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On the cover: Artist's depiction of two astronauts with a drill that is boring into the top layers of the lunar surface for resource extraction. Cover design by Alan Yue. Photo courtesy of NASA/John Frassanito & Associates.

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Moving Backwards In Space

In a stealth mode, after Friday business hours preceding the three-day Columbus Day holiday weekend in October 2006, the White House posted a 10-page U.S. National Space Policy paper on an obscure government web site, clearly hoping that no one would notice it.

The misnamed "space" policy is not, as one might expect, an elaboration of the space exploration Moon-Mars initiative that President Bush had announced at NASA headquarters in January 2004. In fact, the 10-page document includes just *one paragraph* concerning NASA's civilian space programs.

Rather, the primary goal of space policy as stated in this document is to "further U.S. national security, homeland security, and foreign policy objectives." The second goal, is to "enable unhindered U.S. operations in and through space to defend our interests there."

The document states that the United States is committed to the exploration of space "for peaceful purposes," to "allow U.S. defense and intelligence-related activities in persuit of national interest." Cooperation with other nations will "protect and promote freedom around the world."

Further, the policy asserts that the United States will "preserve its rights, capabilities, and freedom of action in space." To do this, the United States will "dissuade or *deter* others from either impeding those rights or *developing capabilities intended to do so;* take those actions necessary to protect its space capabilities; *respond to interference; and deny, if necessary, adversaries the use of space capabilities hostile to U.S. national interests*" (emphasis added).

There was no question in anyone's mind as to which countries were the target of this policy to prevent the development of military space capabilities that could be construed as "hostile to U.S. national interests," whatever that means. The reaction from China and Russia to this unilateral declaration of U.S. ownership of the "high ground" of space was swift. The policy itself was widely seen as a response to China's increasing capabilities in space.

In fact, it is up to the United States whether or not there will be any actions "hostile to U.S. interests" in space.

In the early 1960s, and even afer the Cuban missile crisis, President Kennedy extended an offer to the Soviet Union to jointly go to the Moon, to lower tensions, and as a war-avoidance initiative. During the Cold War, the United States and the Soviet Union sent astronauts and cosmonauts into Earth orbit to "shake hands" in space, through the Apollo-Soyuz Test Project.

China has made clear its plans for the long-term exploration of space. Its leaders have continually expressed their nation's interest in cooperating with the United States.

The exploration of the universe, and discovery of new fundamental scientific principles, is the most challenging project facing mankind. As more and more nations join this endeavor, it is incumbent upon policymakers in the U.S. to change the current course, and move ahead with our best foot forward.

Launching the Isotope Economy

The limitations of the Bush Administration's adversarial policy in space stands in stark contrast to the incredible scientific opportunities that lie ahead.

Humanity stands at the threshold of a new era of breakthroughs in science and applications in new technologies. The two greatest achievements of the 20th Century—the discoveries in nuclear science and the possibilities of space travel—are now poised for quantum leaps

that can, and must, revolutionize mankind's mastery of his world, and the universe.

As Jonathan Tennenbaum describes in his feature article on "The Isotope Economy," our ability to overcome the near-term exhaustion of this planet's minerals and raw materials depends upon the deployment of an increasingly energy-dense array of energy technologies.

A fission-based "nuclear renaissance" is now in progress around the world, and the decision in 2006 to begin construction of the International Thermonuclear Experimental Reactor (ITER), have finally placed the world on the proper path for developing both fission and thermonuclear fusion.

Just as dozens of nations that had been excluded from using nuclear technology, for political and economic reasons, are now planning to enter the nuclear age, dozens of developing nations are likewise entering the space age.

What a nation can achieve through a focussed, nationally directed and supported, long-range program in space, is evidenced by China. That developing nation became the third country to launch a man into space three years ago, and has mapped out a multi-decade plan that will bring it up to par with the world's other spacefaring nations.

Under the pressure of Chinese space developments, in January 2007, India tested its first vehicle designed to safely reenter the Earth's atmosphere, which is a necessary first step to developing a manned spacecraft. For the first time in its history, Japan's space agency is considering its own manned spaceflight program.

These developments stand in stark contrast to recent space policy initiatives from the Bush Administration. As in many other aspects of strategic policy, the Administration is not putting America's best foot forward, as a leader that can offer the world new generations of technology, but is threatening other nations to allow the United States to operate unilaterally in space—or else.

Such preemptive war in space, like its counterpart on Earth, is a bad policy.

—Marsha Freeman

On Duesberg and AIDS

We continue to receive letters and comments asking about the Peter Duesberg theory on AIDS, citing his 2003 article, "The Chemical Bases of the Various AIDS Epidemics: Recreational Drugs, Anti-viral Chemotherapy and Malnutrition," authored by P. Duesberg, C. Koehnlein, and D. Rasnick, and published in the Journal of Bioscience, *Vol. 28. Letters have also mentioned the chapter on AIDS in Tom Bethell's book,* The Politically Incorrect Guide to Science, *and Liam Scheff's March 12, 2005 article published by Accuracy in Media, "The Media Campaign for HIV Tests."*

We point readers to our original article on the subject by Wolfgang Lillge, M.D. and others, "AIDS and the Duesberg Controversy" (Spring 1998), answering Duesberg's claims on AIDS. Here, Associate Editor Colin Lowry briefly responds on the issue.

Colin Lowry Comments on Duesberg's Latest Coverup

The latest cover-up attempt by Peter Duesberg et al. to deny the contagious nature of HIV is probably his most pathetic, and immoral masquerade yet. In his 2003 paper, he tries to ignore 22 years of scientific evidence about HIV and AIDS, and simply declares that HIV does not cause AIDS, and that it is not contagious.

Duesberg was a prominent researcher investigating retroviruses back in the 1970s, and surely does not believe the lies he tells publicly these days. His arguments have been answered and shown to be false for over a decade among professional scientists. The main argument of his paper is that AIDS is merely the result of recreational drug use, or in some cases, treatment with anti-retroviral drugs, or maybe just malnutrition.

How can that explain the millions of young children who are infected with HIV and those dying every day? Are they all on recreational drugs, even as infants? This should be mocked as a farce, except that the intent of such lies is to confuse and derail any serious attempt at stopping the AIDS epidemic.

Another of Duesberg's claims is that AIDS patients have HIV antibodies, but they don't have the virus. This too, is not true. The routine tests used for HIV do detect antibodies, but the reason we don't see HIV in the blood at all times is because it is a retrovirus: It can integrate into the genome of a cell, and lie dormant for periods of time, before reproducing and infecting other cells. When someone is infectious, they certainly have HIV in their immune cells circulating in the blood.

Duesberg also attacks the use of the anti-retroviral drugs that have increased the survival time of millions of AIDS patients in the industrialized nations, and have helped decrease mother to child transmission, even in Africa.

The HIV-AIDS epidemic is increasing worldwide every day, with 4.3 million people becoming newly infected last year. In 2006, 40 million people were living with the virus, and 3 million died of AIDS; of those deaths, 380,000 were children under 15 years old. It is amazing that with an epidemic that has already killed 25 million people, some are still confused by Duesberg's distraction, preventing the work required for a cure and the resources needed to build up the health-care infrastructure the world desperately needs.

On Morals and Science

I take this occasion to briefly congratulate you for your editorial work, based on Lyndon LaRouche's intuition, moral certitudes, theoretical developments, and corresponding political action!

I have understood for a long time (even before meeting LaRouche in the 1970s):

(1) that there is no such things as a universe without humans of some sort (nothing to do with quantum mechanics!),

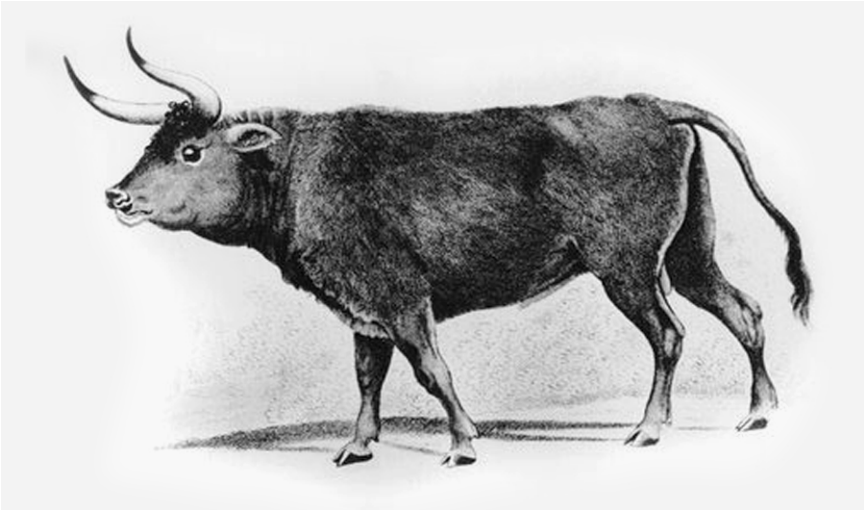
Continued on page 5

Meat and the Planet: A Human View

by Zbigniew Jaworowski, M.D., Ph.D., D.Sc.

Professor Jaworowski here responds to a New York Times *editorial, Dec. 27, 2006, entitled "Meat and the Planet," which calls for "pushing livestock production in more sustainable directions" to help stop "global warming." Jaworowski's letter was not printed by the* Times.

Jaworowski, a multidisciplinary scientist, is the chairman of the Scientific Council of the Central Laboratory for Radiological Protection in Warsaw.



This lithograph is of the last of the aurochs (in Polish tur, *similar to Greek* tauros *and Latin* taurus, *but also to German* Tier, *and English* deer*). They lived throughout Europe after the last Ice Age, but slowly disappeared because of hunting and agriculture. For several hundred years a small group of these animals lived in the large forests in Poland, protected by the king and local princes. The last group lived in Jaktorowski Forest not far from Warsaw, under the protection of the Prince of Masovia. This small group died out in a couple of years, probably because of a disease contracted from domesticated cattle. The lithograph depicts the last female, which died in 1627.*

The editorial "Meat and the Planet" is imbalanced. The 3.2 billion cattle, domestic buffalo, sheep, and goats, plus pigs and poultry, are not just meat, they are also living organisms, which desire to live no less than we do. Stopping rearing them, would mean stopping the lives of these billions. Having a say, would they appreciate this?

Human activity has increased the plant and animal biomass of the cultivated part of the biosphere. In the paleolithic period, the number of aurochs (*Bos primigenius*) that lived in Europe until 1627 A.D., was probably some 100 times lower than the number of cows (descendants of this *Bos*) living there now. Similar calculations are easy to perform for pigs or birds. The cultivated ecosystem is able to provide more food for large mammals and birds than ecosystems of old. This is because we increased production of vegetal nutrients by many folds, in comparison with non-human ecosystems.

The editorial stated that methane released by these domesticated animals is responsible for 18 percent of the global greenhouse effect. This is incorrect. According to the 1990 report of the Intergovernmental Panel on Climate Change (IPCC 1990), methane (CH_4) from all sources (man-made plus natural), contributes 18 percent not to the total greenhouse effect, but only to its man-made fraction.

But the man-made greenhouse effect is only a tiny part of the natural greenhouse effect, the dominant cause of which is water vapor present in the atmosphere—a fact that the greens and the media tend to ignore. According to various estimates, water is responsible for about 96 to 98 percent of the natural greenhouse effect (Ellingson et al. 1991, Lindzen 1991).

Four other-than-water greenhouse gases (CO_2, CH_4, N_2O, and CFCs) add only 2 to 4 percent to the natural greenhouse effect. Taking even the upper limit, 4 percent, methane contributes only a tiny fraction to the global greenhouse effect.

The total natural and man-made atmospheric emission of methane is 0.525 gigaton per year (IPCC 1990). This (according to the IPCC data) contributes 0.68 percent to the total greenhouse effect. All animals with enteric fermentation (wild plus domesticated) add to the global emission of methane only 0.080 gigaton per year (IPCC 1990), contributing 0.10 percent to the total greenhouse effect. This is 180 times less than stated in the *New York Times* editorial, and obviously far from being alarming, as heralded by the *Times.*

The increased nourishing potential of the biosphere should be regarded as a beneficial influence of humans on the planet. The climatic effect of domestic animals is imperceptible. What is really alarming is the misanthropic tune and green blinders with which the *New York Times* treats humankind and its civilization.

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USDA

A Missouri farmer with rice plants. More CO_2 would increase rice productivity.

C4 vs. C3 Photosynthesis: A Response to Low CO_2 Levels

by Christine Craig

About 90 percent of land plants, including both monocots and dicots, are equipped to photosynthesize only through the C3 photosynthetic pathway. Chloroplasts of only one type of plant cell, the mesophyll cell, are primarily involved in photosynthetic light capture and CO_2 assimilation into 3-carbon carbohydrates, which are then used to manufacture plant structural and functional elements.

The problem with this situation, as far as human food production is concerned, is that, "under current atmospheric conditions (0.036% CO_2, 21% O_2), up to 50% of the fixed carbon is lost by photorespiration"[1] in such plants.

Why? The enzyme which catalyzes the primary CO_2 fixation reaction in mesophyll chloroplasts, Rubisco, is sensitive to CO_2 concentration. Under low CO_2 conditions, it will bind with oxygen instead, essentially, breaking down carbohydrate and releasing CO_2, in a process known as photorespiration. This is considered very wasteful to plant productivity.

C4-type photosynthesis apparently evolved at various times, in various plant groups, as a mechanism of concentrating CO_2 in the cells where CO_2 fixation is occurring. In monocots such as maize and sorghum, this is accomplished by a division of labor between two cell types: CO_2 is brought into mesophyll cells, chemically joined to a three-carbon molecule to make a four-carbon molecule, and shunted to the bundle sheath cell, where it is cleaved off and made available to the Rubisco-catalyzed C3 photosynthetic cycle.

The 3-carbon molecule resulting from the CO_2 removal in the bundle sheath cell is shunted back to the mesophyll cell for reuse, and two ATP are used up in the process. Therefore, C4 photosynthetic pathways are reactions in addition to C3 pathways, with a division of labor set up between bundle sheath cells, where photosynthetic carbon assimilation occurs, and mesophyll cells, which house the mechanisms for bringing CO_2 into the cell and temporarily adding it to a 3-carbon molecule for later use by Rubisco. So, both enzymatic and anatomical changes are part of the evolutionary developments which have allowed plants like maize to get around the problem of photorespiration under low CO_2 conditions.

Higher CO_2 Would Boost Rice

C4 plants function well in high-light, high-heat conditions as in the tropics, whereas C3 plants do best in lower light, more temperate conditions. The problem for crop scientists is, that one of the main food crops in tropical climates is rice, a C3 monocot. Under present atmospheric conditions, rice is not nearly as productive as it would be under higher CO_2 concentrations. Until—or unless—that situation occurs, scientists are in a bind

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Letters

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(2) that mathematics cannot be separated from a general understanding of nature,

(3) that political action is coexistent with all the rest. . . .

It's not easy for a scientist to crawl against the current. Even if modern science is full of so-called accepted "paradoxes," it's not a good basis for reflection.

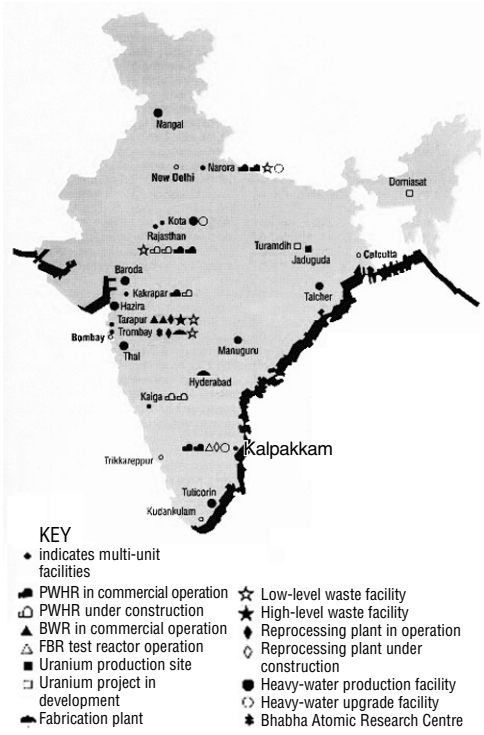
It's necessary, as you do, to return to older conflicts, an idea out-of-fashion, except perhaps recently. (As I must go frequently to an university hospital, I went to the library there, only to find that all books older than 10 years are thrown away!)

We must not accept "technical" truth, reread critically even Cauchy, and accept that morals may be a key of mathematics!

Jean-Pierre Wallenborn
Brussels, Belgium

Correction

A box titled "Thorium Converter Reactor Ready for Development," on p. 49 of the Fall 2005 *21st Century* erroneously states that Tak Pui Lou, Ph.D., of Lawrence Berkeley National Laboratory, is a co-owner of the company Thorenco LLC. He is not, and we regret the error.



Argonne National Laboratory

Two of the new breeders are planned for the Kalpakkam site.

INDIA TO BUILD FOUR FAST BREEDER REACTORS

India's Department of Atomic Energy official Dr. Baldev Raj announced Jan. 31 that India will simultaneously build four 500-megawatt fast breeder reactors, as a next step in its thorium program. A breeder reactor generates electricity and at the same time makes more new fuel than it uses up, the only truly renewable energy system. Raj is the director of the Indira Gandhi Center for Atomic Research in Kalpakkam, where a 20-MW Fast Breeder Test Reactor has been in operation for 20 years. Two of the new reactors will be based in Kalpakkam, where a prototype 500-MW Fast Breeder Reactor will go critical in 2010. Tamil Nadu, the state where Kalpakkam is located, is bidding for the second two reactors also, to meet the need for desalination and electricity production.

The new breeders would first use uranium-plutonium oxide as fuel, and later switch to metallic fuel. The neutrons produced by the fission of the uranium and plutonium will convert thorium oxide, positioned in a blanket around the reactor wall, into fissile U-233. The conversion ("breeding") of thorium into U-233 is the first step in the thorium cycle, which would make India energy-independent, as it possesses the world's second largest reserves of thorium in the black sand beaches in Kerala state. The U-233 bred from the thorium would then become the fuel for nuclear generating plants to be built on the model of a prototype reactor now running at the Bhabha Research Center.

NASA HEAD QUESTIONS HUMAN ROLE IN GLOBAL WARMING

"We have yet to find out whether the present climate change is man-made, or whether it is just a short-term vacillation," NASA Administrator Mike Griffin told the German daily *Frankfurter Allgemeine Zeitung* Jan. 26. This, despite an annual investment of $5.5 billion in research on planet Earth. "What I also want to know from our scientists," he said, "is why the Vikings settled in Greenland and cultivated wheat, and why one day it became too cold to do that."

Griffin gave the interview to the Frankfurt paper while he was attending the World Economic Forum at Davos, Switzerland.

Google Tech

Fusion scientist Robert Bussard presenting IECF fusion to Google staff members. The video can be viewed at http://video.google.com/videoplay?docid=1996321846673788606.

POLYHEDRAL FUSION PROVEN IN INERTIAL ELECTROSTATIC CONFINEMENT

A novel method of achieving nuclear fusion by inertial electrostatic confinement was given wide publicity by the posting on Google Tech of a 90-minute lecture Nov. 9 by veteran fusion researcher Dr. Robert W. Bussard. Bussard explains how a program funded by the Defense Advanced Research Projects Agency (DARPA) achieved 100,000 times the neutron flux produced in earlier devices of this kind.

Bussard began work on inertial electrostatic confinement fusion (IECF) in the 1980s, after losing faith in the bureaucracy administering the magnetic confinement (tokamak) program, of which he was a pioneer. In IEC fusion, deuterium or other positive ions are drawn to the center of a spherical vacuum chamber by the high negative voltage potential on the inner of two concentric metal grids. Part of the problem of achieving fusion involves steering the electrons stripped from the ions. Bussard realized a means of guiding the electrons using magnetic fields. It turned out that the ideal configuration required placing magnets around a polyhedron in which four faces come together at a vertex. The cuboctahedron was chosen. In the seventh prototype, built at a Manassas, Va. lab funded by the Navy and DARPA, six toroidal-wound magnetic coils were placed at the cubic faces of a cuboctahedral configuration, achieving a 100,000-fold increase over the best results achieved by electrostatic-only devices. The results were achieved in the last run of the prototype device, just before the program was shut down because of funding cuts stemming from the Iraq war.

Bussard is seeking $200 million in funding for further work. He will also try a configuration based on the icosidodecahedron.

IT'S CHEAPER TO REPROCESS SPENT NUCLEAR FUEL THAN TO BURY IT

The French nuclear conglomerate Areva announced a new study that refutes the long-held claim of the anti-nukes and the nuclear industry that recycling is prohibitively expensive. The study, released July 25, was carried out by the Boston Consulting Group. It involves only "market" and "competitive" assumptions, and does not include the valuable isotopes that could be "mined" from the small amount of nuclear fuel—the so-called high level waste—that cannot be recycled into new uranium fuel or mixed oxide fuel. If the technologies were developed to extract these isotopes for medical and industrial purposes, the economy would have no waste burial costs.

At present, the United States has a once-through cycle for nuclear fuel. Reprocessing was stopped in the 1970s, in a policy pushed by neo-con Albert Wohlstetter and carried out by President Carter, which equated nuclear plants with bombs, and reprocessing with proliferation.

Savannah River Site

Spent fuel handling at the Department of Energy's Savannah River Site, which also used to reprocess nuclear fuel, until U.S. reprocessing was shut down.

NEW TB TEST IS QUICK AND EFFECTIVE

A group of scientists working in a clinical setting in Peru have developed a new test for TB that is fast and effective, as reported in the *New England Journal of Medicine,* Oct. 12, 2006. The new test, called the microscopic-observation drug-susceptibility (MODS) assay, uses microscopically visible growth morphology to spot TB quickly in culture. Differential growth media were used to determine drug susceptibility. The scientists claimed that their MODS assay produced results in 7 days, compared with the two methods presently used: automated mycobacterial culture, which takes 13 days, and culture on Lowenstein-Jensen medium, which takes 26 days. The new test is also more accurate.

In addition, the MODS assay can test for drug resistance at the same time, producing drug resistance profiles in 7 days, versus 22 days and 68 days, respectively, for the other two methods. The advantage of such quick results is that patients will be identified sooner, and will not be treated for weeks with therapies which may not be effective.

The test itself is inexpensive, but it will still require safe handling of the cultures for preparation and observation in a well-organized tuberculosis lab with biosafety Level 3 standards.

