redesigned to include the correction), and once for the light path that goes to three other instruments still in place, the Faint Object Camera, the Faint Object Spectrograph, and the Goddard High Resolution Spectrograph. For these three, the correction is contained in the COSTAR optics module that was put in the place of the High Speed Photometer module the night of Dec. 7. COSTAR stands for Corrective Space Telescope Axial Replacement, and is about the size of a telephone booth. The high speed photometer, for measuring variations in light emission from rapidly varying sources, was the least used of Hubble's instruments.



Two astronauts from the Shuttle Endeavour work on the Hubble Space Telescope. Both the shuttle mission and the telescope itself should revive excitement about scientific and technological progress.

With the fix, man's vision will extend farther back in time as it extends in space. This will bring Hubble very close to its original specifications, but it should be noted—contrary to unfriendly press and television reports—that vast amounts of scientifically important data have already been received and processed from Hubble.

The success of the mission depended upon the fact that the astronauts were very highly trained and experienced. They vindicated the entire concept of manned space exploration, which, in fact, was the rationale for the Space Shuttle itself and for having a timely completion of the Space Station. Critics of NASA who nonetheless endorse a continued space effort have wrongly counterposed unmanned explorations of the universe. Hopefully, the Clinton administration will take a lesson from this stunning NASA success and pull back from plans to make the U.S. Space Station dependent upon Russian cooperation.

Cold fusion

We will be reporting at length, in upcoming issues, on the status of cold fusion research nearly five years after the historical announcement of the phenomenon by the electrochemists Martin Fleischmann and Stanley Pons. Briefly, the Fourth International Conference on Cold Fusion, held in Hawaii over Dec. 6-9, reported substantial work accomplished in a number of laboratories to establish the parameters for repeatability of the experiment. While there were no dramatic surprises reported, the breadth and depth of the program are impressive, and the number of industrial representatives attending was significant.

Most questions still remain open, especially in the area of theory; however, excess power production in the range from 4 to 70% has been well established by numbers of researchers. Significant tritium production was also reported. New results regarding helium-4 production remain tentative. Led by Steven Jones, the conclusion was reached that neutron production in most cold fusion reactions is so low as to be barely detectable. Jones, in fact, retracted some of his earlier claims of five neutron bursts, explaining that he had discovered these measurements to be the result of artifacts in the experiment, rather than genuine fusion occurrences.

Cold fusion is enormously promising, both because it should open up new frontiers for scientific investigation, and because it may lead to a highly attractive method—technologically and economically—for tapping the energy of the nucleus. Ironically, the failure of the reaction to produce the fusion ash, which would be expected according to prevailing physics theory, is really its great benefit. Cold fusion is virtually aneutronic, and other significant radiation effects have yet to be discovered. Unfortunately, many scientists have difficulty accepting a situation in which we do not yet understand what can be happening to produce the detected excess heat, which is over and above any known chemical reaction.

To date, the leading programs in the world are those run by the U.S. Electric Power Research Institute (EPRI) at Stanford Research Institute, and that of the two Japanese IMRA laboratories—in France where Fleischmann and Pons work, and in Japan under the direction of Dr. Keiji Kunimatsu. The next largest program is run by the Italians, with just under 100 part-time researchers, and there is a possibility that a large-scale industrial program led by the Fiat and Montedison corporations will be launched in the near future. At the conference, a representative of the Japanese Ministry of International Trade and Industry (MITI) announced that their $30 million program had been begun in November. The first milestone of this combined industry-university major research program would be a test of the Fleischmann and Pons cell, and of one using a fuel-cell design provided by the IMRA Japan laboratory. A representative of Mitsubishi Heavy Industry also reported that he had replicated the Yamaguchi gas-loading experiment, as part of ongoing research at Mitsubishi. British, American and French oil companies also have experimental programs in progress, although by-and-large these are not being openly reported on for proprietary reasons. Lastly, the Utah-based corporation ENECO announced that they now have obtained exclusive licensing rights from the University of Utah for the Fleischmann-Pons patents.