CHERNOBYL BIOLOGY STUDY: NO MARKED GENETIC EFFECTS ON WILDLIFE

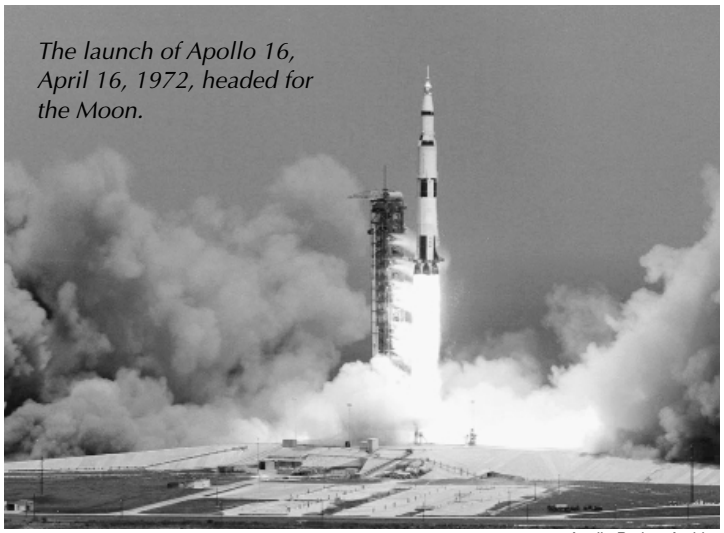
Writing in the *American Scientist,* Nov.-Dec. 2006, biologists Ronald K. Chesser and Robert J. Baker review their 12-year study of wildlife at the site of the Chernobyl accident, where they were astounded to discover an abundant and thriving ecosystem, just eight years after the accident. They report that they are still challenged by what they found there—higher than normal radiation levels with no marked genetic effects on the wildlife, and very complex ecological variables. Their unusual article admits that they were "terribly naive about radioecology" and the "politics of science" at the start, and says that they wrote the article to share some "brief lessons" of what they learned, including, "Beautiful theories are often destroyed by ugly facts," and "Be prepared to be unpopular and uncomfortable." Scientists must have a single agenda: the truth," they conclude.

WIND ENERGY FIZZLES WHILE CALIFORNIA SIZZLES

California's vaunted windmills produced only 4 to 10 percent of its capacity in Summer 2006, when it was most needed. A Department of Energy nuclear engineer reported in the *Energy Pulse* web newsletter Sept. 8, on the output of windpower during California's 2006 heat wave: "On the day of peak demand, August 24, 2006, wind power produced at 254.6 MW at the time of peak demand. 254.6 MW represents only 10.2% of wind's rated capacity of 2,500 MW. . . . Over the preceding seven days, August 17 to 23, wind produced at 89.4 to 113.0 MW, averaging only 99.1 MW at the time of peak demand or just 4% of rated capacity."

clipart.com

No wind, no power.



The launch of Apollo 16, April 16, 1972, headed for the Moon.

Apollo Project Archive

The technologies for creating and harnessing new "natural" resources are already known today. We need the political will to mobilize them now, for the benefit of mankind.

Nuclear Medicine Research Council

A robot manipulator holds a vial of yttrium-90, a radioactive isotope used in medicine. Although radioactive substances are used widely in medicine today, the United States must import 90 percent of its medical isotopes.

The Isotope Economy

by Dr. Jonathan Tennenbaum

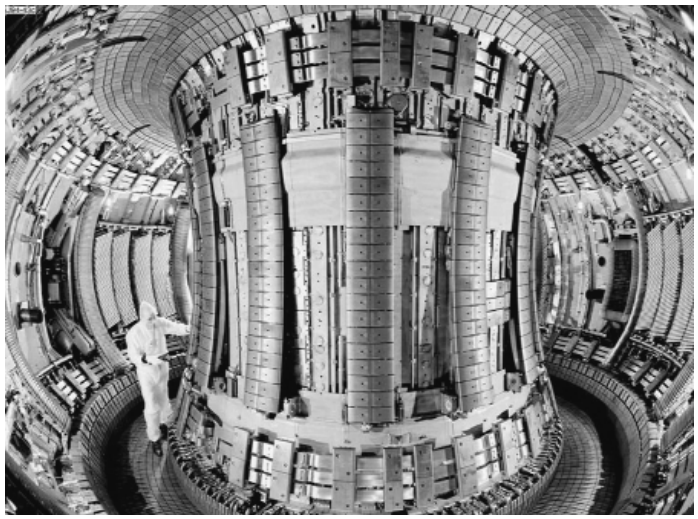
South African Nuclear Energy Corporation

Technicians working with nuclear medicine radioisotopes in a hot cell.

Prologue

The subject of this essay is a crucial component of the economic mobilization which must be launched in the immediate future, if the world is to be saved from a physical and socio-political collapse of a severity comparable only, on a global scale, to what occurred in Europe in the period leading to the outbreak of the "Black Death" of the 14th Century. The essential problem, addressed here, is how to overcome the effects of the savage destruction of in-depth industrial and scientific-technological capabilities, and of the educational level, skills, and cognitive powers of the labor force, which has occurred in the major industrial nations of both the East and West under recent decades' policies of globalization, deregulation, privatization, "shock therapy," and "the postindustrial society."

Any serious program of economic mobilization and reconstruction, must take account of the fact, that the



EFDA-JET

A full-scale Isotope Economy will require the development of controlled thermonuclear fusion power. Here, the Joint European Torus (JET), an experimental reactor which produced over 16 megawatts of power in 1997.

largest single, organically interconnected repository of highest-level scientific research, technological and advanced-technology manpower, and industrial capability on this planet, is located in and around the nuclear energy sectors of the United States, Russia, Ukraine, Japan, Germany, France, India, China, South Africa, Argentina, Brazil, and some others; and in areas of astrophysics, space technology, geology, and biomedicine, most closely linked to research and applications of nuclear physics. By the very nature of nuclear science, its roots and history, and the needs of the world over the coming 50 years, a mobilization of the world's nuclear sector, as a vanguard and locomotive for a generalized economic mobilization of the world's leading nations, must take a specific form. After discussions with Lyndon LaRouche, with S. Subbotin of the Kurchatov Institute, and F. Gareev at the Joint Institute for Nuclear Research in Dubna, I have chosen to call it the "Isotope Economy."

* * *

Approximately a century ago, it was experimentally demonstrated that the naturally occurring chemical elements, whose harmonic ordering Dmitri Mendeleyev embodied in his periodic system, were not homogenous bodies, but rather mixtures of distinct species of atoms—isotopes—having nearly identical chemical behavior, but profoundly different physical properties.[1] The investigation of this "new dimensionality" of the periodic system, and of the processes of transformation of atoms underlying it, led eventually to the discovery of fusion, fission, and other nuclear reactions, the realization of the first nuclear fission chain reaction, and the first atomic weapons, during World War II. The creation of those devices depended upon the separation of the pure isotope U-235 from naturally occurring uranium, and upon the artificial generation, in nuclear reactors, of the first several kilograms of plutonium-239: a species of atoms hitherto virtually absent from the Earth's natural environment.

Today, 60-odd years after the first man-made nuclear chain-reaction, large-scale production of power from nuclear fission reactions has become a reality in 30 countries. Approximately 3,000 different isotopes are known, most of them artificially generated, and more than 200 are presently in commercial use. Modern medical care, and countless other vital activities of modern society, would be unthinkable without the daily use of a hundred-odd radioactive isotopes, produced in nuclear reactors and particle accelerators. Meanwhile, the creation of nuclear weapons profoundly changed the face of history, shaping the entire era of the "Cold War" and creating a situation, where the launching of large-scale warfare, in the form known up to World War II, were practically tantamount to an act of suicide. Certainly, very few even among nominally highly educated persons today, are fully conscious of the extent to which our world has been shaped by the implications of what initially appeared as "infinitesimal" nuances in the behavior of chemical elements.

And yet, the implications of what was set in motion by the discovery of radioactivity and the isotopes, growing out of Mendeleyev's "Keplerian" understanding of the periodic system, go far, far beyond anything the world has seen up to now.

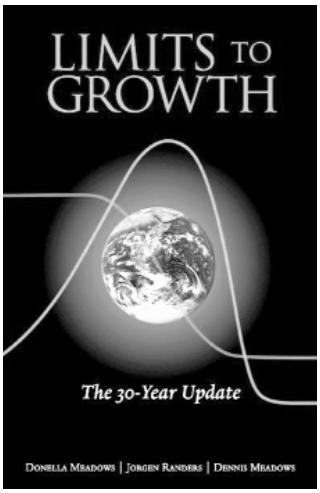
As Vladimir Vernadsky and others recognized already a century ago, the discovery of new dynamic principles, transcending the chemistry of the periodic system and closely bound up with the origins of our Solar System and the elements themselves, meant unleashing a fundamental revolution in all aspects of man's relationship to nature. Science had delivered into man's hands a new power: the power to generate a "fire" millions of times more concentrated than the chemical combustion processes, which had been a chief basis of human civilized existence since the legendary gift of Prometheus. A new power sufficient to send a large ship 20 times around the Earth on 55 kilograms of fuel; sufficient, in principle, to support a thriving human population many times larger than that existing today; but also a power to create, on Earth, physical conditions found otherwise only in stars and centers of galaxies; a power that opens the way, in the not-too-distant future, for the expansion of human activity throughout the inner regions of the Solar System, and eventually beyond.

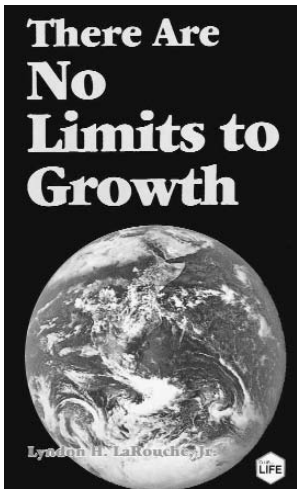
Man's beginning mastery of the power to transmute chemical elements, and to create new states of matter, not previously existing on the Earth and perhaps not even in the universe as a whole, demonstrates once more, that we are living in the universe of Plato, not of Aristotle. This is a universe in which *processes are primary;* in which "nothing is permanent, but change itself," and in which, in dealing with such things as atoms and so-called elementary particles, we must constantly speak, not of a "this" but of a "thus" (as Plato wrote in the *Timaeus*—see below). More than in any previous "phase state" of man's physical economy, the emergence of what I am calling the "Isotope Economy" signifies a condition, in which social practice must necessarily be oriented to *true ideas:* to the discoverable, universal principles that govern change and development of the universe, and not primarily to objects of the senses. This means the end of empiricism and materialism.

Such a revolution has profound political implications. Its realization is plainly incompatible with further toleration of an irrational, oligarchical organization of society, in which essential decisions, concerning the future of nations and the fate of humanity as a whole, are subject to the whims of a tiny number of influential families, while the vast majority of humanity lives in ignorance and servitude. The revolution, proclaimed

1. The sense of the distinction between "chemical" and "physical," referred to here, is historically specific and will become more clear as our discussion progresses. Briefly, the term "chemical" refers essentially to the circumscribed area of experimental and industrial practice which Mendeleyev (for example) dealt with in his influential textbook *General Chemistry.* There, elements are characterized, for example, in terms of the array of compounds they participated in, their mutual affinities and valences, and the geometrical type of crystals they form. Those properties turn out to be essentially identical for atoms belonging to the isotopes of one and the same element. "Physical" refers to all characteristics without restriction. In the historical context of the process leading to the discovery of isotopes, this meant above all the then-anomalous phenomenon of radioactivity, which fell outside the domain of "chemistry" as then understood.

   Nowadays, textbooks generally try to "objectify" the distinction, by attributing the "chemical" properties to the structure of the electron shells of the corresponding atoms, and the differences between isotopes of a given element to differences in the composition of their nuclei. However, as we shall see later in this article, the attempt to treat the electron and nuclear structures as if there were hermetically separated worlds, introduces a crippling fallacy.





Since the mid-1960s, there has been an all-out assault against the very notion of scientific and technological progress. The Club of Rome's 1972 book Limits to Growth *(at left, in a new edition), was highly influential in the battle for population reduction. The LaRouche movement countered the Club of Rome with a pamphlet widely circulated on college campuses, and later with a 1983 book (right) by Lyndon H. LaRouche, Jr.*

by Vernadsky as the coming of the Noösphere,[2] and which he saw as inseparable from a coming era of nuclear power, means a society living the Promethean self-conception of man; it means a society whose activity would revolve around the principle of creative scientific discovery, like the planets around our Sun. It means a highly educated population, capable of deliberative self-government, and organized on the basis of a scientific understanding of the dynamic relationship between the sovereign creative individual, the sovereign nation, and the interests of humanity as a whole.

In a word, the image of society that Leibniz and the "American Prometheus" Benjamin Franklin had in mind, in the original design for a republic in the New World. This view of mankind's future inspired the enormous optimism that people all over the world attached to nuclear energy—"the atom in the service of man"—in East and West, North and South.

The Olympians' War Against Progress

The response to this challenge, from the oligarchical would-be "Gods of Olympus," was explicit and savage. From the mid-1960s on, an all-out psychological and political war was unleashed against the institutions of industrial society and against the very notion of scientific and technological progress. The assault, focussing on the United States, Britain, and Western continental Europe, was loudly proclaimed in advance by Bertrand Russell and his circles, and executed by leading Anglo-American financial institutions and intelligence agencies close to the British monarchy and to oligarchical circles on the European continent. It lay at the origin of the orchestrated spread of the rock-drug-sex youth "counterculture," the New Left movement, the 1968 student revolution, the Malthusian propaganda of the Club of Rome's *Limits to Growth,* and the "Green" environmentalist movement worldwide.

These forces chose *nuclear power,* the clearest embodiment of scientific and technological progress, and the single most crucial technology for world development in the postwar period, as a main focus of their assault. Parallel with the buildup of the anti-nuclear scare campaign, institutional measures were enacted to stop the spread and development of nuclear energy worldwide: The Administration of Jimmy Carter initiated a 180-degree reversal of President Eisenhower's wise "Atoms for Peace" policy. It attempted to impose a virtual moratorium on nuclear exports to developing countries under the pretext of "nonproliferation," worked to dismantle the in-depth nuclear research capabilities of the United States itself, and to delay or halt, if possible, the realization of controlled fusion as a power source of the future.

The ambitious nuclear power programs of developing countries such as Brazil, Argentina, Mexico, and others, and the kinds of North-South cooperation exemplified by the long-term German-Brazilian nuclear agreement, were crushed by the opposition of the Carter Administration and its successors. Amidst the mass-media-orchestrated anti-nuclear hysteria of the 1980s, the nuclear program of Germany, once world leader in export and technology-transfer of nuclear technology, was shut down, along with the smaller, but qualitatively significant programs of Sweden, Italy, and a number of other nations. With the collapse of the Soviet Union and the subsequent, savage looting and destruction of the scientific-technological and industrial capacities of that nation, the single largest nuclear sector in the world outside the United States nearly went out of existence, only to be partly revived in the most recent period.

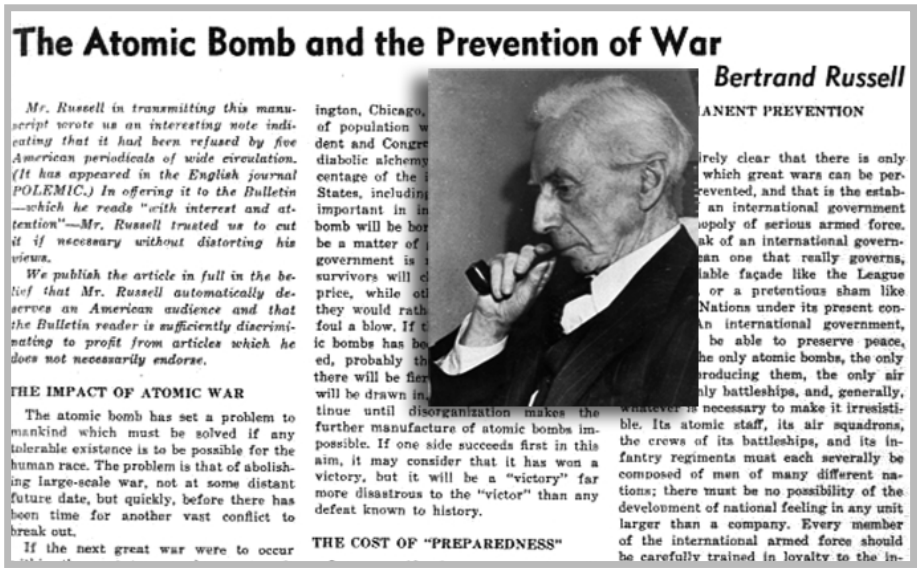
All of this destruction, and more, was already promised to the world by Bertrand Russell in his vehemently anti-science tracts during the 1940s and 1950s. Russell went so far, in 1946, as to propose dropping nuclear bombs on the Soviet Union, in case the Soviets refused to submit to a world government having an absolute monopoly on nuclear technology. Russell's essential argument—that the existence of truly sovereign nations was "too dangerous" to be tolerated in an age of nuclear weapons—remains the basis for the use of so-called "nonproliferation" as a pretext for denying the right of all nations and peoples to full and unhindered use of the fruits of scientific and technological progress. It remains the basis for a de facto regime of "technological apartheid," directed above all against the majority of humanity living in the so-called Third World.

But the oligarchical attempts to snuff out the nuclear revolution began long before the discovery of fission in 1934-1938. They revealed themselves in the orchestrated persecution of Marie Curie in France, in the bitter opposition to Max Planck's discovery at the turn of the century, and in the mafioso-like, bullying behavior of Niels Bohr and others toward Schrödinger and Einstein at the 1927 Solvay

2. See Vladimir Vernadsky, "The Biosphere and the Noösphere," excerpted in *Executive Intelligence Review,* Feb. 18, 2005, http://www.larouchepub.com/eiw/private/2005/2005_1_9/2005_7/pdf/30_33_7_featnoosphere.pdf
See also, the book review of Vernadsky's "Essays on Geochemistry" by William Jones, *Executive Intelligence Review,* June 16, 2006, http://www.larouchepub.com/other/2006/book_reviews/3324_vernadsky.html.

Conference. Bohr et al. explicitly forbade any kind of thinking which conflicted with the chosen occult-empiricist doctrine of "complementarity" and with the claim, that microphysical processes are intrinsically statistical-indeterminate in character.

In opposition to Einstein, Schrödinger, and others, who sought to conceptualize the *higher principle* underlying the apparently *discontinuous character* of quantum phenomena, Bohr, Max Born, Wolfgang Pauli et al. arbitrarily asserted that reality on the microphysical scale is *intrinsically* beyond the conceptual powers of the human mind! This explicit, savage attack on the principle of scientific creativity, backed up by the growing oligarchical takeover of the financing of scientific research, especially in the wake of World War I, served the obvious underlying purpose, to break what remained of the Promethean spirit of physical science, reawakened during the Renaissance, and to enslave science to the oligarchical agenda. Insofar as the fruits of scientific research were needed, for military and other "practical" purposes, scientists would be allowed to work; but they would not be allowed to think in a truly creative way. This repeated the tactic that had once deployed Laplace et al. to crush the circles of Monge and Carnot, and convert the Promethean École Polytechnique into a tool of Napoleon's imperial drive.



The Atomic Bomb and the Prevention of War

Bertrand Russell

Mr. Russell in transmitting this manuscript wrote us an interesting note indicating that it had been refused by five American periodicals of wide circulation. (It has appeared in the English journal POLEMIC.) In offering it to the Bulletin —which he reads "with interest and attention"—Mr. Russell trusted us to cut it if necessary without distorting his views.

We publish the article in full in the belief that Mr. Russell automatically deserves an American audience and that the Bulletin reader is sufficiently discriminating to profit from articles which he does not necessarily endorse.

THE IMPACT OF ATOMIC WAR

The atomic bomb has set a problem to mankind which must be solved if any tolerable existence is to be possible for the human race. The problem is that of abolishing large-scale war, not at some distant future date, but quickly, before there has been time for another vast conflict to break out.

If the next great war were to occur

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tinue until disorganization makes the further manufacture of atomic bombs impossible. If one side succeeds first in this aim, it may consider that it has won a victory, but it will be a "victory" far more disastrous to the "victor" than any defeat known to history.

THE COST OF "PREPAREDNESS"

ANENT PREVENTION

irely clear that there is only which great wars can be prevented, and that is the establ an international government opoly of serious armed force. ak of an international governan one that really governs, iable façade like the League or a pretentious sham like Nations under its present con- An international government, be able to preserve peace, he only atomic bombs, the only roducing them, the only air nly battleships, and, generally, whatever is necessary to make it irresistible. Its atomic staff, its air squadrons, the crews of its battleships, and its infantry regiments must each severally be composed of men of many different nations; there must be no possibility of the development of national feeling in any unit larger than a company. Every member of the international armed force should be carefully trained in loyalty to the in-

Bertrand Russell's infamous call for nuclear war against the Soviet Union was published in The Bulletin of the Atomic Scientists, *Oct. 1, 1946. If war were to take place soon, before Russia gains nuclear weapons, he wrote ,America would surely win, "and American victory would no doubt lead to a world government under the hegemony of the United States—a result which, for my part, I should welcome with enthusiasm."*

In the sequel, theoretical nuclear physics was elaborated, in the hands of a "kindergarten" of admittedly very brilliant and capable young scientists, into what it still largely remains today: a Ptolemaic mixture of mutually contradictory models, mathematical formalisms, and calculational procedures, that can be extremely useful and even indispensable in certain specific domains of application—such as building bombs!—but embody no intelligible conception of the universe. It is not surprising, that in the stormy developments leading to the discovery of nuclear fission, so-called "theory" lagged far behind the experimental work, which was the real "driver" of development. The discovery of fission was itself held back for four years, because this process was regarded by the theorists as "impossible."[3] The subsequent rapid development of nuclear physics and technology, from the wartime bomb projects, up to and including the realization of civilian nuclear power and the vast complex of medical and other applications of

Masked terrorists assault a nuclear plant in Germany in 1986. The anti-nuclear hysteria succeeded in shutting down Germany's nuclear program; Germany was once the world's leader in the export of nuclear technology.

3. See my article "How Nuclear Fission Was Really Discovered," *21st Century,* Spring 1991.

isotopes, was driven forward largely by people who were trained in the tradition of physical chemistry, geochemistry, and related industrially oriented fields of natural science. These people, exemplified by William Harkins, the Noddacks, or Vernadsky, often despised the mathematical sophistry of theoreticians who had been elevated to the stature of "high priests of science."

But the state of nuclear physics today is no less a product of the enormous external pressures imposed on science, and on many of the most brilliant scientists in the context of the wartime atom bomb projects and the ensuing Cold War. The subservience to military aims, of some of the most revolutionary areas of fundamental research in the physical sciences, and the imposition of strict regimes of secrecy, both in the West and East, preventing the free exchange of scientific ideas and experimental results, were virtually unprecedented in the millennia-long history of science. These circumstances had a devastating effect upon the intellectual integrity of many among the most brilliant scientists, and upon the organic development of science as a whole. Although the military relevance of advanced scientific areas such as nuclear physics, caused enormous resources to be devoted to their pursuit, the managed environment within which many scientists worked, became a powerful barrier to fundamental scientific progress.

Courtesy of Robert J. Moon

Chemist William Draper Harkins, who taught at the University of Chicago, was trained in industrially oriented fields of natural science and despised the mathematical sophistry of the science establishment. In the 1920s and early 1930s, Harkins investigated the relationships of the isotopes.

This was no mere incidental side-effect. Under the strategic policies promoted initially by Russell, Leo Szilard, and others—which later became known as the "balance of nuclear terror" and "Mutually Assured Destruction (MAD)"—the *suppression of fundamental breakthroughs* became more and more a *deliberate feature* of the management of scientific research. The essential argument of the Russell faction was, that once the United States and Soviet Union possessed sufficient numbers of nuclear warheads and delivery systems to inflict catastrophic damage on the other side, even after having suffered a first strike, a certain "stability" in the form of mutual deterrence had been achieved, which should not be disturbed at any cost. Accordingly, both sides should agree, not to pursue certain directions of research and development that might overturn the rules of the game. This had as a necessary consequence, however, that the *very possibility of fundamental scientific revolutions, would be seen, increasingly, as a potential threat to the strategic balance, and thereby to national security!*

Chaining Prometheus

The view, that Prometheus had to be chained down in the interests of preserving strategic stability, was institutionalized in certain understandings reached between the U.S. and Soviet governments, through Bertrand Russell's Pugwash Conferences and other "back channels," going back to the post-1957 Khrushchov period, and later exemplified by the ABM Treaty negotiated under Henry Kissinger. Superpower competition was thereby supposed to be limited to a narrow range of "permitted" directions—with a certain amount of cheating on both sides, of course—while at the same time the two sides cooperated to prevent any third country from developing "dangerous" scientific and technological capabilities. The active suppression of fundamental scientific breakthroughs, through bureaucratic and other means, applied not only to nuclear physics and areas directly connected with nuclear weapons, their delivery systems, and possible means of defense against them, but also to revolutionary areas in biophysics (bioelectromagnetism) and many other fields of science.

These U.S.-Soviet government understandings shaped world events for the entire period up to the collapse of the Soviet Union. Their effects even reached into school classrooms. They cleared the way, for example, for the 1960s liberal educational reforms in the United States and other NATO countries, which degraded the role of "hard physical science" in general education, in favor of the so-called social sciences, and for the subsequent assault upon the concept of scientific and technological progress. With the founding of the International Institute for Applied Systems Analysis (IIASA) as a joint project of top elements of the Anglo-American establishment and the Soviet *nomenklatura,* the oligarchical conception underlying the long-standing "condominium" arrangements between the two sides came out into the open: to manage the world by methods intrinsically opposed to the Promethean impulse of science. Many on the Soviet side failed to realize that the elimination of the Soviet Union, and especially of its advanced scientific-technological potentialities, was high on the list of priorities.

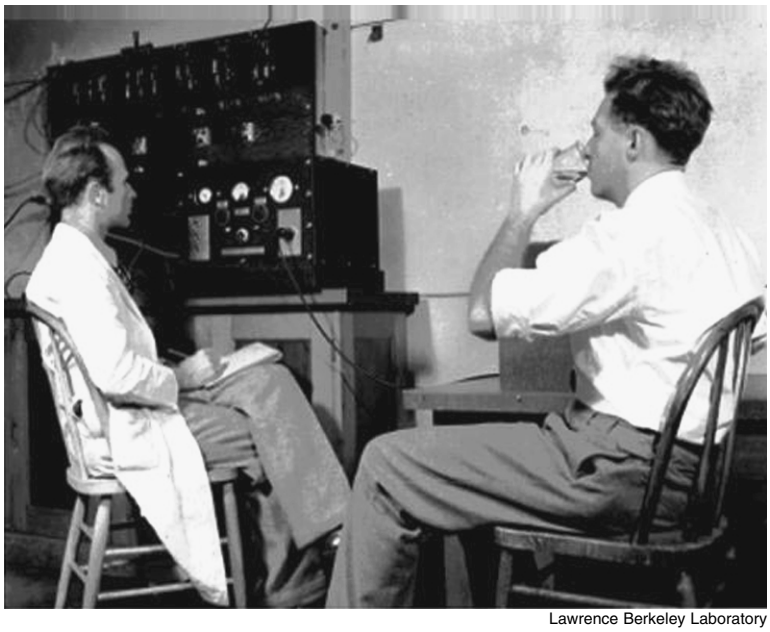
The only substantial attempt to break the world free from these policies, was Lyndon LaRouche's fight to cause a fundamental change in strategic relations between the two nuclear superpowers, centered on a jointly agreed commitment for both to develop and deploy antiballistic-missile defense systems based on "new physical principles" (sometimes called directed-energy or beam weapons). This would have eliminated the doctrine of "Mutually Assured Destruction" and thereby the whole game of Bertrand Russell and Szilard, and at the same time permitted both nations to move into a "science-driver" mode of economy, in which the revolutionary civilian spinoffs of research into "new physical principles" would pay back investment into defense systems many times over.

Unfortunately, Soviet General Secretary Yuri Andropov refused the proposal, which LaRouche had communicated

and explored in "back-channel" discussions with the knowledge of the Reagan Administration. Six years later, the Soviet Union collapsed, as LaRouche had warned it would, if his proposal were rejected. The policy of destroying the U.S.S.R.'s in-depth scientific-industrial capability went into full gear. But with the end of the Cold War, the need to continue large-scale state investments into advanced science and technology in the United States and Western Europe, from an oligarchical standpoint, no longer existed.

Nor was there any "need" to maintain an all-around industrial base. The floodgates were opened for savage deindustrialization and "outsourcing" of production to "cheap labor" nations, accompanied by the creation of a gigantic speculative bubble in the financial system. To most of the youth growing up in the formerly industrialized nations, true scientific and technological progress is at best a distant, secondhand memory.

We have come to the end of the cycle. The destruction of large parts of the total scientific-technological potentials of mankind, the loss of much of its best-qualified labor force, and the stupefication of the population in formerly industrialized countries, if not reversed soon, would doom the world economy to inevitable physical collapse. There is no way that the nations of the developing world, including China and India with their oceans of poor people, could generate the technologies they need for their long-term survival, without a revival of the kinds of scientific and industrial capabilities in the United States, the former Soviet Union, and Europe, that were typified by the first decades of development of nuclear energy. The world is faced with a simple choice: either to launch an economic mobilization, rejoining the track of development of the "nuclear age" that Vernadsky and others had foreseen, or to fall back into a murderous dark age. Prometheus must be set free! Human civilization cannot survive without scientific revolutions.



Lawrence Berkeley Laboratory

One of the first isotope metabolism studies, during the 1930s, at what was then called the Lawrence Radiation Laboratory.

A Nuclear Revival

Presently, the world is witnessing the beginning stages of a revival of nuclear power, which encompasses not only major developing countries such as China, India, South Africa, Argentina, and Brazil, but also Russia and even advanced-sector Western nations such as the United States, which had virtually abandoned their once-ambitious nuclear energy programs, for foolish ideological reasons, some 30 years ago. If the world does not descend into a dark age of chaos and war, a period of large-scale construction of nuclear power plants is pre-programmed, if only by the sheer scale and rapidity of expansion of demand for electrical and other forms of power, and the need to renew large sections of existing power-production capacities, which are coming to the end of their service lives.

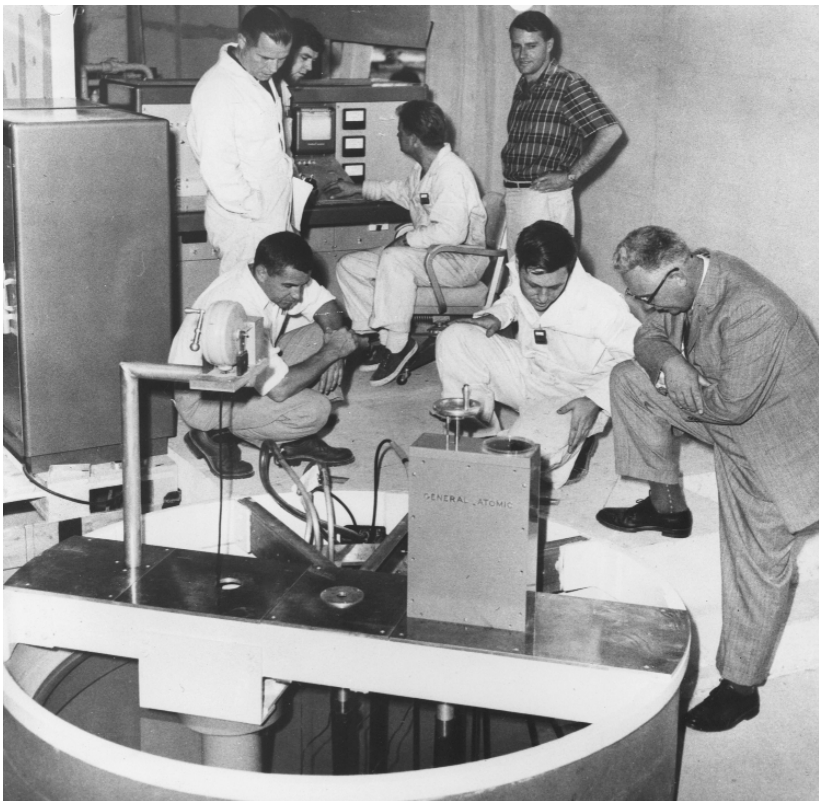
However, the world we are living in now is not the same as it was at the point that nuclear power development was aborted, three decades ago. Even an all-out commitment to a nuclear power plant construction program now could not possibly compensate for the severe damage the world economy, and human civilization generally, has suffered as a consequence of the sabotage of nuclear power development, and of the virtual war against industrial culture of which nuclear technology was a crucial vanguard element. Much of the science and engineering capabilities that once existed in the United States, Germany, Russia, Italy, Sweden, and other countries, is simply no longer there. They must be built up again in a process that will require a generation or more.

In the meantime, huge challenges facing mankind, which the early architects of nuclear energy development had recognized 50 years ago on the horizon of the future, stand today at our doorstep: the need to produce large quantities of fresh water by desalination or other artificial means; the need to replace the burning of petroleum products by a combination of electric power and synthetic, hydrogen-based fuels; the need to apply much larger power densities to the extraction, processing, and recycling of basic materials, and more.

To meet all these requirements, a revolutionary *new phase* in the development of nuclear energy must be launched now. I christen it, the "Isotope Economy."

What Is the Isotope Economy?

The immediate context for the emergence of the Isotope Economy is the now-beginning transition-process of the global physical economy, from the present, still-dominant role of fossil fuels, to nuclear power as the chief basis for the world's power production systems—both with respect to the generation of electricity, as well as, increasingly, industrial process heat and the production of hydrogen-based synthetic fuels to cover a growing percentage of total consumption of chemical fuels. The first stage of this process relies on nuclear fission reactors, with increasing emphasis on high-temperature reactors (gas-cooled as well as liquid-metal-cooled, slow- and fast-



Courtesy of General Atomics

The TRIGA research reactor was designed for training engineers and scientists and for producing nuclear isotopes for medical and industrial use. It was conceived by Edward Teller in 1956, and a working model was installed in 1958 in Geneva, at the Second Geneva Conference on the Peaceful Uses of Nuclear Energy. Today there are 65 TRIGA reactors in 24 countries.

neutron systems), and an integrated fuel cycle, with comprehensive reprocessing and recycling of fissionable materials, and employing thorium as well as uranium and plutonium.

The necessary inventory of fission reactors encompasses a large spectrum of different reactor designs, including small-sized, series-produced modular units, as well as standard large units; reactors optimized variously for use as electricity generators, as industrial heat sources, for desalination, for production of hydrogen and other synthetic fuels; for breeding of fission fuel and transmutation of nuclear waste products; for ship propulsion, etc. Reactors requiring little or no supervision and running for very long periods without refueling—the so-called "nuclear batteries"—may play a significant role in outlying and developing regions of the world.

This transition to nuclear energy as the basis for the world's power systems, necessitates a massive buildup of industrial capacities for isotope-separation and for the reprocessing of nuclear materials, with emphasis on use of revolutionary laser- and plasma-based technologies. The latter buildup, in turn, provides an immediate jumping-off-point for the emergence of the Isotope Economy.

The Isotope Economy is characterized by the combination of four main features:

First, the Isotope Economy means incorporating the entire open-ended array of individual species of atoms known as "isotopes," of which today 3,000 are known, into the economy as fully differentiated instruments of human activity. Thereby, the familiar system of the 92-odd elements of Mendeleyev's Periodic Table will be superseded, in broad economic practice, by an incomparably more complex and multifaceted System of Isotopes. At first, these developments will concentrate on a subset of 1,000 or so relatively longer-lived isotopes known today; later, however, this number will grow, as means are devised for extending the lifetimes of even very short-lived isotopes, modifying or even suppressing the radioactivity of unstable nuclei and rendering them economically usable, by "binding" them in suitable physical geometries.[4]

At the same time, the Isotope Economy will systematically *expand* the array of isotopes, beyond those known today, deep into the range of superheavy (transuranic) new elements and "exotic" isotopes of existing elements. Each of those species constitutes a singular condition of the universe: Each possesses a bundle of unique characteristics and anomalies, relative to the others, enriching the spectrum of degrees of freedom in the development of the mankind and the universe.

Second, the mode of economic utilization of isotopes themselves will change radically, extending far beyond their presently predominant role as sources of ionizing radiation, as tracers, and as tools of specialized scientific research, to focus on much larger-scale applications of the *exquisitely fine "tuning" of subatomic processes,* both in respect to the inorganic domain, and in respect to the specific role of isotopes in the domain of living processes. Of immediate significance, in the first phases of the Isotope Economy, are the differences in mass, and above all, in the magnetic properties of the nuclei of isotopes, which interact with each other and the electron structures in their environment, by processes referred to today as "hyperfine interactions" and "nuclear magnetic resonance." This development can be usefully compared to the introduction of the principle of "well-tempering" into vocal polyphony in music, whereby small shifts in intonation

4. The fact that the radioactive characteristics of atomic nuclei, including the so-called "radioactive decay constants," depend upon the physical environment within which the nuclei are situated, and can be drastically modified by changes in that environment, has been demonstrated in a number of striking experiments (see Notes 18 and 19 below). There should be nothing surprising about this in principle. For, the essence of quantum physics lies in the realization, that "particles" exist only as global processes, interacting everywhere in the universe, and never as strictly localized entities.

   Nevertheless, the reductionist view of particles as "little hard balls" and of nuclear processes as fundamentally decoupled from their environment (for example, in atoms and molecules) continues to persist in the minds of even many professional physicists. See also my remarks here in the subsection on "Changing the Constants of Radioactivity."

cause new "cross voices" to emerge between and among the voices, resulting in a vastly increased power in the communication of ideas.[5]

By exploiting to the fullest extent, the implications of the ambiguity that arose in chemistry with the discovery of different isotopes of one and the same element, mankind opens up a "higher cardinality" of potentialities, incomparably greater than the mere numerical increase in the exploitable atomic species, mentioned above, would suggest. If, for example, we are synthesizing an organic molecule having 4 carbon atoms in nonsymmetrical positions, then by choosing for each carbon either of the two stable isotopes of carbon, C-12 or C-13, we obtain 16 different molecules, having the same chemical structure, but different "fine-tuned" magnetic and other properties. If we include the long-lived isotope C-14, the number grows to 81. If, in addition, there are 5 hydrogen atoms in the molecule, then by choosing between ordinary hydrogen and the stable isotope deuterium, up to 2,592 different molecules result!

"Isotopically engineered materials," synthesized from pure isotopes or selected combinations of them and possessing novel "collective" physical properties, will begin to supplant the more primitive types of materials employed today in human activity. Some of these are already under development today.[6] In addition to their special thermal, magnetic, electrical, and mechanical characteristics, these materials will play an essential role in the realization of new forms of nuclear energy and in generation and application of coherent, ultrashort-wavelength radiation, such as the gamma-ray laser.

At the same time, mankind stands on the threshold of revolutionary developments in biology and medicine, connected with understanding *how the fundamental distinction between living and nonliving processes,* demonstrated most forcefully by Louis Pasteur and Vernadsky, expresses itself on the subatomic level. While we cannot today predict the exact forms this revolution will take, we already know that it will have much to do with the specific role of isotopes in living processes, and will lead to a qualitative and quantitative transformation in the uses of isotopes, not only in biology and medicine, but also in agriculture and the management of the biosphere as a whole. It is, for example, quite conceivable, that by altering and controlling the isotopic composition of plant, animal, and human nutrition in certain ways, mankind could obtain a variety of beneficial effects; and that in the not-too-distant future, very large amounts of isotopically enriched substances will be required for that purpose.

Third, the Isotope Economy will employ artificial transmutation on a large scale, to generate various species of atoms as raw materials for industrial production. This means, to begin with, utilizing nuclear fission reactors, coupled with reprocessing of all fission products, more and more as *atom-generators and transmutation machines,* rather than simply sources of heat and electricity. By their very nature, fission reactions of heavy nuclei produce a wide spectrum of lighter isotopes, as well as a flux of neutrons which can induce further transmutations in surrounding material. A next step will be to add the potentialities of nuclear fusion, to create a combined "fission-fusion economy" mimicking the astrophysical generation of elements in certain respects.

The large neutron fluxes generated by fusion (deuterium-tritium) reactions, permit much faster rates of "breeding" of fuels for fission reactors, and of transmutation generally. Production of neutrons through accelerator-driven spallation,[7] provides a third method for large-scale atom-generation, probably starting with facilities for the transmutation of high-level nuclear "waste."

In the foreseeable future, more sophisticated methods will begin to emerge, based on the coherent control of nuclear processes by precisely tuned electromagnetic radiation and related means. Man will progressively develop the capacity to synthesize macroscopic amounts of atoms of any desired species, increasingly at will; and to do this on such a scale as to substantially supplement, and in some case even surpass, the quantities and qualities of raw materials available from "natural sources." Parallel with the artificial generation of elements, applications of high-temperature plasmas to the processing of ores, waste, and other materials—the so-called "fusion torch"—will vastly increase the range of economically exploitable natural resources, and permit a virtually 100 percent recycling of used materials in the economy.

Fourth, the Isotope Economy is intrinsically "astrophysical" in nature and in cultural orientation. Its maintenance and development will depend upon extensive, ongoing astrophysical investigations, that cannot be carried out from only the Earth and near-Earth region, but require an expansion of human activity throughout the inner region of the Solar System. To master subatomic processes for the Isotope Economy on the Earth, we must learn how those processes operate on the galactic scales of space-time; and we must come to know, much better than present-day earthly specula-

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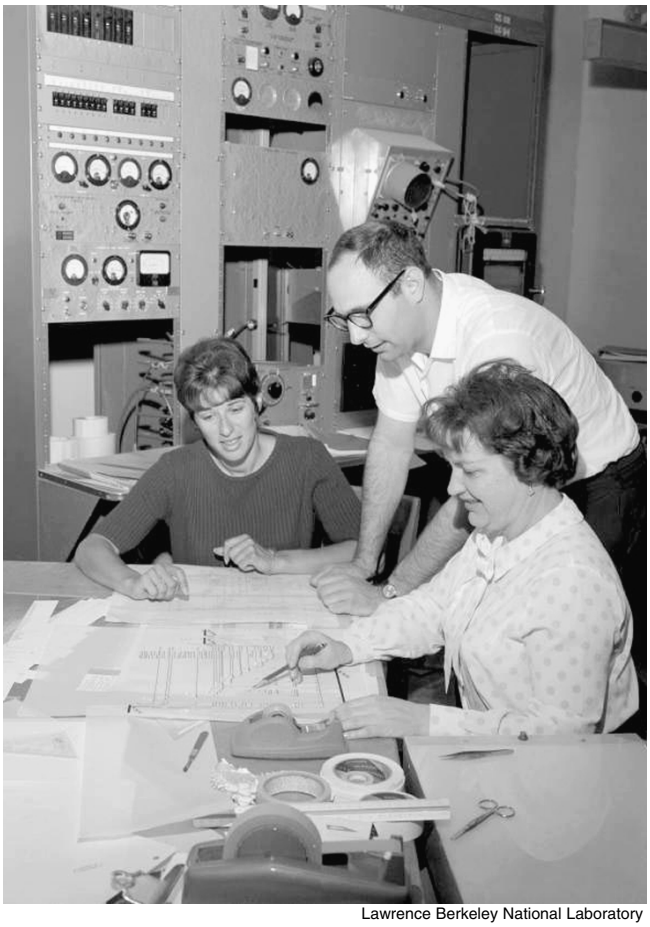
5. See, for example, the web page of the Schiller Institute on the singing of Bach's choral "Jesu meine Freude," including excerpts from Lyndon LaRouche's Washington, D.C. presentation on Nov. 9, 2004: http://www.schillerinstitute.org/music/jesu_meine_text.html, as well as the presentation by LaRouche to a youth cadre school at the Presidents' Day Conference, Feb. 18, 2003, on "Classical Art: The Art of Communicating Ideas," http://www.schillerinstitute.org/conf-iclc/2003/pres_day/lar_to cadre.html.

6. See, for example, "Isotope Engineering," by V.G. Plekhanov, in the English edition of *Uspekhi Fizicheskikh Nauk,* Sept. 2000, Vol. 170, No. 11; also see Notes 9 and 10 below.

7. Spallation is a process in which the "shock" created by the impact of a very high-energy particle on a nucleus, causes its disintegration into a large number of fragments, including many neutrons. Spallation reactions occur all the time as the result of cosmic rays impinging on the Earth's upper atmosphere. It is now possible to "artificially" generate neutrons by spallation on a large scale, using modern particle accelerator technology producing high-current proton beams with energies of 500 MeV or more.