The hot fusion story

On Dec. 10, physicists at the Princeton Plasma Physics Laboratory in New Jersey announced that they had achieved a record tritium-deuterium fusion burn in their Tokamak Fusion Test Reactor (TFTR). Without the addition of neutral beams, on their first test, they produced 3 million watts of thermonuclear fusion energy, which is a new record for fusion power, over and above that reached in 1991 in England by the Joint European Torus (JET). Much diluted (11%) tritium was used as a fusion fuel by JET, to reach a then-record of 1.7 million watts of power. On subsequent days, bringing neutral beam heating on line raised the output of the TFTR to 6 million watts.

Fusion energy is what powers the Sun and the stars: During a fusion reaction, two hydrogen atoms are fused together to form helium, and energy is released in the process. It has been a dream of scientists and others for decades to harness this energy as a clean, virtually inexhaustible, and therefore, extremely cheap, power source for mankind. In the TFTR experiment, the deuterium and tritium are heated to over 100 million degrees to form a very thin ionized plasma. In the Fleischmann-Pons table-top electrolysis cell, the nuclear reaction is evoked using only deuterium as a fuel, which is packed into a palladium electrode, and the experiment is run at room temperatures.

Tritium has a half-life of 12 years and it is radioactive. For this reason scientists have held back from using it as a fuel, despite the fact that fusion energy breakeven cannot conceivably be achieved in a tokamak by using only deuterium. Thus, earlier TFTR and JET experiments using deuterium only were extremely useful in establishing scientific parameters for containing the fusion plasma, among other things; however, only by introducing tritium could the energy output be scaled up toward breakeven.

The TFTR performed its first fusion experiments, using only deuterium, in 1983. The burning of tritium was delayed by cutbacks in the magnetic fusion energy budget. "Fusion research has taken longer than expected," wrote Lyman Spitzer, one of the founders of the Princeton Plasma Physics Lab, in a Dec. 11 *New York Times* opinion column, "partly because of cutbacks in federal money but also because a hot gas confined by a magnetic field behaves in odd ways undreamed-of initially."

Note that, despite the impressive energy output, in terms of the ratio of power output to power input—and taking into account neutral beam heating—only two-tenths of scientific breakeven was met at first. For an economically viable fusion power reactor, the scientific breakeven level of 1:1 will have to be surpassed and we would aim to get 20 times excess output to input power. Researchers hope to reach 10 megawatts of power in this year's TFTR tests, which would bring the ratio up to nearly 50% of breakeven.

Deuterium is a heavy hydrogen atom which contains an additional neutron along with a proton in its nucleus; tritium has two neutrons. In D-D fusion, normally either tritium or helium-3 is produced in equal amounts. Each D-T fusion reaction produces one neutron and one alpha particle. The neutrons carry approximately 80% of the fusion energy produced, which could be used to produce power. The positively charged alpha particles, carrying 20% of the fusion energy, remain trapped in the magnetic field and, through collisions, transfer this energy to the remaining D-T plasma. The confinement of the high-energy alpha particles in the magnetic field is needed for the eventual production of self-sustained, or "ignited" plasmas.

In cold D-D fusion, the one-to-one branching ratio of tritium to helium-3 production is violated: Close to a million times more tritium than helium is observed. More importantly, the excess heat measured cannot be accounted for by the relatively small amounts of tritium or helium-3 which are detected. One suggestion is that the more unusual helium-4 reaction that occurs, rather than helium-3 or tritium, is the nuclear ash for cold fusion, but this has yet to be proved. Helium-3 has two protons and one neutron in its nucleus, while helium-4 is balanced by two protons to two neutrons.