   Such beams, when directed at a target made of lead (for example), produce 20 to 30 neutrons for every lead atom. As neutron radiation constitutes the most efficient means for the transmutation of atoms, development of these and other large-scale neutron sources is crucial to the Isotope Economy. Neutrons also have a huge range of applications in material science, medicine, and basic physics. See, for example, "Accelerator Radioisotopes Save Lives: The Isotope Production Facility at Los Alamos," by Eugene J. Peterson, http://library.lanl.gov/cgi-bin/getfile?LA-UR-06-0034.pdf.

   See also, "Spallation Reactions for Nuclear Waste Transmutation and Production of Radioactive Nuclear Beams" by J. Benlliure, *Eur. Phys. J.,* A 25, S01, 757-762 (2005), http://www.edpsciences.org/articles/epja/pdf/2005/11/10050 2005_Article_506148.pdf; and the website of the U.S. Spallation Neutron Source, https://www.sns.gov/.



Lawrence Berkeley National Laboratory

Lawrence Berkeley technicians checking a new edition of the Table of the Isotopes in 1966. An updated version, "The Trilinear Chart of the Nuclides," was published in 2005 by the Radiochemistry Society.

tions permit, the pre-history of our own Solar System and the origin of the elements we find in it today. These requirements translate into the need to build up large networks of space-based astronomical observatories in solar orbits, able to carry out interferometric and related measurements of our galactic and extragalactic environment on a length-scale comparable to the orbit of Mars; plus a greatly expanded program of exploration of the Solar System itself.

All of this cannot be accomplished without establishing a large-scale logistical/production infrastructure in space, with emphasis on the Moon and Mars, capable of sustaining a large scientific-technical labor force living and working for long periods away from Earth, on a relatively self-sufficient basis. Conversely, it is precisely the "quantum jump" in overall productivity, inherent in the technological developments of the Isotope Economy, which make feasible routine travel throughout the inner Solar System and the establishment of permanent manned colonies on Mars. Fusion propulsion systems, for example, can cut the journey times between near-Earth orbit and Mars down from many months, as are required with present chemical propulsion systems, to a couple of weeks or less.

The Isotope Economy In the Process of Becoming

To readers not familiar with recent developments in nuclear-related technology, our characterization of the Isotope Economy might seem to be a very distant prospect, even smacking of "science fiction." In reality, the Isotope Economy is already in the *process of becoming,* and many of its features already exist, in more or less developed form, in laboratories and advanced production facilities around the world.

Isotope separation. The technology of isotope separation, greatly hindered in its progress by efforts to monopolize its military applications, has undergone revolutionary developments over the last 20 years. Initial breakthroughs in laser- and plasma-based methods (AVLIS, SILEX, plasma centrifuge, ion cyclotron resonance, etc.), promise enormous advantages relative to conventional methods.[8] At the same time, conventional methods (centrifugation, diffusion processes, electromagnetic separation, gaseous and thermal diffusion) have been further refined and their range of industrial applications extended to an ever larger number of isotopes. Also, the end of the Cold War freed up for civilian use large capacities for isotope separation, formerly employed in the military sectors of the United States and the former Soviet Union. This, in turn, has greatly expanded the range of isotopes generally available, and reduced their cost, spurring the search for new applications in all fields.

Qualitative transformation in the uses of isotopes. The demand and production of isotopes are presently growing at an exponential rate, led particularly by the medical uses of radioisotopes. At present, in the United States alone, more than 10 million diagnostic procedures are carried out each year using radioisotopes. At the same time, *a qualitative jump* is occurring in the *range* of applications of pure and enriched isotopes in the economy, as exemplified by the greatly expanded role of stable isotopes, and the beginning emergence of a new industrial sector producing "isotopically engineered materials" for the fabrication of semiconductor devices and specialized mechanical components such as cutting tools in metalworking machines. But this is just the beginning of a vast development, comparable in relative economic importance to the explosive development of the chemical industry in the hundred years beginning in the middle of the 19th Century.

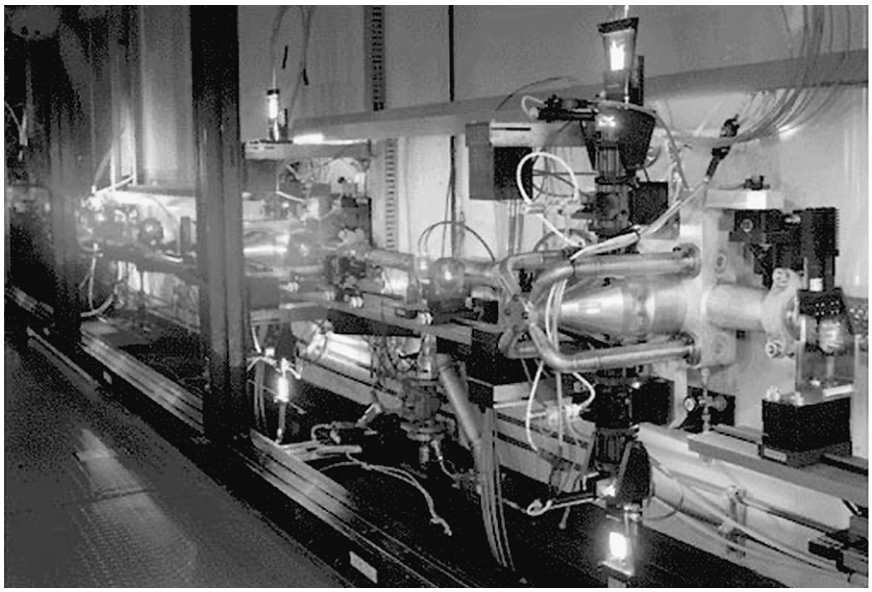
Isotopically tuned materials. In this process, the preeminent role of radioactivity in most present-day uses of isotopes, is gradually being supplemented by other characteristics, connected with the exquisitely fine "tuning" of nuclear interactions and with the collective properties of materials, crafted from specifically chosen combinations of isotopes. The differentiation between isotopes of one and the same element is thus becoming more and more important in applications that have nothing directly to do with radioactivity or even, appar-

8. *Isotope Separation in Plasma by Ion-Cyclotron Resonance Method,* by A.E.Dubinov, I.Yu.Kornilova, and V.D.Selemir (Russian Federal Nuclear Center), www1.jinr.ru/Archive/Pepan/v-32-4/v-32-4-3.pdf.

On laser isotope separation, see, for example, the article by Steven Hargrove of Lawrence Livermore Laboratory: http://www.llnl.gov/str/Hargrove.html.

ently, with so-called "nuclear properties" of the isotope.

When embedded in crystal lattices or other molecular structures, the nuclei of different isotopes, having differing masses, oscillate at different frequencies. For this reason, among others, materials made using only a single, carefully separated isotope of a given element have a different and more coherent internal "tuning," than materials made with a mixture of isotopes; they display significantly different behavior. At present, for example, laboratories worldwide are researching the possibility of overcoming existing limitations on the power-densities, and therefore the computing power, of semiconductor chips, by utilizing a pure isotope of silicon. "Isotopically pure" structures of silicon, as well as of carbon and a number of other elements, have been found to possess a significantly higher thermal conductivity than the corresponding "natural" materials.[9] A higher thermal conductivity accelerates the potential rate of heat-removal from semiconductor chips, permitting them to operate at a higher power without overheating. A similar effect has been demonstrated in "isotopically pure" diamonds, opening up the possibility of increasing the productivity of various machining operations.[10] It has been established that diamonds made of pure carbon-13, are significantly harder than diamonds composed of the naturally occurring mixture of isotopes.



LLNL

The Atomic Vapor Laser Isotope Separation (AVLIS) technology was developed in the 1970s, and a full-scale pilot plant was built at Lawrence Livermore National Laboratory, which successfully demonstrated uranium enrichment and other potential isotope uses in the 1990s. But the AVLIS was shut down in a stunning example of "shareholder values." The U.S. Energy Policy Act of 1992 "privatized" uranium enrichment, transferring the technology to a private company, USEC, which decided in 1999 to halt the AVLIS project because the investment returns were projected to pose too much risk to shareholders. The pilot plant was dismantled. Here, a dye laser in the AVLIS project.

Hyperfine interactions and magnetic isotope effects. These applications, just mentioned, however, make use of effects of differences of *mass* between isotopes, while not yet taking into account what is really a much more essential differentiating characteristic: their *magnetic properties,* which are crucial to the phenomenon of *nuclear magnetic resonance.* As I shall point out in the following section, a new field of chemistry and biology has opened up in recent years, in connection with the experimental demonstration that so-called "hyperfine interactions," involving nuclei, play a fundamental role in all living cells.

Isotope-dependent nuclear magnetic effects will become ever more important, also, in determining the behavior of man-made nonliving materials, including most probably new types of "room-temperature superconductors."

Fission reactors as atom factories. Meanwhile, the economic importance of the isotopes generated by nuclear fission reactors and accelerators, in many ways *already* exceeds that of the electrical power produced by those same reactors! In the foreseeable future, fission reactors, instead of being seen chiefly as electric power sources, generating isotopes as a by-product, will operate more and more as *atom-producers, generating electricity as a by-product.* Fission reactions have the peculiarity, that starting from a single heavy isotope (U-235, Pu-239, or Th-232), they generate an extensive spectrum of different isotopes, encompassing nearly all the elements of the Periodic Table. It is already possible today, by "tuning" the neutron spectrum and fuel composition in a reactor, to influence the distribution of fission products to a significant extent.

Nuclear waste as a valuable "ore" for the extraction of precious metals. Already today, in addition to large amounts of useful radioisotopes and recyclable fission fuels, nuclear fission reactors have generated large amounts of industrially important precious metals, such as palladium, rhodium, and ruthenium. The extraction of these metals from so-called "nuclear waste," for economic use as catalysts, in special alloys, and in corrosion-resistant materials, has already been proven feasible.[11] The

9. See two papers by E.E. Haller, Lawrence Berkeley National Laboratory and University of California, Berkeley on "Isotopically Controlled Semiconductors" at http://www.osti.gov/bridge/servlets/purl/799566-6qpAuC/native/799566.pdf and http://www.osti.gov/energycitations/servlets/purl/861238-fD0wMA/861238.pdf.

10. See "South Africa Leads World Race for Carbon-isotope Laser-separation Plant," in Creamer Media's *Engineering News Online*, http://www.engineeringnews.co.za/eng/features/laser/?show=19347, and "Isotopically Enriched Designer-Diamond Anvil," at http://www.phy.uab.edu/research/DOE/IsotopicallyEnriched.htm.

11. "Potential Applications of Fission Platinoids in Industry," by Zdenek Kolarik, *Platinum Metals Rev.,* 2005, Vol. 49, No. 2, http://www.platinummetalsreview.com/pdf/79-90-pmr-apr05.pdf. Also, "Electrochemical Separation of Rare Metal Fission Products from High-level Liquid Waste of Spent Nuclear Fuel," by Masaki Ozawa and Tetsuo Ikegami, Japan Nuclear Cycle Development Institute, Ooarai Engineering Center, Japan, http://www.nea.fr/html/pt/docs/iem/jeju02/session2/SessionII-14.pdf.

iter.org

The International Thermonuclear Experimental Reactor (ITER), now under construction in Cadarache, France, will be the next step toward a prototype power station, producing 500 megawatts of fusion power.

amounts of these metals, synthesized every year as reaction products in the world's presently operating nuclear power reactors, if they were to be extracted from the spent fuel during reprocessing, would already amount to significant percentages of the total yearly amounts extracted from the Earth by mining. Noting that the relative concentrations of many rare metals contained in the spent fuel of nuclear breeder reactors, is tens of thousands to millions of times higher than their average content in the Earth's crust, Japanese researchers recently declared such spent fuel to be one of the most valuable "ores" known today.

Complete reprocessing. The full exploitation of fission's potential as an atom-producer, will begin with the "closing" of the nuclear fuel cycle, by the complete chemical reprocessing of spent fuel, separation of useful isotopes, recycling of fissionable materials, and transmutation of undesired species through irradiation with accelerator-generated neutrons, or in specially designed "nuclear waste-burning" reactors. All of this has been worked out in detail by nuclear laboratories around the world, and the essential technological base already exists.[12]

Large-scale transmutation by particle accelerators. The technology of high-current particle accelerators has advanced to the point, that the transmutation of macroscopic amounts of isotopes by irradiation with neutrons from an accelerator-driven neutron source is already a technological possibility. Numerous laboratories around the world are presently working on designs for Accelerator Driven Transmutation Systems (ADS), as a means to deal with the problem of long-lived radioactive isotopes from "nuclear waste." A single ADS system with a beam power of 20 megawatts, could transmute the long-lived isotopes from 10 standard nuclear power plants into short-lived and stable isotopes, producing 800 megawatts of thermal power at the same time.[13] Similar technology could be used for other transmutation applications, as well as for driving "subcritical" nuclear reactors of various types.

The advent of nuclear fusion. The next step toward a full-scale Isotope Economy will be to combine the potentials of fusion—which in many respects are complementary to those of fission—with fission processes and accelerator-based transmutation, while at the same time phasing in new methods of controlled transmutation, now under experimental development (see below). Over the last 10 years, nuclear fusion technology has progressed steadily, on multiple fronts. In 1997, the experimental fusion reactor JET (Joint European Torus) in Culham, England, produced more than 16 megawatts of power through fusion reactions, sustained over several seconds, at temperatures of 100 million degrees C. The International Thermonuclear Experimental Reactor (ITER), now under construction in Cadarache, France, will produce 500 megawatts of fusion power, in pulses of over six minutes, with the next step being a prototype power station. Parallel with the standard tokamak design, there has been significant progress across the board in fusion experiments, including fast liner, plasma focus, "inertial confinement" by lasers, ion beams, and others.

The "brute force" approach to fusion: Not the best, but approaching success. Contrary to often-repeated myths, the possibility of generating large amounts of power by fusion reactions has long since been demonstrated—namely, in the explosion of the first hydrogen bomb, over a half century ago. The hydrogen bomb, however, requires a smaller, fission chain-reaction detonator (a small atomic bomb) in order to bring a mixture of hydrogen isotopes to the necessary high densities and temperatures, for large quantities of fusion reactions to occur. The essential difficulty of tapping fusion as a power source for civilian purposes, lies in the challenge of generating large amounts of fusion reactions in an efficient, controlled way, without using an atomic bomb as a trigger. Over the last 30 years, progress in controlled nuclear fusion has been greatly retarded by lack of political will, orientation toward a merely engineering or "applied science" approach, rather than going for fundamental discoveries; restriction of pursuit of experimental hypotheses to a few chosen directions; the stifling atmosphere of bureaucratically managed "Big Science," etc. Nevertheless, the accumulation of hard, "brute force" applied physics and engineering work, has

12. See, for example "Processing of Used Nuclear Fuel for Recycle," World Nuclear Association, Oct. 2006, http://www.world-nuclear.org/info/printable_information_papers/inf69print.htm.

13. See for example: "Introduction to ADS for Waste Incineration and Energy Production," by H. Condé, Dept. of Neutron Research, Uppsala University, http://www.nupecc.org/iai2001/pdf/ADS.pdf; and "Progress Report on Nuclear Transmutation," by Hiroyuki Oigawa, http://j-parc.jp/documents/pdf/iac/ADS.pdf

brought a first-generation fusion power reactor into technological reach.

As mentioned, work is beginning on the construction of a giant fusion test reactor, the ITER, in Cadarache.[14] The core of the ITER reactor is a toroidal chamber, filled at the start with extremely thin gas, which an electrical discharge, induced by huge transformer coils surrounding the chamber, transforms into the initial plasma. The plasma is subsequently heated by microwaves and neutral particle beams to a temperature the equivalent of more than 100 million degrees C, and additional deuterium-tritium fuel mixture is injected. The reactor employs a combination of currents generated inside the plasma, and magnetic fields imposed from the outside, creating a kind of "magnetic bottle" holding the plasma suspended in the chamber's central region, and keeping it insulated from the chamber's walls by a high vacuum. When in operation, this reactor is projected to be able to generate a sustained gross power output of 500 megawatts from fusion reactions between nuclei of the hydrogen isotopes deuterium and tritium, during periods of approximately six and a half minutes at a time. (The device will be able to produce a pulse about once every thirty minutes.)

Because of this pulsed mode of operation and the high power consumption of its magnetic and plasma heating systems, ITER cannot be regarded as a full prototype of a future fusion power plant; nevertheless, it is expected to finally establish the practical feasibility of such a power plant, while at the same time bringing a large number of technologies, required for a future power reactor, to a relatively high degree of perfection.

The fusion-fission hybrid. The distribution of atomic species found in the Solar System today, bears strong evidence to the effect, that the isotopes we find around us today were generated by a combination of fission and fusion processes. So also, the coming Isotope Economy will base itself on a synergy of these complementary nuclear processes. The first, near-term embodiments of this principle are known as the "fusion hybrid" or "fusion-fission hybrid" reactors.

The hybrid technology takes advantage of the fact that "fission reactions are neutron-poor, but energy-rich, while fusion reactions are neutron-rich, but energetically poor." Although each fission reaction of uranium releases about three neutrons on average, in fission reactors the bulk of those neutrons is immediately consumed again, partly to maintain the fission chain-reaction process, and partly by absorption in the complex mixture of isotopes present in a fission reactor core, plus losses to the outside. For this reason, nuclear fission reactors operate with a relatively strict neutron balance. In a fusion reactor, however, neutrons produced from the fusion of deuterium and tritium are not needed to maintain the process, nor does the fusion plasma contain large amounts of neutron-absorbing substances; hence, these neutrons are available to do useful work elsewhere. On the other hand, D-T fusion releases 10 times less energy per reaction, than the fission of a U-235 nucleus.

Accordingly, the principle of the "hybrids," is *to use fusion reactions to produce neutrons, and fission reactions to produce power.* The synergy works as follows: We utilize the neutron flux generated by a fusion plasma (1) to breed nuclear fuel for fission reactors, from U-238 or thorium; (2) to transmute radioactive products from fission reactors; or (3) to drive a fission reactor operating in a subcritical mode.[15] These applications do not require that the fusion reactor itself produce an excess of power. The overall power benefit comes from the fission side of the equation, so to speak: in the "burning" of fission fuel, produced by the hybrid, in separate fission reactors; in the fission reactions occurring in an adjacent "subcritical" blanket; or, in the case of transmutation of waste, from the release of energy stored in the radioactive fission products.

Dropping the requirement of "energy breakeven" greatly reduces the demands on the fusion reactor, putting them within the reach of the type of design and parameters that were already demonstrated by the European JET reactor in Culham, and will be greatly improved in the ITER reactor being constructed in France. These reactors, while still operating far below the breakeven levels for power generation, have already achieved parameters that are sufficient, in principle, for the construction of hybrid systems for the production (breeding) of nuclear fission fuels, for large-scale transmutation of nuclear waste, and for power production using neutrons, generated in fusion reactions, to drive a "subcritical" nuclear fission reactor.

The fusion torch and plasma mass separation. The level of technological mastery of energy-dense plasmas, achieved in the course of fusion reactor development so far, also makes it possible to, in principle, realize "first approximations" of the so-called *fusion torch (or high-temperature plasma torch)* concept invented by the American fusion scientists Bernard Eastlund and William Gough.[16] Utilizing magnetically confined plasmas fusion torches, either alone or in combination with the so-called plasma centrifuge, we will ultimately be able to process and separate any material—low-grade ores, waste, sea water, or anything else—into its component atomic species, obtaining pure isotopes from an arbitrary feedstock. In the limit, this technology will permit a nearly 100 percent

14. The official website of the ITER project is http://www.iter.org.

15. The term "subcritical" refers to a nuclear fission reactor, whose configuration and parameters fall below the threshold required for a self-sustaining fission chain reaction process. A subcritical reactor can nevertheless be used as a power source, if an additional source of neutrons is provided—from a particle accelerator or a fusion reactor, for example—to keep the fission processes going. One advantage of a "subcritical" fission reactor, is that the danger of a "runaway" chain reaction is eliminated: the chain reactions stop immediately when the external source of neutrons is turned off.

    See, for example, "Accelerator-driven Sub-critical Reactor System (ADS) for Nuclear Energy Generation," by S.S. Kapoor, http://www.iisc.ernet.in/pramana/v59/p941/fulltext.pdf, and "Tokamak Fusion Neutron Source Requirements for Nuclear Applications," by W.M. Stacey, Georgia Institute of Technology, Atlanta, Ga., http://www-pub.iaea.org/MTCD/Meetings/FEC2006/ft_p5-5.pdf.

16. For an overview on the fusion torch and background on fusion technology see the accompanying article, this issue, "Fusion Torch Can Create New Raw Materials." A detailed description of a tokamak-based fusion torch design can be found via the patents page of the Eastlund Scientific Enterprises Corporation, http://www.eastlundscience.com/index.html.

    See, for example, the patent "Method and Apparatus for Ionizing All the Elements in a Complex Substance. . . ." available under http://www.freepatentsonline.com/5681434.html.

Lawrence Berkeley Laboratory

The main tunnel at Yucca Mountain, the U.S. nuclear "waste" storage facility in Nevada. Although it is the subject of great hysteria, the products generated by nuclear fission include large amounts of precious metals, making it a valuable "ore." The fusion torch technology will make it possible to deal with such radioactive materials.

effective recycling of materials, and expand the exploitable range of natural resources by many orders of magnitude.

Thanks to the fact that plasmas can have almost unlimited power densities, and at the same time be readily manipulated by applied currents, magnetic fields, and microwaves, plasmas have become an ever more important working medium for the processing of materials. Today's industrial applications include plasma steel-making, plasma chemistry, plasma surface treatments, plasma ion deposition, and many others. But in the future, the most important large-scale use of energy-dense plasmas, apart from fusion power generation, will almost certainly be the "fusion torch."

The original inventors, Eastlund and Gough, realized that fusion plasmas, with their high temperatures and power densities, constitute a kind of "universal solvent": Any known material, injected into such a plasma, is instantly dissociated into electrons and ions of the component atoms. Once that dissociation has taken place, the different component species of ions, making up the resulting mixed plasma, can be separated by a variety of methods, either in the original region, or by drawing the mixed plasma off into a separation chamber.

The most familiar method of isotope separation is by centrifugal action, as exemplified by the classical gas centrifuges used today for enrichment of uranium isotopes, on the basis of their slightly different masses. Plasmas can in principle sustain rotation at orders-of-magnitude higher speeds than can mechanical devices. Experimental plasma centrifuges for isotope separation are already in operation today. In practice, future plasma mass separation devices may employ combinations of electric, magnetic, and electromagnetic fields, as well as induced waves and high-speed rotational motion in the plasma itself, to accomplish the desired results. Also, a variety of different devices may be operated in a cascade, as is already done today.

Most likely, in large-scale practice, dissociation and element separation/isotope separation operations will not be carried out directly in a fusion reaction plasma, but either in plasma diverted from a fusion reactor into auxiliary chambers, or in a freshly created plasma, powered by an outside source.

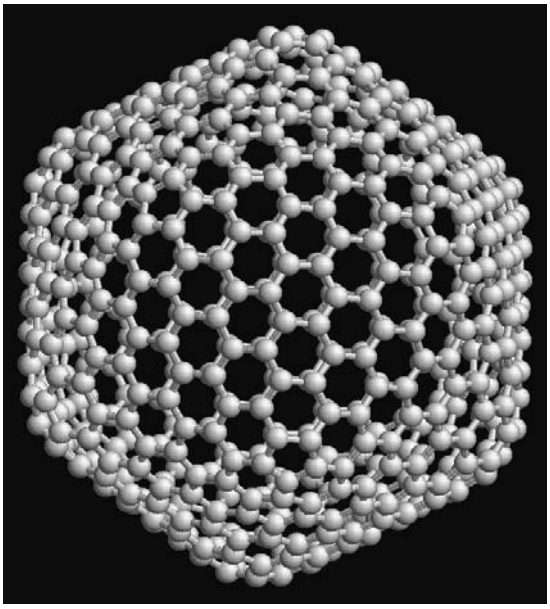
First applications of the "fusion torch" principle are presently being studied in the United States as a possible method of dealing with the huge accumulation of radioactive materials, left over from 50 years of nuclear weapons production at Hanford and other locations. The first torch plasmas will be externally powered.

Laser-controlled nuclear transmutation. The last five years' breakthroughs in the construction of powerful ultra-short-pulse lasers (femtosecond lasers) and of lasers operating in the X-ray range, now make it possible to trigger nuclear transmutation processes directly with lasers. So-called "tabletop femtosecond lasers," compact devices which are now available commercially and are becoming standard equipment at major physics departments and laboratories, use novel methods of "pulse compression" and amplification to produce extremely short light pulses—of the order of 10^{-13} to 10^{-15} seconds in length. Some of these lasers can now reach power densities of up to 10^{19} watts per square centimeter, sufficient to trigger nuclear reactions, on a routine basis, through the action of gamma-rays generated in a material irradiated by the laser.

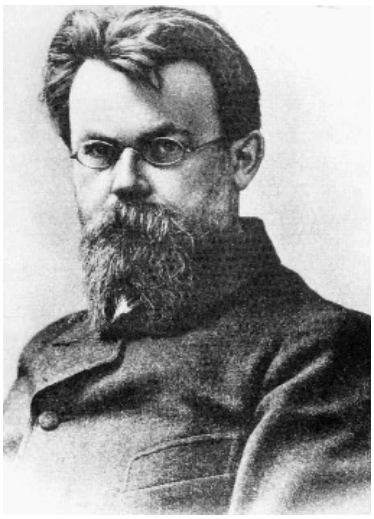
Also, the electromagnetic fields generated by these lasers can be used to accelerate charged particles to energies sufficient to trigger nuclear reactions. Thereby, small laboratories can today carry out experimental work which in the past required gigantic cyclotrons and other particle-accelerator machines.

The "tabletop lasers" are replicating, with much simpler means, results obtained earlier by giant lasers such as the VULCAN laser at Rutherford Appleton Laboratory in England and the Petawatt Laser at Lawrence Livermore Laboratory in California. In 1999, for example, Livermore induced the fission of nuclei of U-238 by laser pulses. Soon, a laboratory at the Friedrich Schiller University in Jena did the same thing with a tabletop laser. Other experiments on VULCAN demonstrated the use of laser pulses to transmute long-lived radioactive isotopes, such as iodine-129 (half-life 15 million years), into short-lived isotopes (in this case, I-128 with a half-life of only 25 minutes).[17] Such methods, once perfected, may provide an effective means to "deactivate" radioactive waste produced in nuclear fission power plants, transforming it into stable, non-radioactive elements. Laboratories around the world are today striving to develop laser sources of ever shorter wavelengths, moving ever further in the direction of "harder" X-rays. Every decrease in the wavelength expands the range and efficiency of nuclear processes that can be generated directly (photonuclear reac-

17. "Laser-driven Photo-transmutation of Long-lived Nuclear Waste: Application to Iodine-129," by K.W.D Ledingham, http://www.clf.rl.ac.uk/Reports/2002-2003/pdf/10.pdf.



The stability of many nuclei can change, depending on the electronic environment of the nucleus. Decreases in radioactive half-lives have been obtained by embedding beryllium-7 atoms in a "buckyball" complex of atoms, such as this one.



Vladimir I. Vernadsky, the Ukrainian-Russian biogeochemist, recognized a century ago that the discovery of new dynamic principles, transcending the chemistry of the periodic system and closely bound up with the origins of our Solar System, would unleash a revolution in all aspects of man's relationship to nature.

tions). The realization of gamma-ray lasers, not yet within immediate reach, would revolutionize the experimental methods of nuclear physics.

Changing the "constants" of radioactivity. The teaching and practice of nuclear physics continue to be encumbered by prejudices and misconceptions that were introduced very early into the field. Among the most crippling is the preconceived idea, that the processes "inside" the atomic nucleus constitute a categorically separate world, governed by mysterious entities called "strong forces," and basically not interacting with their surroundings except through violent, "high-energy" events, considered to be essentially statistical in character. The popular term "atom smasher," used for high-energy particle accelerators in the early days, reflects a simplistic, Rambo-like quality of conception which persists, despite massive evidence of the exquisitely fine tuning of nuclear processes. The prejudice remains, even among professionals today, that such processes as radioactive decay of nuclei are practically beyond human control, except by subjecting the nuclei to gigantic forces, or bombarding them with particles from high-energy accelerators or nuclear reactors. The rate of radioactive decay of a nucleus, is still wrongly regarded as a kind of natural constant, rather than a function of the physical geometry within which that nucleus is embedded.

This dogmatic attitude among professionals led to the silly misconception, adopted as a "fact" of public policy for decades, that the long-lived isotopes contained in "nuclear waste," could only be dealt with by storing them underground for tens or hundreds of thousands of years!

This notion continues to dominate public discussions today, even though the professional world has long since acknowledged the option of large-scale transmutation through particle accelerators or in fusion devices, as mentioned above. These methods will work, but they represent a primitive, "brute force" method, to be replaced by much more intelligent approaches, as soon as they become available.

In the meantime, overwhelming experimental evidence has accumulated for the existence of finely tuned, "low-energy" nuclear processes, very different from those upon which nuclear technology has been based until now, and whose future mastery defines a revolutionary pathway for development of the Isotope Economy.

It is now well established, for example, that the stability or lifetimes of nuclei can change by many orders of magnitude, depending on the electronic environment of the nucleus. Thus, for example, the isotope dysprosium-163 is stable in normal atomic form, but when ionized (stripped of its electrons) the Dy-163 nucleus becomes unstable. The rhenium isotope Re-187 has a half-life of over 40 billion years in atomic form, but when ionized, the half-life is reduced more than a billion times, to less than 33 years.[18] The complete ionization of a free atom is a very energy-intensive process. Smaller, but still easily measurable decreases in radioactive half-lives, have been obtained by much "softer" means: by embedding beryllium-7 atoms in so-called fullerines ("buckyball" complexes of atoms), and just recently again, by embedding sodium-22 in palladium metal, afterward cooled to a temperature of 12°K.[19]

The effects in these experiments were only on the order of 1 percent, but (1) they refute the dogma that nuclear processes are "oblivious" to their environment, except under "high-energy" conditions; (2) they broadly cohere with the results of many "cold fusion" experiments, which are more difficult to interpret, but show a multitude of transmutation effects—sometimes very spectacular ones—that demonstrably do not come from usual "high-energy" sorts of nuclear reactions.

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18. See M. Jung et al. "First Observation of Bound-state β– Decay," *Physical Review Letters*, Vol. 69, No. 15, pp. 2164-2167, 1992 (on Dy-163); F. Bosch, et al., "Observation of Bound-state β– Decay of Fully Ionized ^{187}Re, *Physical Review Letters*, Vol. 77, No. 26, pp. 5190-5193, 1996; and P. Kienle, "Beta-decay Experiments and Astrophysical Implications," in N. Prantzos and S. Harissopulus, *Proceedings: Nuclei in the Cosmos*, pp. 181-186, 1999.

19. See for example "Radioactivity Speeds Up," Physics Web 21, September 2004, http://physicsweb.org/article/news/8/9/12/1.

The Role of Isotopes In Living Processes

The truly revolutionary aspect of the Isotope Economy, lies in the areas of intersection of the three great experimental domains in our universe: the domain of ostensibly nonliving processes, the domain of living processes, and the domain of those processes that depend upon human creative reason. The unequivocal proofs of the absolute distinction between the principles governing these three domains, were provided by Vladimir Vernadsky for the first and second domains, and Lyndon LaRouche for the second and third.[20] All three domains are anti-entropic in character.

The most paradoxical, and fruitful feature of this strict division, arises from the circumstance that the principles underlying the three stated domains, insofar as they are truly universal, are *implicitly ever-present* and coextensive with the universe as a whole! In other words, we do not have three separate universes, one for each domain, but only *one, multiply connected universe,* in which every existing thing (singularity) participates simultaneously, but in different ways, in each of the three distinct principles (or sets of principles) of action. The meaning of this becomes clear, when we examine the special case of isotopes and nuclear reactions.

The existence of an intimate connection between nuclear reactions, isotopes, and living processes, is deeply rooted in the prehistory of our planet. To the best of our knowledge, the great bulk of atomic species, from which the tissues of living organisms on this planet are composed, were generated during earlier phases of the evolution of our Solar System, prior to the formation of the Earth, and constitute in that sense a "fossil" of that earlier development. Also, to the best of our knowledge—although there are somewhat divergent viewpoints on this question—the Solar System originated in a single, proto-stellar entity which was our Sun at an earlier stage in its development.

A Unitary Origin of the Solar System

Before turning to living processes per se, let us look at the most coherent of the available hypotheses on what the earlier evolution of the Solar System may have looked like.

According to the "polarized fusion" hypothesis put forward by LaRouche, the array of atomic species found in the Solar System today was essentially generated in situ, as part of the same unitary process that led to formation of the system of planets: The proto-Sun was a rapidly spinning object, "spinning off" a disk of plasma and going on to "process" it, by a combination of intense radiation and powerful magnetohydrodynamic inductions, driven by the proto-Sun's rapid rotation and intense magnetic field. This action by the Sun created the conditions for "polarized fusion" to take place in the disk—a fusion process in which, it is proposed, an extremely strong magnetic polarization of the nuclei, and perhaps other "catalytic" effects of the electromagnetic geometry set up in the disk, caused the fusion process to be orders of magnitude more efficient than ordinary "thermal" fusion.

Thereby, the proto-Sun was able to generate the entire range of elements and isotopes, which we find on the Earth and elsewhere in the Solar System today. (This would include the atomic species heavier than iron in the periodic system, which could not have been generated, in the observed amounts, by the sorts of fusion reactions thought to occur in our present-day Sun.) The magnetohydrodynamically structured plasma disk, with its newly generated stock of elements, subsequently resolved into an harmonically ordered array of rings, corresponding to the locations of the planetary orbits as we find them today. Finally, the planets themselves condensed out of the rings.

Unfortunately, most astrophysicists today reject the notion of a unitary origin of the System, its elements, and the harmonic ordering of its planets. Instead they believe that the heavier elements found today in the Solar System, pre-date the birth of our present Sun and were generated by nuclear reactions during one or more gigantic explosions of stars—the "supernovas." Which star or stars these were, nobody can say, because no astronomical traces of such an early explosion have been observed in the vicinity of our Solar System. But there is another possibility; namely, that the supernova events that astronomers actually observe from time to time in our galaxy, and which the astrophysicists interpret as bomb-like explosions, are actually processes of the type LaRouche has proposed; and that the heavy-element-generating supernova the astrophysicists postulate, is in reality just an exuberant phase in the early life of own proto-Sun!

However these issues may be resolved in the future, the implications are these:

First, from the standpoint of the prehistory of our Solar System, the existence of life on our Earth is inseparably connected with the existence of the nuclear reactions that produced the atomic species from which living tissue is composed. In that sense, the material preconditions for our biosphere and its organic evolution, were created by a preceding phase of non-organic, but anti-entropic evolution of the Solar System—the "nucleosphere."

Second, life on Earth continues to be *nuclear-powered:* Our entire biosphere lives from the Sun, whose radiative power is generated by fusion reactions. But the biosphere is coupled to our star not only in terms of the gross flow of radiant power, but also through more subtle magnetic interactions, which cause what the Russian researcher A.L. Chizhevsky called "the biosphere echo of solar activity," reflected in the behavior of microorganisms and other living processes, as well as in the weather and climate.[21]

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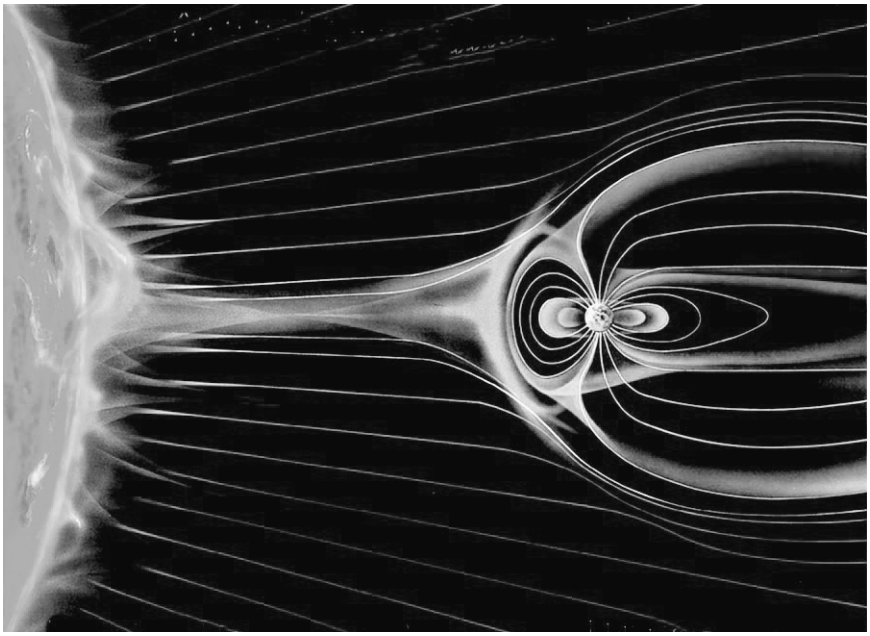
20. See the author's comparison of the work of Vernadsky and LaRouche on these points, in "Vernadsky and the Future of Biophysics," in *EIR,* Feb. 18, 2005. Also, see "On the Fundamental Material-Energetic Distinction Between Living and Nonliving Natural Bodies of the Biosphere," by Vladimir Ivanovich Vernadsky, *21st Century,* Winter 2000-2001, http://www.21stcenturysciencetech.com/articles/vernadsky.html; and Lyndon LaRouche, "On the Noetic Principle: Vernadsky and Dirichlet's Principle," *EIR,* June 3, 2005, http://www.larouchepub.com/lar/2005/3222vernad_dirichlet.html.

21. See for example "The works of A.L. Chizhevsky on Solar-Terrestrial Links. Heliobiology on the Eve of the XXI Century: Results, Problems, and Prospects," B.M. Vladimirsky, *Biophysics,* Vol. 43, No. 4, pp. 532-536 (1998)



K. Endo/NASA/National Geophysical Data Center

Artist's illustration of solar winds impacting the Earth's magnetosphere.The atomic species found in the Solar System today were generated in the same unitary process that led to the formation of the system of planets: A process of polarized fusion taking place in the disk allowed the proto-Sun to generate the entire range of elements and isotopes found today. Note that the Earth-Sun distance is not to scale.

Having thus established, without any doubt, the *astrophysical* relationship between nuclear processes and life on the Earth, let us now look for the relationship on the *microphysical* level.

Following the discovery of isotopes, much experimental work was done in the effort to find a special role of particular isotopes in living processes. Early work indicated that living processes enriched isotopes to a certain extent—i.e., the ratios between the concentrations of isotopes of a given element in living tissue, differ from those in the environment around them in a *characteristic* way. Although this is today a well-established fact, widely exploited in investigations of geology, geochemistry, ecology, botany, paleontology, and so forth, the shifts in the isotope ratios involved are nearly always on the level of parts per thousand. This is comparable in magnitude to the isotope shifts caused by nonliving processes, and orders of magnitude less than the effect of concentration of the chemical elements themselves, to which we owe the biological origin of many concentrated mineral deposits.

There have also been some indications, that microorganisms may be able to carry out certain transmutations; however, the evidence remains equivocal, and no very good hypothesis has been proposed, for what fundamental role such transmutations, to the extent they occur, might play in the organization of living processes.

Leaving aside strongly radioactive isotopes, whose isotope-specific effects on living organisms appear entirely explicable on the basis of the radiation itself, living organisms seem rather insensitive to even gross changes in the isotope concentrations in the environment and in the material they ingest. Indeed, it is on this apparent indifference that the technique of isotope tracing of metabolic pathways and many medical diagnostic methods are based. The clear, but not surprising exception is deuterium, twice as heavy as ordinary hydrogen, whose chemical properties are already sensibly different from those of hydrogen. Ingestion of heavy water (D_2O) in large quantities leads to lethal metabolic disturbances in animals; nevertheless, bacteria can be raised on heavy water to the point that nearly all the hydrogen in them is replaced by deuterium, without seeming to cause harm.

The Role of Nuclear Magnetism

Does this mean that isotopes play no direct role, as such, in the organization of the living processes? On the contrary! But the best clue we have so far, comes from a very different direction than a mere statistical effect of isotope concentrations. The key lies in the *magnetic* characteristics of atomic nuclei, which differ radically among different isotopes of one and the same element. These characteristics are exploited on a routine basis in nuclear magnetic resonance (NMR) imaging, used in every modern hospital, and NMR spectroscopy, but their full significance is only beginning to be grasped.

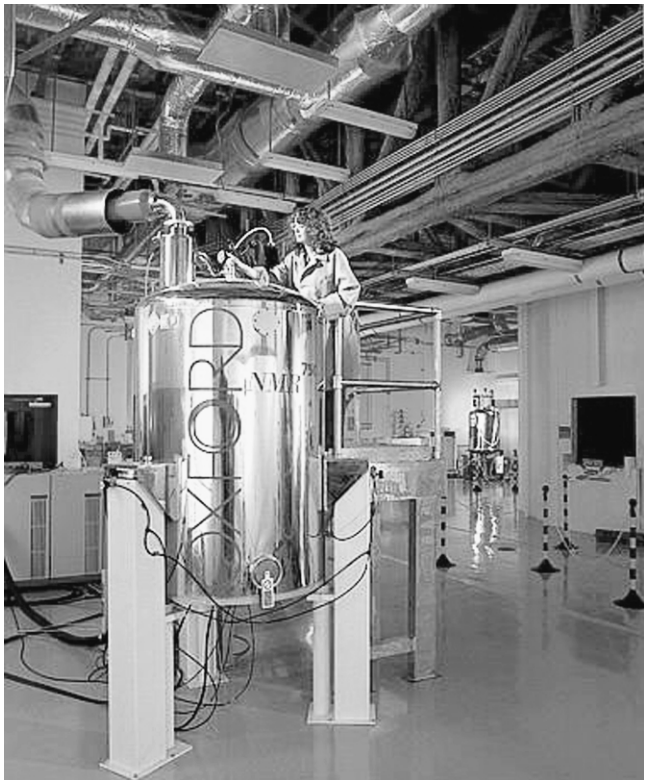
The signals used in NMR, for example, are emitted by atomic nuclei interacting with the combination of a magnetic field produced by the coils surrounding the patient or specimen and a microwave pulse used to "excite" nuclear oscillations. Here, the differences among isotopes become decisive. For nuclei of isotopes whose atomic number and mass number are both even, the magnetic moments that determine the strength of interaction with the magnetic fields, are indistinguishable from zero. These nuclei contribute nothing to the signal. The nuclei with odd atomic number or odd mass number, on the other hand, have noticeable magnetic moments, whose values depend somehow on the internal configuration of the nuclei. They give distinct signals that permit NMR machines to "tune in" to specific isotopes in living tissue. Those signals express not only the presence of the corresponding isotopes, but also certain characteristics of the physical geometry around them, mediated through magnetic interactions among the various nuclei and the electron structures within which they are embedded.

The interaction between nuclei and the surrounding electronic structures—known as the "hyperfine interaction"—also reflects itself in extremely slight, but very precisely defined shifts in the optical spectra of atoms and molecules, and in other types of spectra. The hyperfine structure is closely related to the quantum-physical invariant called "spin," which is

believed to underlie the magnetic properties of nuclei and other particles, and is closely interwoven with the so-called fine structure constant and other basic constants of physics. Unfortunately, of all the topics in quantum physics, the phenomenon of "spin" suffered the relatively greatest amount of mystification at the hands of Wolfgang Pauli and others.

Now, it is hard to imagine that such a well-organized, finely tuned process would have no *functional* significance in living processes. In fact, the extraordinary sensitivity of living processes to constant and varying magnetic fields is well known and forms an entire field of research, called "magnetobiology" or "biomagnetism." The biosphere is constantly subject to the magnetic field of the Earth, which in turn is coupled to that of the Sun and with the solar activity.

But despite many attempts, the fundamental biological significance of this sensitivity and the nature of the interactions involved, have not been clarified. Part of the reason, is the seemingly "infinitesimal" magnitude of the *"nuclear component"* of the magnetic fields in living and nonliving material. The magnetic interactions among molecules, which have been intensively studied and are known to play a decisive role in the biochemistry and biophysics of living processes—especially as concerns the role of so-called free radicals[22] derive nearly entirely from their *electronic* structures. These—at least so it was assumed—are relatively independent of the isotope-related nuclear magnetism. The magnetic moments of nuclei are 1,000 or more times weaker than those associated with the electrons and their orbital configurations. To obtain a sufficient signal from the nuclei, NMR machines employ magnetic fields that are typically 20,000-30,000 times stronger than the natural magnetic field on the Earth.