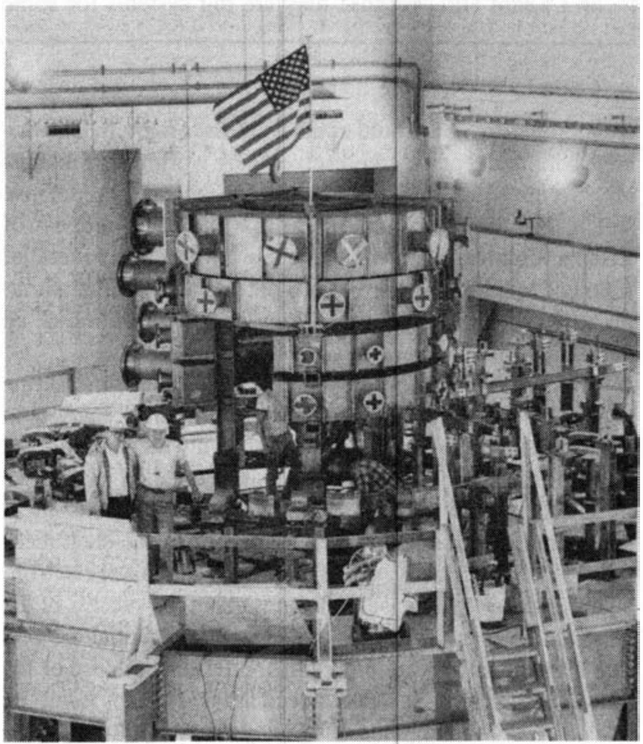
The problem in developing a fusion reaction comes from the need to develop materials capable of sustaining the high heats and high neutron flux. Not only are there structural problems with the materials, but also, because of the use of tritium as a fuel and the emission of neutrons (around 3.4×10^{18}), there is the problem of activation of the materials used in the containment vessel. While fusion energy is a clean source from the point of view of a working reactor, materials handling for repair and reconditioning the machine appear to be prohibitively expensive at the moment.

A further problem to be solved is containment of the plamsa fuel, which in the present design of the tokamak depends upon increasing the radius of the containment vessel. In the TFTR the major plasma radius is 2.52 meters, and the minor radius of the donut-shaped design is 0.87 meters. The energy is contained during each 4-second activation pulse for only about 0.14 seconds of the burst, before neutrons travel to the wall of the containment vessel and cool down the plasma. The next state of the international fusion effort is geared to the development of the International Thermonuclear Experimental Reactor (ITER) now in its design phase. This scaled-up machine is estimated to cost tens of billions of dollars, and would probably not come on line until, at the earliest, near the middle of the next century, if it is built. Some critics suggest that rather than scaling up the size of the machine, the need is for more cleverly designed small fusion machines, such as the plasma focus, or zeta pinch. Harold Furth, former director of the Princeton program, was quoted in Robin Herman's 1990 book *Fusion, the Search for Endless Energy,* expressing the problem with large fusion machines such as the TFTR. "If the Martians were attacking," he said, "if money were no object, and the military wanted a working fusion reactor by the year 2000, there is no question we could have it. By the year 2000 we could build such a *big* turkey." However, he said, government does not want "a hugely expensive thing that produces a modest amount of power. Money will solve *a* problem not *the* problem."

Mars, the next step

President Reagan's announced policy for the Strategic Defense Initiative certainly rivalled President Kennedy's Apollo program in potential. Had the SDI been implemented along the lines outlined by Lyndon LaRouche, the strategic situation today would be entirely different, and we would be in the midst of a period of economic development without historical equal. Reality, however, proved otherwise, and the SDI was sabotaged by a combination of Soviet stupidity and American greed.

Although the Soviets agreed with LaRouche on many of the positive implications of the SDI proposal which he presented to them in back-channel negotiations sanctioned by the U.S. government before Reagan's 1983 announcement, the Soviets attacked the SDI as a *casus belli*. Rightly fearing the collapse of the Soviet economy, they refused to take the steps proposed by LaRouche to transform it into a viable system, modelled upon the Leibnizian economic policies also known as the American System. The Soviets recognized that an SDI based upon new physical principles would generate an enormous boost to the economies of the West because of their ability to rapidly assimilate the new



The Princeton Plasma Physics Laboratory's Tokamak Fusion Test Reactor (TFTR), in 1982.

LaRouche on Princeton, Hubble achievements

Lyndon LaRouche commented on the fusion breakthroughs at Princeton and the success of the Hubble Space Telescope mission in his weekly radio interview "EIR Talks" *on Dec. 15, 1993.*

I'm very happy, as a lot of other people are, about the Princeton results. But I'm unhappy about other things.

This was a policy issue which I discussed with a number of people, including the late Harold Grad back in the 1970s, when the tokamak policy was being pushed through the relevant government bureaucracy at that time. I thought that this idea of concentrating for a breakthrough on the tokamak-type reactor was a terrible mistake and would slow us down greatly; that we ought to keep a broader-based experimental program.