The magnetic characteristics of atomic nuclei play a key role in living processes. These are exploited routinely in nuclear magnetic resonance (NMR) spectroscopy. Here, an NMR spectrometer at the William R. Wiley Environmental Sciences Laboratory in Washington state.

The Strength of Weak Effects

But as science over the centuries has demonstrated again and again, it is often the weakest effects, the ones that tend to be ignored, that actually control the largest ones. In recent years, thanks particularly to the work of physical chemists in Russia, decisive evidence has been brought to light, for an essential role of isotope-specific "hyperfine" interactions in all living processes.

In the course of 2005, a research group led by the famous chemist Prof. Anatoly Buchachenko at the N.N. Semenov Institute for Chemical Physics of the Russian Academy of Sciences, demonstrated "magnetic isotope effects" in the biological synthesis of ATP, commonly known as the key "energy-carrying" substance in *almost all living cells.*

The decisive process in ATP synthesis, known as phosphorylation, depends on the activity of several enzymes that contain magnesium ions in specific locations. Now, it turns out that the rate of functioning of those enzymes changes dramatically, when one magnesium isotope is replaced by another. In a paper published in the Aug. 2, 2005 issue of the U.S. *Proceedings of the National Academy of Sciences,* Buchachenko et al. report the results of their investigations with the following words:

> In one of their brilliant papers, Weber and Senior pointed out that, despite great progress in our knowledge on the structure and our understanding of the molecular dynamics and functioning of ATP-synthesizing enzymes, the chemical mechanism of phosphorylation remains enigmatic: "Our understanding of ATP synthesis remains rudimentary in molecular terms.". . . The key reaction for the formation of the energy-carrying chemical bond P-O-P remains obscure. . . . Within the area of enzymatic reaction chemistry, all ideas are limited to speculations. . . . [But] an insight into the chemical mechanism follows from a recently discovered and remarkable phenomenon: a dependence of the phosphorylating activity of enzymes on Mg [magnesium] isotopy. This unusual effect was found for creatine kinese and ATP synthase. The rate of ATP production by enzymes in which the Mg 2+ ion has magnetic nucleus ^{25}Mg (nuclear spin 5/2, magnetic moment, -0.855 Bohr magneton) was shown to be *two to three times higher*

22. The term "free radical" signifies, in the language of present-day conceptions of physical chemistry, roughly the following: The electrons, participating in the electronic configurations of atoms and molecules, display the strong tendency to form (essentially) magnetically coupled pairs with oppositely oriented spins. When, in a given atom or molecule, this pairing is incomplete and the outerward-most electron configuration contains a lone, unpaired electron, then the given entity is called a "free radical." Generally speaking, such free radicals are chemically highly reactive, and possess strong paramagnetic properties, giving them a special role in chemical, and above all, biochemical processes. But the last word has not been said on this topic, by far.

than that induced by the same enzymes carrying spinless, nonmagnetic nuclei ^{24}Mg and ^{26}Mg. The discovery of this attention-catching effect convincingly demonstrates that enzymatic phosphorylation is an ion-radical, electron-spin-selective process in which the Mg ion Mg 2+ manifests itself as a reagent.

The paper goes on to report the comparable effect for still another crucial magnesium-containing enzyme involved in phosphorylation, phosphoglycerate kinase (PGK). Here the phosphorylation rates are 2.6 times higher with the magnetic isotope Mg-25, than with the nonmagnetic isotopes. Further analysis shows also that this is not a mere kinetic acceleration effect, but that the reaction process follows *different pathways* according to which isotope is present.

The technical details are not important for our present purposes. The point to be made here, is that a vast new field of biology and chemistry has been opened up, in which the magnetic characteristics of specific isotopes play a decisive role. Although the recent demonstration of isotope-specificity in the synthesis of ATP, obtained in materials of uniquely biological origin, constitutes a particularly striking case, these results cohere with the research in so-called "spin-selective chemistry," that has been developing over the last 20 years. The following quotes give a certain sense of this direction, while highlighting the need to overcome the mystification of quantum physics, which I mentioned above:

> Spin chemistry as a new field of chemical science is based on the fundamental principle: *chemical reactions are spin selective; they are allowed only for such spin states of products whose total electron spin is identical to that of the reagents and are forbidden if they require a change in spin.* Only magnetic interactions are able to change the spin of reactive intermediates. . . . Being *electron spin-selective,* the chemical interactions between the spin-carrying chemical species (radicals for instance) are also inevitably nuclear spin selective. If both electron and nuclear spin subsystems are coupled by the Fermi, or hyperfine magnetic interaction (HFI), then the nuclear subsystem can affect the behavior of the electron spin subsystem through HFI and, hence, modify the chemical reactivity. The *nuclear spin selectivity* differentiates the reaction rates for radicals (or, in general, for any other spin-bearing chemical species) with magnetic or nonmagnetic isotopic nuclei. This new phenomenon is the *magnetic isotope effect (MIE)* in contrast to the well-known classical isotope effect (CIE) which is a consequence of the nuclear mass selectivity of chemical reactions. Both isotope effects sort the isotope nuclei among the reaction products: *CIE selects the nuclei according to their masses, while MIE selects the nuclei according to their spins and magnetic moments.* (A. Buchachenko, "Comparative Analysis of Magnetic and Classical Isotope Effects," *Chem. Rev.,* 1995, 95.)

> The value for magnetic interactions of a field of 100,000 gauss with a nuclear spin is only ca. 1×10^{-5} Kcal/mole . . . or less [i.e., 500,000 times weaker than intermolecular bonds and more than 30 million times weaker than ordinary covalent bonds—JT]. In spite of the tiny value of these magnetic forces, we shall show that they can control the reactivity of radical pairs in a spectacular manner, if the supramolecular conditions are correct. (Nicolas Turro, *Chemical Communications,* 2002.)

Another, more speculative direction of thinking deserves mention:

> The availability of chemical elements on Earth has spawned a nearly unlimited variety of structures and organisms by variations of the chemical composition. It appears that by finding some biological role for essentially all chemical elements (including "microelements") Nature optimizes the resources of chemical diversification available to it. A similar possibility can likely arise for the isotopic diversity of elements. It seems improbable that Nature could "overlook" an additional level of informational diversification available through the isotopic degree of freedom. . . .
>
> Sternberg, DeNiro, and Savage (1986) and Galimov (1982) presented much-ignored findings about the isotopic composition of biochemical and genetic pathways. For example, during photosynthesis, the carbon obtained from CO_2 consists of ^{12}C and ^{13}C, but depending on the species of the plant, only one of these isotopes is preferentially fractionated. In the production of energy in the form of ATP, the carbon isotopes are selectively placed so that they will be propagated throughout the series of reactions in that same position. The conservation of isotopic structure persists in spite of the fact that the catalysis of enzymes changes the carbon skeletal structure of the intermediate molecules. . . .
>
> Elementary combinatorial analysis leads to an enormously large number of possible isotopic permutations of chemically fixed structures. For example, a segment of a DNA molecule with 1 million carbon atoms has about 10,000 randomly distributed ^{13}C atoms. The number of isotopically distinguished distributions (the number of possible placements of 10,000 atoms among 1,000,000 sites) is about 10^{24000}, far greater than the number of atoms in the Universe. . . . (J. Pui and Alexander Berezin, "Mind, Matter and Diversity of Stable Isotopes," *Journal of Scientific Exploration,* Vol. 15, 2001.)

Pui and Berezin go on to speculate, that permutations of the isotopic distributions in the tissues of the brain, may play an essential role in mental processes.

I should emphasize, that the above-cited work on the "magnetic isotope effect" represents only one, rather promising direction of research. Relative to the question we posed at the beginning of this section, the cited work still has the weakness, that it focusses only on the chemical-combinatorial "machinery" of these new isotope effects, and not on their relationship to the principles of living processes per se.

We can clearly see from these studies, however, that it is the special *physical-geometrical* environment, created in living

tissue, that provides the context within which "infinitesimally small" isotopic shifts—which in the nonliving domain under normal circumstances would have only marginal, apparently merely statistical effects—can play a determining role in the course of macroscopic events. The unique character of living processes would thus reside, not in some specific mechanism or structure, but in the *power to generate and maintain such higher physical geometries,* which Vernadsky identified in his work, but which is more adequately addressed by LaRouche's elaboration of the Riemann-Dirichlet Principle.

The Multiple-Connectness Of the Isotope Economy with Astrophysics, Space Colonization, and the History of the Solar System

Man's physical existence, which depends upon his constant action upon the universe, calls forth another aspect of the relationship between the nonliving, living, and Noöspheric domains, which takes a new form in the Isotope Economy.

Up to now, mankind's requirements for raw materials have been met nearly entirely on the basis of extracting those materials from surface or subsurface deposits of minerals, created in the course of hundreds of millions or even billions of years of the Earth's geological history. The origin of many, if not most of those deposits is connected with activity of living organisms (mostly microorganisms) which concentrated specific chemical elements from their environment, and deposited them in fossil formations, sediments, or biologically transformed rocks.

In almost all cases, man's present rate of extraction of raw materials vastly—sometimes by billions of times—exceeds the rate at which mineral deposits of comparable quality are spontaneously replenished or created anew in nature.

Clearly, this process cannot continue indefinitely. True, in absolute terms man is still very, very far from exhausting the Earth's immense store of mineral deposits. But the implicit limits of the present, purely extractive mode reflect themselves today in marginally increasing physical costs in extraction and processing, required to obtain any given quality of material. We are thus obliged to go into increasingly remote areas of the Earth's surface, to meet greater costs in transport and other infrastructure; to dig or drill much deeper into the ground or sea bottom; to resort to lower-quality deposits having larger processing costs, as the higher-quality deposits become exhausted, and so forth.

These circumstances, together with the highly uneven geographical distribution of most raw materials, have already led to serious bottlenecks on a regional level and to a rise of geopolitical tensions through the maneuvering of nations such as China to secure their access to raw materials supplies, at the same time as speculative financial interests move to grab control over those same supplies, on the eve of an anticipated major crisis of the world financial system.

In the face of this situation, Lyndon LaRouche has proposed a "Vernadsky Strategy" with a 50-year time-frame. The Vernadsky Strategy provides for large-scale physical investments and other measures to guarantee adequate raw materials supplies at stable prices to all the world's nations, as a key component of an overall policy for reorganization of the world financial and economic system. LaRouche's strategy starts from the realization, that the task of securing long-term raw materials supplies to the world economy over the coming 50 years, can only be solved from the standpoint of Vernadsky's "Noösphere": Man must now progress from the stage of simply extracting mineral resources in a more or less disorganized way, to consciously managing and developing the entire process of generation and utilization of those resources on a planetary scale. This includes not only the "natural" processes of replenishment of resources within the biosphere, but also—increasingly!—the deliberate "de novo" creation of resources by man, through such processes as the large-scale transmutation of elements. At the same time, we need revolutionary advances in the technology of extraction and processing of raw materials and recycling of waste material, offsetting the tendency for marginal increase in the cost of raw materials, while at the same time radically improving the range and quality of the final products.

Until the emergence of nuclear energy, man's existence had been based exclusively upon a store of 83-odd stable chemical elements preexisting in the biosphere, and whose existence dates back nearly entirely to the genesis of the Solar System itself (the exception is certain quantities of elements created after the formation of the Earth by the radioactive disintegration of other elements).

In the course of the biosphere's evolution, the circulation of chemical elements on the Earth—the geochemical migration of atoms, as Vernadsky called it—has become more and more dominated by the action of living processes. In virtue of their ability to concentrate elements existing in their environment, living organisms, among them especially microorganisms, actually created many of the mineral deposits that man mines today as sources of raw materials.

In addition, even "inorganic" processes of ore-formation and evolution, which did not involve the *direct* action of living organisms, were *indirectly* influenced by the *biogenic migration of elements in the biosphere.*[23] This migration of elements is by no means limited to the immediate vicinity of the Earth's surface; the "sphere of influence" of the biosphere

23. In his 1938 paper "On the Fundamental Material-Energetic Distinction Between Living and Nonliving Natural Bodies of The Biosphere" (translation published in the Winter 2000-2001 edition of *21st Century*), Vladimir Vernadsky elucidated the significance of the biogenic migration of elements in the following terms:

"Between the living and inert matter of the biosphere, there is a single, continuous material and energetic connection, which is continuously maintained during the processes of respiration, feeding, and reproduction of living matter, and is necessary for its survival: the biogenic migration of atoms of the chemical elements, from the inert bodies of the biosphere into the living natural bodies and back again. This appears in the form of motion—the departure and arrival of specific chemical compounds and elements to and from living organisms in connection with the processes of feeding, respiration, excretion, and reproduction, characteristic of living matter. These processes define the biogeochemical energy of living matter. . . ."

NASA

Artist's illustration of NASA's Mars rover, with its robotic arm ready to explore a rock. Very few of the conclusions of astrophysicists, Tennenbaum writes, "have been established with any real degree of certainty; nor could they be, so long as human activity remains bound to the immediate vicinity of the Earth."

extends via the constant vertical circulation of water (and the gases and ions dissolved in it) all the way down to the upper and lower mantle of the Earth.

Man's development of large-scale mining, transport, and industrial activities, has fundamentally changed the patterns of "migration" of mineral elements in the biosphere, leading finally to the point where man begins to create new resources by the transmutation of elements. This latest stage, Vernadsky associated with the emergence of the Noösphere.

As long as we merely used the pre-existing stores of elements on the Earth, Man was not directly concerned with the historical process of their creation, although the geologist and prospector are very much concerned with the history of their subsequent migrations on the Earth. Now, this changes dramatically.

Man's Economy Becomes Astrophysical

For the first time, human activity is transcending the limits of mere redistribution and combination of elements, to deal with their processes of generation. Indeed the business of large-scale synthesis, by nuclear reactions, of old and new atomic species, characteristic of the emerging Isotope Economy, brings man's economic activity into immediate, intimate relationship with the astrophysical domain, and the processes of formation of stars and planets. Discovering the principles behind those processes, and applying them to the task of further development of the biosphere and its extension into ever larger regions of the Solar System, self-defines man as a *universal being,* and not merely an inhabitant of the planet Earth; a being acting in accordance with a higher directionality, embedded in the Cosmos as a whole.

Conversely, the constant stream of new scientific discoveries in subatomic physics and related areas, required for the realization and maintenance of an Isotope Economy on Earth, cannot be supplied without the extension of *large-scale human activity beyond the orbital vicinity of the Earth,* to Mars and eventually beyond.

There are many, interconnected scientific and physical-economic reasons for this. As even the notion of a "neutron star," for example, suggests, subatomic processes are essentially *astrophysical* in character. Mankind's increasing mastery of such processes demands extensive cross-spectral investigations of faraway anomalous objects in our galaxy and in other galaxies, which cannot be made from the Earth or even from the Earth-plus-Moon system, on account of the insufficient parallax, disturbances coming from the Sun, and other causes. We must be able to carry out interferometry and related measurements on a length scale comparable to the Mars orbit—measurements eventually involving hundreds of laser-interlinked measuring stations "parked" in suitable solar orbits.[24] To set up and maintain these stations, and to constantly update them with new instruments in keeping with the advance of science and technology, requires constant human intervention and, accordingly, a vast logistical base to support the needed labor force and its activity in these distant orbital regions.

Some, even among professionals, might disagree with our assertion, that the progress of nuclear physics and astrophysics really necessitates such a—seemingly extravagant—program of space colonization. The "authoritative" tone of standard astronomical and astrophysical treatises, concerning such matters as the early universe, the structure of our galaxy and the mechanism of star-formation, the nuclear processes going on in the Sun, stars, and so forth, often gives the misleading impression, that the basic facts in these fields had already been established, and only details remain to be investigated. The truth, however, is that very few of those conclusions have been established with any real degree of certainty; *nor could they be,* so long as human activity remains bound to the immediate vicinity of the Earth.

This is the case even on the level of such "elementary" kinds of astronomical data, as the distances and true motions of relatively "nearby" objects in our galaxy. A shocking demonstration of this occurred late last year, when an international group of astronomers determined, by direct triangulation, that previous estimates of the distance separating our Solar System from the closest spiral arm in the galaxy—the Perseus Arm—were in

24. For the current applications of large-scale interferometry in astronomy, see for example, "Space Very Long Baseline Interferometry" at http://www.hia-iha.nrc-cnrc.gc.ca/projects/vlbi_e.html. Also, the article "Very Long Baseline Interferometry" in Wikipedia.

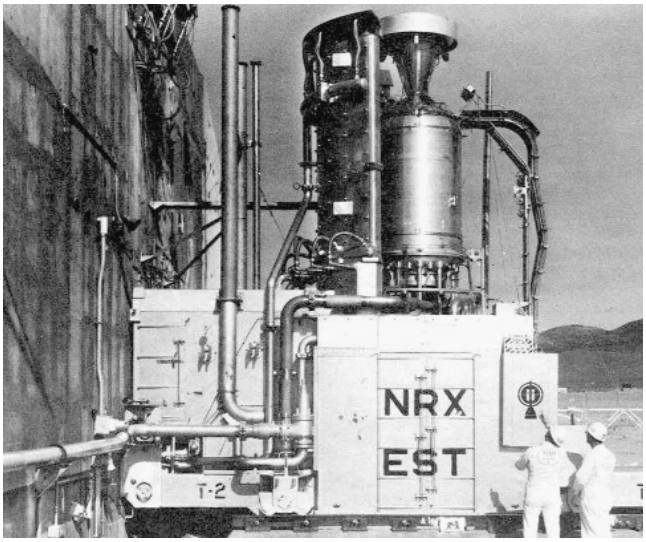
error by 200 percent![25] That occurred, despite the impression of super-precision of modern astronomical measurements, generated with the help of sophisticated instrumentation on the Earth and orbital observatories.

Evidently, the maps of our galaxy, reproduced as "fact" in countless treatises and textbooks, will have to be redrawn. Perhaps we know as little about the real form, history, and inner workings of our galaxy today, as Europe knew about the continent of America prior to Columbus's voyages! It is true that Eratosthenes, many centuries earlier, was able to determine the diameter of the Earth to an astonishing degree of precision, from the evidence of a small portion of its surface; just as Johannes Kepler, a century after Columbus, could discover the basic principle of the planetary motions in our the Solar System, without leaving the Earth. The significance of those triumphs of human reason, however, is not that we can learn everything about the universe merely sitting in our armchair on the Earth, but rather, that, thanks to the accumulated accomplishments of human reason, we have learned enough, working *from* the Earth, to now move out beyond the Earth. Accordingly, Eratosthenes' breakthrough was immediately followed by the first documented attempt to circumnavigate the Earth.

The point here is, that our present knowledge of nuclear physics, while highly imperfect, nevertheless suffices for the construction of first generations of nuclear fission- and fusion-powered space vehicles, and other technologies, and that will permit us to carry out the kinds of activities in the Solar System needed to assure a flow of future breakthroughs in nuclear physics.

Naturally, the mere spatial expansion of man's activities constitutes only a *necessary* condition for continued scientific breakthroughs. To get the breakthroughs, we need not only observations, but improved ways of *thinking* about them.

25. See a short report "Perseus Spiral Arm of the Milky Way much closer than thought"on Physorg.com at http://www.physorg.com/news9124.html; and "The Distance to the Perseus Spiral Arm in the Milky Way," by Y. Xu et al. at http://arxiv.org/pdf/astro-ph/0512223.



NASA

Nuclear rockets and fusion rockets are essential for man's exploration of the universe. Here, a nuclear rocket system ready for engine testing; the reactor and exhaust nozzle are visible above the lettering NRX (NERVA Reactor Experiment). The U.S. nuclear propulsion program, known as NERVA (Nuclear Engine for Rocket Vehicle Application), was developed in the 1960s as an essential component of the space program, but the nuclear program was killed in 1972 as part of the attack on science, and nuclear science in particular. Now NASA is again funding nuclear propulsion systems in its "Project Prometheus."

Back to Dynamics: The Revival of Nuclear Physics

In most of the discussion so far, I have restricted myself to developments that can be projected on the basis of the current knowledge and technological capabilities. These developments suffice to "insert" the world into the "orbit" of the Isotope Economy, but not for much more. Very soon, the need to carry out a long-overdue, sweeping revision of present physical theories will become acute. The medium- and long-term success of the Isotope Economy, depends upon doing the same thing for nuclear physics and physical science in general, as Johannes Kepler did for astronomy nearly 500 years ago.

Indeed, the present state of nuclear physics bears an uncanny resemblance to the hodgepodge of conflicting models and calculational procedures, which characterized the astronomy of Kepler's day, and which he swept away with his epoch-making *New Astronomy.* Kepler was well aware of the fact that he was not simply correcting flawed theories, but was combatting a monstrous fraud, perpetrated centuries before by Aristotle and Ptolemy, whose political promotion imposed a "dark age" in European science, from the death of Archimedes until the 15th Century Renaissance.