It's like the problem of the Texas business, the super-collider. It's not really a wrong thing to do, and it was a terrible thing to shut it down once we were committed to it and had the investment in it. But it was the wrong approach to focus everything on one or two big systems which have a lot of, shall we say, "political sex appeal" on Capitol Hill, because they are big systems for some part of the country, and to fail to see that science does not base itself largely on big systems, but on crucial experiments which sometimes are very small, like the so-called solid-state fusion experiments, which are small experiments. And many of the great discoveries of mankind, have come through these small experiments.

In the area of fusion processes and related matters, there are a lot of areas of research which would accelerate the benefit, which were neglected in order to fulfill the bureaucratically made decision to proceed with a choice of one mainline, big system. . . .

And we should say, if we want to be a great nation again—not be a junkpile—we're going to have to go for broad-based experimental work. . . probably doubling—at least—the percentile of our labor force which is coming out of qualified science training programs in universities. We're going to have to go back to something like the Sputnik program of the 1958-68 period in education, to get the people who actually know a little geometry out of the high schools so we have somebody who is teachable in physics, when they get to college.

If we don't do that, we're not going to be able to do this; and we should take this inspirational moment of achievement at Princeton in the Tokamak and in the Hubble repair operation, and say, all right, let's stop being stupid. Let's go back to doing the kinds of things which enabled us to put a man on the Moon; and then we'll be a great nation again.

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technologies which would come from the program. The Soviets admitted that they themselves were working to unilaterally develop just such systems for an anti-missile defense shield, but they also understood that the backwardness of Russian culture, coupled with their corrupt, bureaucratic, stagnant economic system would not permit a similar stimulus to work for them. Instead they chose the option of an accelerated arms race, détente to the contrary.

Things were little better in the West. While British Prime Minister Margaret Thatcher did everything in her power to reverse the Reagan initiative, a campaign which culminated in the Reykjavik summit of 1986, the so-called supporters of the SDI within the U.S. military-industrial establishment sought to divert the program to the use of off-the-shelf technology, in place of advanced systems such as laser, electron, and plasma beam defenses. Illusions about the success of the condominium and failure to recognize the potential dangers of a revival of Russian imperialism after the collapse of the U.S.S.R., turn the SDI into a dead letter. Perhaps it will be revived under the impetus of a policy change in Russia typified by the Russians' "Trust" offer to President Bill Clinton made public on April 1, 1992, to have a collaborative SDI program along the lines of the initial LaRouche proposal.

A similar opportunity for the Reagan administration existed in 1986, when the National Commission on Space, led by former NASA administrator Thomas O. Paine, issued its report on space initiatives which had been commissioned by the U.S. Congress. This called for a 50-year program to establish a colony on Mars. While President Reagan nominally endorsed the initiative, he succumbed to the despair that enveloped the nation in the wake of the tragic explosion of the Space Shuttle Challenger in January 1986.

In contrast, continuation and expansion of the Kennedy space program was a centerpiece of LaRouche's policy guidelines for America, for which he had been actively campaigning for years. While LaRouche welcomed the 1986 Paine report, he suggested to specific amendments: LaRouche believed that a 100,000-person science city could be established on Mars within a 40-year timeframe. Such a city, he suggested, should be primarily directed to astronomical investigations, and should be ringed by a network of telescopes in space—like the Hubble.

In this he was even more ambitious than Tom Paine, who had assumed that within 50 years a smaller outpost would be possible, but that to establish a city with 100,000 residents would require a century. Moreover, Paine's commission advocated manned space flight to Mars using conventional non-nuclear rockets in the beginning, which would take up to two years' flight time. For LaRouche, such a long period of space travel for astronauts, under conditions of zero gravity and exposed to cosmic radiation, was an unnecessary risk. Instead, LaRouche was confident that nuclear rockets could be quickly developed, which would allow the trip to be shortened to months, or perhaps with fusion rockets, even weeks. Of course, such disagreements were secondary, and LaRouche wholly endorsed the congressional Mars initiative, which President Reagan also supported. The program was allowed to die through inaction by Vice President George Bush, who had been chosen to oversee the project.

In endorsing the Paine Commission Report, Ronald Reagan had chosen to reiterate the best goals of his administration, which was confirmed in a speech he delivered in Houston before the workers at the Johnson Space Center, when Shuttle flights finally resumed in the second half of 1988. With Vice President Bush and the five astronauts who would fly Discovery present, Reagan reasserted America's commitment to man's future in space.

Calling the space frontier the United States' manifest destiny, he told his audience: "In the next century, leadership on Earth will come to the nation that shows the greatest leadership in space. It is mankind's manifest destiny to bring our humanity into space, to colonize this galaxy. I say that America must lead. The nation that has achieved the greatest human freedom on Earth must be the nation to create a human future for mankind in space, and it can be none other."

The theme was reprised later in the speech, where he referred to the aftermath of the Challenger disaster. "Our early settlers knew great risks," he said, "and made great sacrifices and moved the frontier forward to build a great nation."

Echoing LaRouche's March 3, 1988 national broadcast, "The Woman on Mars," which we excerpt in an accompanying article, Reagan said: "Somewhere in America, there is alive today a small child who one day may be the first man or woman ever to set foot on the planet Mars or inhabit a permanent base on the Moon."

The McCormack fusion energy act

In 1981, just before leaving office, President Jimmy Carter signed into law the Magnetic Fusion Energy Engineering Act of 1980, popularly known as the McCormack Act, after its sponsor Rep. Mike McCormack (D-Wash.). The Fusion Energy Foundation, which LaRouche had founded, justifiably took credit for the success of its three-year effort to secure passage of this law, which committed the United States to a broad-based effort to secure fusion energy as a viable energy source by the end of the century.

The funds to carry out the program were never made available, however, and, under the aegis of Reaganomics, appropriations for the fusion program were cut back. As a result, the broad-based U.S. fusion effort of the 1970s, which came under pressure during the Carter administration, was narrowed to allow the Princeton TFTR program to realize its just-accomplished (and long-postponed) goal of a test tritium-deuterium burn. Furthermore, future planning for the U.S. program has been vectored toward international collaboration on the scaled-up ITER machine.

The McCormack Act stated in part: "The United States must formulate an energy policy designed to meet an impending worldwide shortage of many exhaustible, conventional energy resources in the next few decades. . . . Fusion energy is one of the few known energy sources which are essentially inexhaustible, and thus constitutes a long-term energy option. . . . It is the proper role for the federal government to accelerate research, development and demonstration programs in magnetic fusion energy technologies; and acceleration of the current magnetic fusion program will require a doubling within seven years of the present funding level without consideration of inflation and a 35% increase in funding each of fiscal years 1982 and 1983."

Rather than doubling the budget in a seven-year period, subsequent Congresses, acting under perceived budgetary restrictions (in real dollar terms), reduced appropriations for magnetic fusion by one-third. The McCormack Act stated that its purpose was "to maintain the United States as the world leader in magnetic fusion." The moral of the story is clear: Granted that there are serious obstacles standing in the way of realizing the promise of controlling fusion energy in order to transform it into economically useful forms, the present policy in the West, not only in the United States, is not vectored to solving them. Indeed, there is reason to fear that the effort to build the ITER is not a serious proposal for international cooperation in fusion energy research, but instead a subterfuge for eventually coming to a decision to close down the program entirely—as appears to be the fate of the Superconducting Supercollider (SSC), which was also an international project.

The Fusion Energy Foundation (FEF), established in November 1974, took the national lead not only in formulating the policy which culminated in the passage of the McCormack Act, but has been on the forefront of every effort in the frontiers of science. FEF published the *International Journal of Fusion Energy,* and *Fusion* magazine, which had a peak circulation of 200,000, and had affiliates in India, Germany, France, Italy, and Sweden. FEF was a scientific institution with a worldwide reputation recognized as such in the scientific community. Its founding members included Drs. Robert Moon and Winston Bostick, as well as Lyndon LaRouche.

The foundation was summarily shut down on April 21, 1987 by the U.S. government under bankruptcy proceedings subsequently ruled by U.S. courts to have been fraudulent. This outrageous violation of the First Amendment was part of a broader pattern of judicial misconduct that resulted in the imprisonment of Lyndon LaRouche and 12 of his associates. In March 1988, some of the staff of *Fusion* cooperated to start a new magazine, *21st Century Science & Technology.*