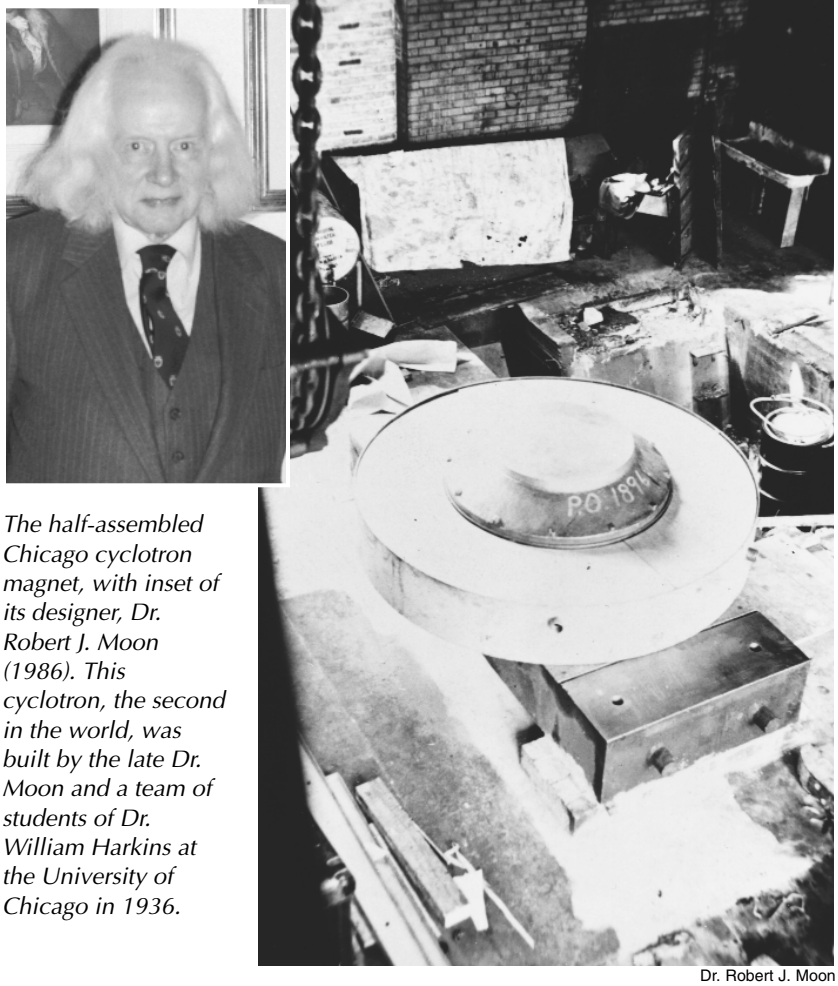
We should hope that the kind of training obtained by working through Kepler's method of discovery, will permit a new generation of young physicists to accomplish the analogous task with nuclear physics and astrophysics today.[26]

The concluding two sections of this article are intended as a prelude for things to come. I shall start with a very simple paradox, which one of the founders of nuclear physics, Werner Heisenberg, returned to at the end of his life.

The question is simply this: Nearly all of us are raised in the empiricist-reductionist doctrine, that every entity in the universe is built up from some sort of simpler elements or "building blocks" which are parts of them. A typical example of this is the notion that molecules are composed of atoms, atoms from electrons and nuclei, nuclei from protons and neutrons, etc. But what do we really mean, when we say that one entity is a *part* of another? Or that it is "made up of" such parts?

Without needing to go into anything so advanced as nuclear

26. See the article, "Animating Creativity: The Functioning of a Healthy, Human Mind," by the New Astronomy Animations Team, in *EIR* Oct. 13, 2006. Work by the Animations Team can be found on the website of the LaRouche Youth Movement, www.wlym.com, at http://wlym.com/@~animations.



The half-assembled Chicago cyclotron magnet, with inset of its designer, Dr. Robert J. Moon (1986). This cyclotron, the second in the world, was built by the late Dr. Moon and a team of students of Dr. William Harkins at the University of Chicago in 1936.

Dr. Robert J. Moon

physics, we can demonstrate the paradox very beautifully with the case of *water.* In high school, we learn that water is composed of entities called water molecules, and that these are composed of one oxygen and and two hydrogen atoms each according to the formula H_2O. But, there is no simple relationship at all between the *properties* of oxygen and hydrogen, on the one side, and the properties of "water" which is supposed to be composed of them! In fact, the high school chemistry student, letting a bit of oxygen and hydrogen gas combine, will be very hard put to recognize *anything* at all suggesting the properties of those two gases in the droplets of water that are formed as a product of the little explosion in his test tube! At most, the *masses* of the reacting portions of hydrogen and oxygen, or rather their *sum,* appear to have been preserved as the mass of the resulting water. But even this (approximate) invariance is noticeably violated in the world of nuclear reactions: There, the result of the fusion of two nuclei can be very significantly *lighter* than the sum of their masses. (See discussion below.)

These anomalies make it clear, that the *source* of the properties of water (for example) cannot be found in either oxygen or hydrogen, neither separately nor together. Whence, then, did those properties come? Should we not rather assume, that "water" was already *present,* as a potential state of organization, and merely required the two as means to *express* itself? The essence of "water" lies in the *change* that occurred in the reaction.

The source of the difficulty is the tendency, going back to Aristotle, and renewed by Galileo and Paolo Sarpi's counterrevolution against Kepler's Platonic method, to falsely regard objects of the senses as "real," and ideas as "abstract"; whereas in reality, the opposite is true; namely, that it is ideas that are real, and what we call sense objects are merely effects deriving from them.

This elementary error, in turn, lies at the origin of the still-ongoing, vain attempts by physicists, to deduce the properties of atomic nuclei from the assumption, that the nuclei are "made up" of particles interacting pairwise according to this or that mathematical formula. This attempt to emulate Isaac Newton, who in fact totally failed to account for the most elementary harmonic features of the Solar System with his force law,[27] has now occupied nuclear physicists for nearly a century. Yet no one has been able to come up with a solution, and the vain search for one has led the entire theoretical development of nuclear physics into a blind alley.

In former times, many scientists had some awareness of the fraud of reductionism. Back in the early 1970s, for example, in the process leading to the founding of the Fusion Energy Foundation, Lyndon LaRouche became acquainted with the University of Chicago physicist and physical chemist Prof. Robert J. Moon, a veteran of the wartime Manhattan Project who had designed the first cyclotron used in the Project.[28] According to the story I have heard, Moon

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27. In his works, *Mysterium Cosmographicum, Nova Astronomia,* and *Harmonia Mundi,* Johannes Kepler set forth a comprehensive conception of the organization of the solar system as a single, harmonically ordered system in which the orbits and motions of the planets are all coupled to one another. Unfortunately, Kepler's conception was subsequently buried under the influence of Galileo and Newton, and especially the politically motivated promotion of Newtonian mechanics as the supposely *sine qua non* of physical theory. In fact, Newton derived his famous "force law" by a mere algebraic inversion of the empirical laws that govern motion in single elliptical orbit, ignoring the deeper harmonic features of Kepler's system.

    The resulting, abstract reductionist approach of Newton, while apparently suited to the hypothetical case of a single, isolated planet orbiting the Sun, is plunged into hopeless mathematical difficulties—the infamous "Three Body Problem" or "N-body problem"—when confronted with a more complex system. Not only does Newton's approach fail to account for even the most elementary features of the harmonic distribution of the planetary orbits taken together, but it completely misses the reality, that our Solar System has developed, and continues to exist, as a single coherent astrophysical system, organically linked to the Sun. On a deeper level, it is necessary to rethink the assumption, that the so-called "gravitational," "electromagnetic," and "nuclear forces" really exist in nature, as separable entities.

28. See the special issue of *21st Century,* "The Continuing Legacy of Dr. Robert J. Moon," Fall 2004.

then voiced his opinion, that "contemporary nuclear physics is a bunch of garbage." As an *example* of this, Moon claimed that the standard interpretation of the famous "alpha scattering" experiments, upon which Rutherford and later physicists derived their estimates of the size and other fundamental characteristics of the atomic nucleus, were based on fallacious and arbitrary assumptions concerning the nature of the interactions between the nucleus and the alpha particles used to bombard the nucleus.

Similarly, according to Moon, the entirety of research into controlled nuclear fusion had been thrown onto the wrong track by the mistaken assumption, that a so-called "Coulomb force" between nuclei must be overcome, in order to make fusion reactions occur. It is this assumption, which precludes the possibility of "polarized fusion" of the sort LaRouche proposes. In the search for means to "overcome the Coulomb barrier," fusion scientists saw themselves obliged to impart enormous velocities to the nuclei, which in turn meant working with temperatures of millions of degrees celsius. And yet, as many experiments demonstrate, that "barrier" can be made to disappear, if the system is placed in a suitable physical geometry. (Such a possibility is already acknowledged in so-called wave mechanics, but in a sophistical way, as "resonant tunnelling.")

But if the states of atomic nuclei are not determined by elementary forces, and if indeed there is no such thing as an "elementary force," then what determines the states of atomic nuclei? The first step would be to admit that *it is the states of organization themselves, and the intentionality behind them, which are the proximate efficient agents of nuclear processes.* It is exactly with this idea in mind that the late Dr. Moon, inspired by discussions with LaRouche, in 1985 proposed a new, geometrical approach to nuclear physics, without the assumptions about "elementary forces." In proposing his now-famous model of the nucleus in terms of embedded regular solids, Moon emphasized, for example, that "the proton is a singularity that exists within, and depends upon, the geometry of the whole of space." He insisted that *the particles arise from the geometries, rather than the geometries arising from particles deciding to arrange themselves in this or that way.*

But how, for example, could a geometrical entity—let us say, a regular solid—be able to exercise any sort of efficient action in the universe? Consider the following four passages, one from Plato's *Timaeus,*[29] two from posthumous fragments by Bernhard Riemann,[30] and one from the last published writing by Werner Heisenberg in 1976,[31] respectively:

Plato in *Timaeus:*

What we always observe becoming different at different times, such as fire, we should not refer to as a *this,* but in each case as a *thus,* nor refer to water as a *this,* but always a *thus;* and of those things that we suppose we can indicate by pointing and using the expressions "this" and "that," we should never refer to any of them as if they have any permanence. . . . We should not use these expressions, but we should call "such-like" ("thus") that which in each and every thing continually recurs as similar, and thus call "fire" that which is such-like throughout everything, and so on for everything which is subject to a process of becoming.

Riemann:

I. What an Agent strives to realize, must be determined by the concept of the agency; its action can depend on nothing else, than its own nature.

II. This requirement is fulfilled, when the Agent strives to maintain or to establish *itself.*

III. But such an action is unthinkable, if the Agent is a thing, an existent, but is only thinkable, when it is a condition (state) or a relationship. When there is a striving, to maintain something or to create something, then deviations from this "something"—in fact, deviations in varying degrees—must be possible; and this "something" will in fact, insofar as this striving is opposing other tendencies, only be maintained or created as closely as possible. But there is no degree of existence; a differentiation in terms of degree is only thinkable for a state or a relationship. Therefore, when an Agent strives to maintain or create itself, that Agent must be a condition or a relationship.

Second fragment by Riemann:

With each act of thinking, something persisting and substantial enters our soul. I call it *Geistesmasse* [thought-mass]. All thinking, therefore, is generation of new *Geistesmassen*. . . . The *Geistesmassen* are imperishable, everlasting. Only the relative power of these connections changes, through the integration of new *Geistesmassen.* The *Geistesmassen* do not need a material carrier, and do not exercise any constant effect in the world of appearances. They have no relation to any part of matter, and are, therefore, not located in space. But, any new generation, and any new connection between *Geistesmassen,* requires a material substrate. . . . Each *Geistesmasse* strives to generate a similar *Geistesmasse*. It therefore strives to bring about the same form of motion of matter, through which it was generated.

Finally, Heisenberg:

I believe that certain erroneous developments in particle theory—and I am afraid that such developments do exist—are caused by a misconception that it is possible to avoid philosophical arguments altogether. Starting with

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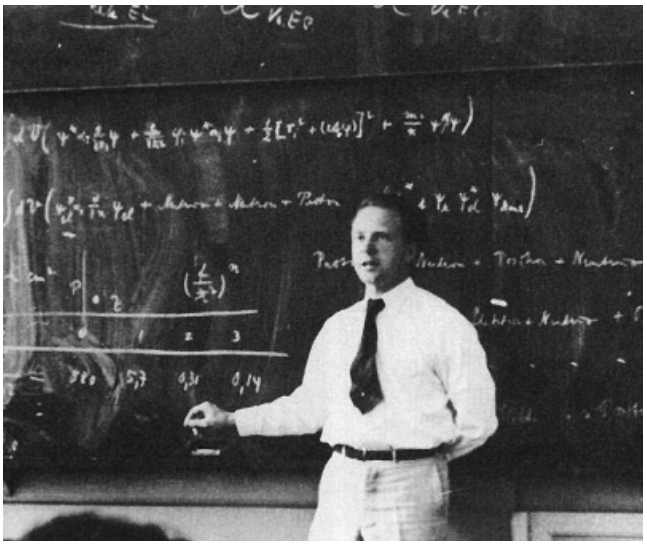
29. The best translation of the *Timaeus* into modern languages, as far as this author knows, is that made by LaRouche's collaborators and published in the February 1980 issue of *The Campaigner,* pp. 35-74.

30. From *Bernhard Riemann's Gesammelte Mathematische Werke,* Sändig Reprint Verlag, in the section "Fragmente philosophischen Inhalts," pp. 509-510 and p. 524. An English version appears in *21st Century,* Winter 1995-1996.

31. "The Nature of Elementary Particles," Werner Heisenberg, *Physics Today,* Vol. 29, No. 3, pp. 32-40 (March 1976), and reproduced in *Heisenberg Gesammelte Werke* (Collected Works), Springer-Verlag 1984, pp. 917-927.



Werner Heisenberg wrote that when the wrong questions are posed in particle physics, the wrong answers naturally emerge. "The particle spectrum can be understood only if the underlying dynamics of matter is known; dynamics is the central problem," he wrote, recommending the study of the philosophy of Plato to solve this problem.

poor philosophy, they pose the wrong questions. . . .

Before this time [the experiments of Andersen and Blackett demonstrating so-called pair production of electrons and positrons by a quantum of light—JT] it was assumed that there were two fundamental kinds of particles, electrons and protons . . . their number was fixed and they were referred to as "elementary" particles. Matter was seen as being ultimately constructed of electrons and protons. The experiments of Andersen and Blackett provided definite proof that this hypothesis is wrong. Electrons can be created and annihilated; their number is not constant; they are not "elementary" in the original meaning of the word. . . .

There is no difference between elementary particles and compound systems [such as atoms and molecules—JT]. This is probably the most important experimental result of the last fifty years. That development convincingly suggests the following analogy: Let us compare the so-called "elementary" particles with the stationary states of an atom or molecule. We may think of these as various states of one single molecule or as the many different molecules of chemistry. One may therefore speak simply of a "spectrum of matter.". . .

Wrong questions and wrong pictures creep automatically into particle physics and lead to developments that do not fit the real situation in nature. . . . We will have to accept the fact that the experimental data on a very large and very small scale do not necessarily produce pictures, and we must learn to do without them. . . . The philosophy of Plato appears to be the most adequate. The particle spectrum can be understood only if the underlying dynamics of matter is known; dynamics is the central problem.

Radioactivity, Isotopes, And the Ironies of The Periodic System

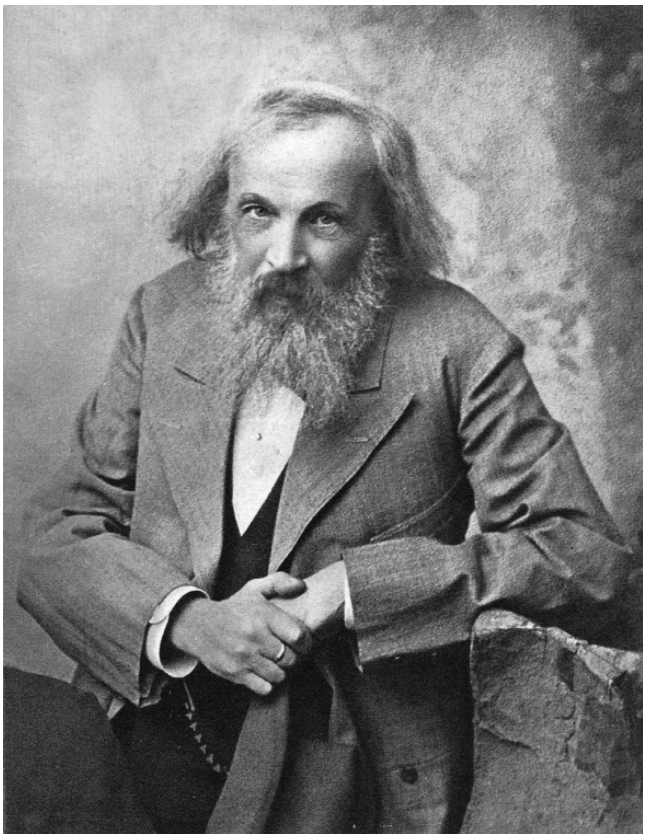
Bearing these paradoxes in mind, the following paragraphs are intended to provide the reader—above all, the non-specialist reader—with some brief background on the discovery and nature of isotopes, and some principles of nuclear physics related to them, as far as they are known today.

One should always remember, that atomic and nuclear physics, insofar as they are valid, developed by applying essentially the same method, used by Johannes Kepler in his original discovery of the principle of gravitation in the *astrophysical* domain, to the domain of *microphysics.* That relationship between astrophysics and microphysics is lawful and necessary. It came to the fore once more, in the manner in which nuclear physics developed out of the anomalies of the periodic system of elements. So I will take up the story at that point.

At the time that Dmitri Mendeleyev began his scientific work in 1855, the central axiomatic assumption of chemistry was the notion of a chemical *element.* This notion is associated with the idea, that we cannot differentiate or divide substance indefinitely, without encountering some kind of a limit, boundary, or, as we say, singularity. In the specific practice of chemistry up to the time of Mendeleyev, the exploration of this area took the form mainly of what are called chemical separation methods: distillation, precipitation, electrolysis, centrifugation, and so forth. Generally speaking, we start with any kind of stuff, and we do various things to it, to see if we can induce a separation or differentiation of the original stuff into two or more new substances, each having clearly distinct characteristics.

So in electrolysis, out of water, we produce hydrogen and oxygen, for example. And then we take those new substances which we produced by the separation of the first one, and try to do the same thing with each of those two. We keep doing that, trying to push the process to the point of a limit, a singularity. Through this kind of exploration, chemists in fact did arrive at a limit, as expected, in the form of what were sometimes called "simple bodies" or elements—substances which seemingly could no longer be caused to differentiate further. From ancient times, a number of such elements had been identified: iron, copper, tin, lead, mercury, gold, silver, sulfur, and carbon. About five more elements were added in the Middle Ages, and then, under the influence of Gottfried Leibniz's work in launching the Industrial Revolution, there occurred, from about the 1740s on, an explosive development of physical chemistry. Thus, by the time Mendeleyev graduated from the Main Pedagogical Institute of St. Petersburg, about 64 chemical elements were known.

There are different, opposing types of hypotheses associated with the term "chemical element." Empiricism has insisted, for example, on the supposedly self-evident axiom or idea which is still repeated, unfortunately, in much of our elementary education: namely that the elements represent unbreakable, ulti-



Dmitri Mendeleyev. "The implications of what was set in motion by the discovery of radioactivity and the isotopes, growing out Mendeleyev's 'Keplerian' understanding of the periodic system, go far, far beyond anything the world has seen up to now."

mate "building blocks" of matter, whose supposed quality of reality is borrowed from the baby's earliest years in the playpen. The great French chemist Lavoisier, on the contrary, adopted the more adult view that the chemical elements are *singularities,* in a search not for ultimate building blocks, but for what he called the "principles" of matter.

In 1869, Mendeleyev published his first version of the Periodic Table, demonstrating that the chemical elements constitute a single, harmonically ordered organism—entirely as Kepler had seen the system of planetary orbits. Mendeleyev's discovery of the periodic system was provoked by his work as a teacher. In teaching, he was irritated and provoked by the chaotic mass of data on the individual elements, and asked himself the question: Is what we're doing here really a science? Can I present this as a science? Mendeleyev wrote the following:

> The mere accumulation of facts, even an extremely extensive collection, . . . does not constitute scientific method; it provides neither a direction for further discoveries nor does it even deserve the name of science in the higher sense of that word. The cathedral of science requires not only material, but a design, harmony . . . a design . . . for the harmonic composition of parts and to indicate the pathway, by which the most fruitful new material might be generated.

Mendeleyev arrived at his discovery, after many failed attempts by other chemists, by juxtaposing two distinct types of experimentally defined orderings of the elements:

First, the natural division of the elements into *distinct chemical groups,* each composed of elements having similar or analogous characteristics of the member-elements, relative to the totality of the elements, in terms of the types of chemical compounds and crystals they form, and other physical-chemical properties.

Second, the "ranking" of the elements in a *single sequence,* according to increasing values of their atomic weight, starting from hydrogen and ending with uranium.

Mendeleyev's choice of that second ordering principle, was crucial. He correctly hypothesized, that the "atomic weights," among all the known physical and chemical parameters, reflected an *invariant,* a "something" that is preserved in all chemical transformations. At the same time, Mendeleyev steadfastly rejected all attempts at a simplistic explanation of the sequence of elements, in terms of their being built up, in a linear fashion; for example, from hydrogen as the main "building block." Mendeleyev insisted that each single chemical element represented a true "individual."

Struggling with the ambiguities and inaccuracies of the then-existing empirical data, Mendeleyev finally gave birth to the "natural system of elements," as he called it, and the fundamental discovery, that the chemical properties of an element are essentially a multiple-periodic function of the *ordinal number* of the element in the series of increasing atomic weights. This principle not only permitted nearly the entirety of then-existing knowledge of the chemical elements to be brought together into a coherent whole, but also led Mendeleyev, and later others, to successfully predict the existence and characteristics of "missing" chemical individuals.

The Underlying Dynamic Process

But Mendeleyev himself regarded his discovery merely as a *first step.* In his 1870 article "On the Natural System of Elements," he wrote:

> When we succeed in discovering the exact laws for the periodic dependence of the properties of elements from their atomic weights, and for the atomic interrelations between the elements, then we will come nearer to understanding the true nature of the mutual differences between the elements; then chemistry will be able to leave the hypothetical domain of the static conceptions, which have prevailed until today, behind it; and the possibility will open up, to apply to chemistry the *dynamical approach, which has been so fruitfully employed for the investigation of most physical phenomena* [emphasis added].

The breakthrough in uncovering the *dynamic* process underlying the periodic system, came from three experimental directions. First, by studying the anomalies of the system of elements: its still-unfilled gaps; the question, why the series of

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Marie Curie surmised that radioactivity was connected with a process of "atomic transformation" that underlay the close association of radium and polonium with uranium and certain other substances. Subsequent research confirmed her conjecture: Radium was slowly being turned into lead.

elements seemed to break off at uranium; and finally, the anomalous character of the atomic weights themselves, whose ratios are often close to, but still distinctly different from, simple whole-number ratios (see below). Second, by investigating various forms of *radiation* emitted by atoms. Third, through pursuit of the anomalies of geochemistry, by investigating the distribution of the elements in nature, in minerals for example, where certain elements are found in close association with one another, "as if" they had some "hereditary" relationship to each other.

Following Roentgen's discovery of X-rays, which are generated when accelerated electrons strike the surface of a metal, Becquerel found that salts of uranium *spontaneously* emitted a weak sort of radiation, capable of darkening photographic plates, but apparently without the need for any stimulation from the outside. Marie Curie later coined the term "radioactivity," suggesting that the source of Becquerel's radiation lay in an inherent, dynamic activity of the atoms themselves. Following up this situation with a new method of measurement, Marie Curie investigated all available minerals, finding Becquerel's radiation present *exclusively* in minerals containing uranium and thorium—the last and next-to-last elements in Mendeleyev's system! Certain anomalies led her to suspect, that the main source of the radiation was not uranium and thorium themselves, but traces of some other element or elements, associated with them in the same minerals. Marie and her husband, Pierre, were subsequently able to isolate, from large amounts of the uranium ore by-product pitchblend, two new, highly radioactive elements: first polonium, and then radium, filling the empty spots of ordinal numbers 84 and 88 in Mendeleyev's table.

That was 1898. An avalanche of new experimental discoveries unfolded in the following years. It was found that radium, in addition to emitting a continuous bluish glow, also produced significant amounts of heat, amounting each year to the equivalent of burning 100 times its weight in coal! And yet, the heat and light emission from radium seemed to continue, year after year, with no sensible decrease. Marie Curie hypothesized that this radioactivity was connected with a process of "atomic transformation" that somehow underlay the close association of radium and polonium with uranium and certain other substances, always found together in uranium-containing minerals; and that the radium was very slowly transforming itself into one or other elements.

Subsequent research confirmed her conjecture: Radium was very slowly transforming itself into . . . lead! The rate of transformation was so slow, that after about *1,600 years* only about *one half* of the original amount of radium will have turned into lead, accompanied simultaneously by a gradual release of helium gas. In that process, the radium will have emitted an amount of heat equivalent to nearly a *million times* its weight in coal. It was immediately evident, that the discovery of this new, "atomic" energy would lead to a revolution in human affairs, as soon as means were found for accelerating the spontaneous, apparently very slow process of atomic transformation.

Meanwhile, the bigger picture gradually came into focus, of the existence of several distinct "radioactive decay chains," starting from uranium and thorium, in the course of which many successive atomic transformations occur, simultaneously and at widely differing average rates, and in which the generation and decay of radium and polonium constitute intermediate steps on the way to lead as the "end-point." One of them, for example, has 15 transformations, jumping back and forth upwards and downwards in the periodic system, before finally arriving at lead. Some of the steps occur within seconds, others several minutes or days, still others take years, all the way up to *several billion years* for the initial step leading from uranium.

As Mendeleyev had anticipated, a highly dynamic reality began to come into view, beneath the apparently tranquil sur-

face of the periodic system, with its seemingly fixed relationships: a world of creation, death, and metamorphosis of elements, in which different principles are at work than those expressed in the Periodic Table per se.

Transmutation and the Discovery of Isotopes

So far, radioactivity concerned only the spontaneous transformations occurring in a small handful of elements. But by 1926, scientists had learned to carry out the first "artificial transmutations" of other elements, transforming nitrogen atoms into oxygen atoms by exposing them to radiation from a radioactive source. Evidently, the transmutation of elements—the dream of the alchemists—was a universal potentiality. The view suggested itself, that the distribution of elements, found today on the Earth, is a "fossil" of an evolutionary process, involving possibly many forms of nuclear reactions. The phenomena of atomic energy provided a crucial clue to the long-standing riddle, what the power source of our Sun might be, as well as a possible relationship between nuclear processes going on in the Sun and stars, and the origin of the chemical elements.

But already, earlier during the first decade of the 20th Century, scientists had discovered something else of fundamental importance: There was something very special about the substances produced in radioactive decay processes. Some of those products of atomic transformations resembled naturally occurring elements very closely, and could not be separated from them chemically when mixed together; yet they had very different radioactive characteristics. For example, the substance then called "ionium," arising from the decay of uranium, appeared chemically identical with thorium, but decayed in mere days; whereas the half-life of natural thorium is so long (over 10 billion years), that it could barely be estimated at that time.

In 1910, Frederick Soddy suggested that there might exist subspecies of one and the same element, having different atomic weights, but virtually identical chemical properties. He coined for these the term "isotope," meaning in Greek "the same position," to signify that from a chemical point of view, these subspecies would belong to the same position in Mendeleyev's periodic system. A few years later, researchers could confirm, for example, that the lead accompanying minerals of uranium has a *different atomic weight,* than the lead found in minerals of natural thorium. Thus, "lead is not lead": different radioactive chains end up in different lead isotopes. These discoveries laid bare an extraordinary ambiguity in the concept of an element, which had been the entire basis of chemistry!

By the late 1920s, with Aston's development of the mass spectrograph, and thereby of the ability to measure atomic weights with vastly greater precision, it had become clear that the existence of distinct isotopes was a ubiquitous property of the chemical elements; and that practically all elements found in nature, whether radioactive or not, consisted of mixtures of isotopes in various ratios. It became evident, that the number of isotopes is many times larger than the number of elements, even as regards the stable isotopes. Iron, for example, has four known stable isotopes; calcium has six, and tin, has the record highest number, with ten, all occurring with significant abundance on the Earth. It lies in the nature of the nuclear transformation processes, that different isotopes of one and the same element will generally have *different* origins, different *pre-histories* in the evolution of the universe.

Today, some 3,000 different isotopes are known, most of which were created by man. That corresponds to an average of about 30 isotopes for each element! Most of these are short-lived in their "free" state, but they nevertheless represent realizable modes of existence of matter in our world.

All of this means adding a new *dimensionality* to Mendeleyev's periodic system. The discovery of isotopes called for a complete reworking of chemistry. How, then, should we now conceptualize the ordering of a newly emerging "periodic system of isotopes"? The answer, as far as science has gone with it until today, is inseparably connected with the *anomalies of the atomic weights.*

Mendeleyev had based his periodic system on the *ranking* or *ordinal number* of the elements in order of their increasing atomic weight, using the comparison between this ranking and the periodicity of chemical and crystallographic characteristics, to correct for the inaccuracies of measurement of the atomic weights and to determine the positions of "missing" elements in the series. The challenge remained, to better understand the significance of the values of the atomic weights themselves, which manifested both regularities, as well as curious irregularities.

On the one hand, those values, regardless of the units used to express them, display an unmistakable tendency to form whole-number proportions. At the beginning of the 19th Century, the English chemist William Prout pointed out that the atomic weights of the elements appeared to be integral multiples of the atomic weight of hydrogen, the lightest element; and upon this he based his hypothesis, that the elements are somehow composed from hydrogen as the basic building-block.

Mendeleyev, however, rejected this reductionist conception on principle, and it was refuted experimentally by more precise measurements of the atomic weights. Particularly striking was the case of chlorine, recognized as a chemical element in 1820, and whose atomic weight, relative to that of hydrogen, is about 35.5. In fact, when Mendeleyev made his periodic table, he listed the values of the atomic weights for the first two "octaves" of his system, as they were then known, in a very rough approximation, as follows:

H 1						
Li 7	Be 9.40	B 11	C 12	N 14	O 16	F19
Na 23	Mg 24.3	Al 27.4	Si 28	P 31	S 32	Cl 35.5

What is the cause of the mixture between (very nearly) integral, as well as clearly non-integral values, and of the irregular distribution of the "jumps" in the values between successive elements? Did this mean more "missing" elements, or even new chemical groups? Elements perhaps of a different kind, than Mendeleyev allowed for?

New Anomalies

Here the discovery of the isotopes, and the subsequent measurement of their atomic weights, brought a crucial breakthrough. An extraordinary regularity emerged, that had hitherto been hidden; while at the same time, new anomalies

appeared, which remain at the core of modern nuclear physics up to this day.

First, it was recognized, that since the naturally occurring elements are in reality mixtures of isotopes, having themselves different atomic weights, the previous measured value for the elements reflected a kind of average of the atomic weights of the corresponding isotopes, "weighted" according to the relative percentages of the isotopes in the mixture. The reason for the half-integral value for chlorine, for example, lies in the circumstance, that naturally occurring chlorine is composed of a mixture of two isotopes, one with atomic weight very nearly 35, the other with atomic weight about 37, in a ratio of approximately 3 to 1.

Comparing the atomic weights of the *isotopes* with one another, instead of those of the *elements,* the large divergences from whole-number ratios disappeared and a remarkable new set of relationships came into focus.

The relationships of the isotope values stick out most clearly, when they are referenced not to hydrogen, but to a certain specific isotope of carbon (nowadays denoted C-12). When we set as unit 1/12 the atomic weight of carbon-12, then the numerical values of the atomic weights of the known isotopes turn out, without exception, to be within a tenth of so, at most, from a whole number. In most cases the deviation is even much smaller (See Table).

Thus, each isotope can be unambiguously associated with a certain whole number, nowadays called its "mass number," which very nearly coincides with its atomic weight.

Hydrogen, for example has naturally occurring isotopes, of mass numbers 1, 2; oxygen has three: 16, 17, 18; calcium has six of them: 40, 42, 43, 44, 46, 48; tin has ten: 112, 114, 115, 116, 117, 118, 119, 120, 122, 124, and so on. It was natural to expect, that where gaps existed in the series of mass numbers, as between calcium-44 and calcium-46 for example, an additional calcium isotope with mass number 45 should exist, and probably an *unstable one*—as that would explain its apparent rarity in nature. Indeed, as accelerators, and later, nuclear reactors began to produce large quantities of new isotopes, many of those "holes" in the series of isotopes were filled, and the existing series extended upwards and downwards. There could hardly be a doubt, that the isotopes of one and the same element are naturally ordered in the manner of successive whole numbers.

But then a new set of questions arises: Why are some isotopes stable and others not? Why do the gaps tend to occur most often at *odd-number* locations? What is the reason that some elements have many isotopes, others very few, or even only one? What is the reason for certain patterns in the relative abundances of different elements in Nature, which have no obvious relationship to the periodicities of Mendeleyev's table?

In the meantime, investigations of the X-ray spectra of chemical elements provided a new physical foundation for Mendeleyev's ordering of the elements themselves, independent of the atomic weights: The array of X-ray spectral frequencies of a given chemical element, change stepwise in completely regular and systematic fashion, as we go from one element to its successor in the periodic system (see Figure 1). It became possible to predict the X-ray spectra of yet-unknown elements, and to identify and discover them, even in extremely small concentrations, through their telltale X-ray "signature." But the X-ray spectra of isotopes of a given element, are nearly exactly identical, like their chemical behavior.

ATOMIC WEIGHTS AND ISOTOPIC COMPOSITION FOR SELECTED ELEMENTS

Isotope			Relative Atomic Mass	Isotopic Composition
1	H	1	1.007 825 032 1(4)	99.9885(70)
	D	2	2.014 101 778 0(4)	0.0115(70)
	T	3	3.016 049 2675(11)	
2	He	3	3.016 029 309 7(9)	0.000 137(3)
		4	4.002 603 2497(10)	99.999 863(3)
3	Li	6	6.015 122 3(5)	7.59(4)
		7	7.016 004 0(5)	92.41(4)
4	Be	9	9.012 182 1(4)	100
5	B	10	10.012 937 0(4)	19.9(7)
		11	11.009 305 5(5)	80.1(7)
6	C	12	12.000 000 0(0)	98.93(8)
		13	13.003 354 8378(10)	1.07(8)
		14	14.003 241 988(4)	
7	N	14	14.003 074 005 2(9)	99.632(7)15
		15	15.000 108 898 4(9)	0.368(7)
8	O	16	15.994 914 6221(15)	99.757(16)
		17	16.999 131 50(22)	0.038(1)
		18	17.999 160 4(9)	0.205(14)
9	F	19	18.998 403 20(7)	100
10	Ne	20	19.992 440 1759(20)	90.48(3)
		21	20.993 846 74(4)	0.27(1)
		22	21.991 385 51(23)	9.25(3)
11	Na	23	22.989 769 67(23)	100
12	Mg	24	23.985 041 90(20)	78.99(4)
		25	24.985 837 02(20)	10.00(1)
		26	25.982 593 04(21)	11.01(3)

This table shows the relative atomic mass and relative abundance of isotopes of the 12 lightest elements.

Source: International Union of Pure and Applied Chemistry, 1997, http://www.iupac.org/reports/1998/7001rosman/iso.pdf

Isotopes and Gaussian Complex Numbers

Thus, atoms in our universe appeared to have a twofold nature:

First, their identity as chemical elements, reflected in their

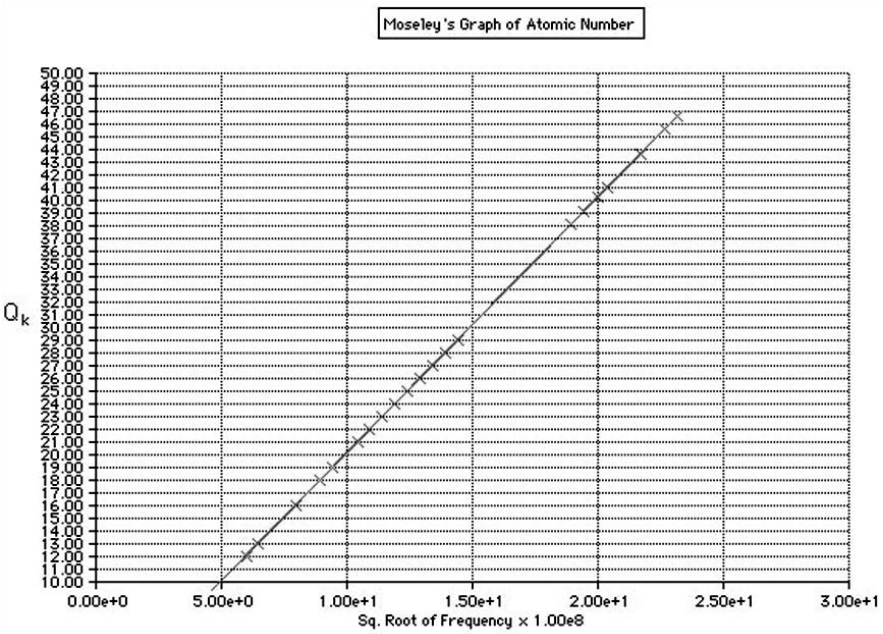

Figure 1
HIGH FREQUENCY SPECTRA OF THE ELEMENTS

British spectroscopist H.G.J. Moseley published this graph of the spectra of the elements in 1913. He arranged the spectra of the elements on horizontal lines spaced at equal distances, ordering the elements according to atomic weight (with a few exceptions). This revealed the simple proportionality between the atomic number (or ordinal number) of elements in the periodic table (vertical axis), and the square roots of the main frequencies of emission (emission lines) of X-rays by atoms of those elements (horizontal axis), when excited by electrons (cathode rays).

"This is equivalent to assigning to successive elements a series of successive characteristic integers," Moseley wrote. ". . .This proceeding is justified by the fact that it introduces perfect regularity into the X-rays spectra. . . . We can therefore conclude from the evidence of the X-ray spectra alone, without using any theory of atomic structure, that these integers are really characteristic of the elements."

Source: H.G.J. Moseley, M.A., "The High Frequency Spectra of the Elements," *Phil. Mag.* (1913), p. 1024. See http://dbhs.wvusd.k12.ca.us/webdocs/Chem-History/Moseley-article.html.

affinities for other elements, with which they form chemical compounds; in the types of crystals they form, alone or in combination with other elements; in the conditions under which they take solid, liquid, or gaseous forms, and so forth; and in their optical and X-ray spectra.

Second, their "new" identity as isotopes, in the context of all the discoveries we have just summarized, which form the main starting point for the domain called "nuclear physics."

Finally, these two aspects must be intimately connected with each other, in ways that are not yet adequately understood.

Much is left to be done, but we know that the emergence of nuclear physics, in the process we have just sketched, exemplifies the form of progression of

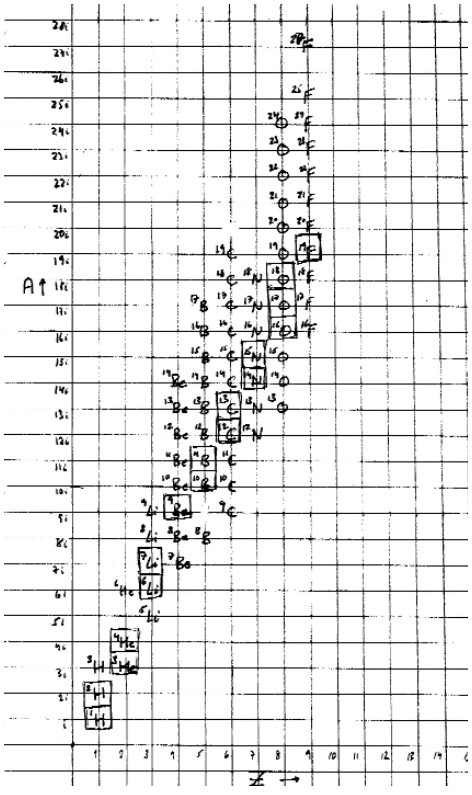

Figure 2
COMPLEX MAPPING OF THE ISOTOPES

The isotopes can be ordered by associating each with a Gaussian complex whole number. The atomic number of the isotope according to Mendeleyev's periodic system is mapped on the horizontal axis (the "real axis"), and the mass number is mapped on the vertical axis, the "imaginary part." This locates the isotopes of an element on lines parallel to the vertical axis, at heights corresponding to the whole number closest to its atomic weight. This lays a preliminary basis for the real work of discovering the physical principles underlying the existence and transformations of the isotopes and the relationship between the chemical and nuclear processes. The tiny discrepancies between the physical values of the atomic weights, and the integers of the mass number are key.

Note that this representation differs from the more common one, which chooses for the vertical coordinate the excess of mass number over atomic number, usually referred to as the neutron number, rather than simply the mass number used here.

human knowledge that Bernhard Riemann described in his famous paper "On the Hypotheses Underlying Geometry": the generation of a higher-order manifold of human practice out of a lower-order one, by the integration of an additional newly discovered physical principle.

How, then, should we now represent the emerging *system of isotopes?* The most straightforward approach, given the fact of the emergence of a new "dimensionality" in Riemann's sense, is that originally employed by Carl Gauss in his treatment of biquadratic residues.[32] To map out the combined effect of two different ordering principles, Gauss extended the ordinary number domain by introducing the so-called *imaginary complex whole numbers.* Gauss's system of complex whole numbers can be represented visually as the system of lattice-points in a plane, where the horizontal, so-called "real axis" represents the mode of displacement corresponding to the ordinary whole numbers, and the vertical so-called "imaginary axis" represents displacement according to the new principle. The relationship between the two principles of displacement, defines a third principle.

Apply this now to the ordering of the isotopes! Think of each isotope as being associated with a complex whole number—i.e., in the geometrical representation, by a specific locus in the lattice—in the following manner. The component of the isotope along the horizontal, "real axis," should be the ordinal number of the corresponding element in Mendeleyev's original periodic system, otherwise known as its atomic number. The "imaginary part," i.e., its component in the vertical direction, should be its mass number. Thus, the isotopes of a given element are located on lines parallel to the vertical axis, at heights corresponding to their atomic weights, or rather to the whole-number closest to them (Figure 2).

To put it more schematically: The isotope of an element of atomic number Z, and having mass number M, corresponds to the Gaussian complex number Z + iM.

Merely mapping the isotopes by complex ordinal numbers only lays a preliminary basis for the real work, which is to discover the *physical principles* underlying the existence and transformations of the isotopes, and the relationship between the "chemical" and "nuclear" processes.

A crucial clue lies in the pattern of *tiny discrepancies* between the actual, physical values of the atomic weights, on the one side, and the integer mass numbers used in our mapping, on the other. It is exactly in those tiny discrepancies, that the whole potential of nuclear power resides! They are analogous to the tiny differences between the observed motion of Mars, from that predicted on the assumption of uniform circular motion of the planets, which permitted Kepler to discover the principle of universal gravitation.

What, for example, is the relationship between the atomic weights of two atoms, and that of an atom that might, hypothetically, be formed by some sort of fusion of the two?

One of the simplest cases, would be to combine two atoms of the *hydrogen* isotope of ordinal number 1 + 2i (called deuterium), to get an atom of the *helium* isotope 2 + 4i (the most common form of helium, helium-4). Here, the complex ordinal numbers add up algebraically. But what about the actual atomic weights?

The atomic weight of deuterium, from actual measurement, is 2.014102 mass units, the double of which is 4.028204. The measured atomic weight of an atom of helium-4, on the other hand, is 4.002603, which is slightly *smaller* than the former value, by 0.025601 mass units, or about 0.6 percent. What might follow from the observation, that a helium-4 atom is 0.6 percent lighter than two deuterium atoms, taken separately? If it were possible for the deuterium atoms to reorganize themselves into a helium atom, the result would involve a *net decrease in mass.*

In fact, the *fusion* of isotopes of hydrogen to form helium is believed to be the main power source of the Sun. The main reactions, that take the form of a chain starting with ordinary hydrogen rather than deuterium, appear to be more complicated than our hypothetical one, but they share the common characteristic: At the end, the atomic weight of the end-product(s) is *less* than that of the reactants. What is the significance of that?

To the best of our present knowledge, Einstein's general answer is correct, namely, that the rate of generation of "missing mass" is proportional to power output of the star. We cannot directly measure the slow loss of mass of the Sun, for example, but we can observe the same sort of proportional relationship quite directly in countless radioactive processes and nuclear reactions. That also holds for nuclear fission, where the sum of masses of the fragments, generated by the fission of a uranium nucleus, is very slightly, but measurably, smaller than the mass of the original nucleus. More precisely, the "missing" mass amounts to 0.087 percent of the mass of the uranium nucleus.

It seems, therefore, to be those tiny discrepancies in terms of atomic weights, that hold the key to the Sun's power to maintain our biosphere, and to our own power to maintain the world population on the basis of nuclear energy in the coming period. And yet, as Kepler confronted the anomaly of slight "errors" in the predicted positions of Mars, relative to the reductionist calculations of Ptolemy, Tycho Brahe, and Copernicus—errors reflecting the existence of a higher principle that he later identified as universal gravitation—so today, a conceptual leap is required, to discover the principles of a new nuclear physics.

I will just note, in conclusion, that the magnetic characteristics of an isotope could be considered as, in a sense, the "imaginary" component of the value of the mass function for the corresponding complex ordinal. By including the additional dimension of nuclear isomers (so-called excited states of nuclei, which have changed magnetic characteristics), we can construct a more comprehensive Riemann surface function for the principles in question.

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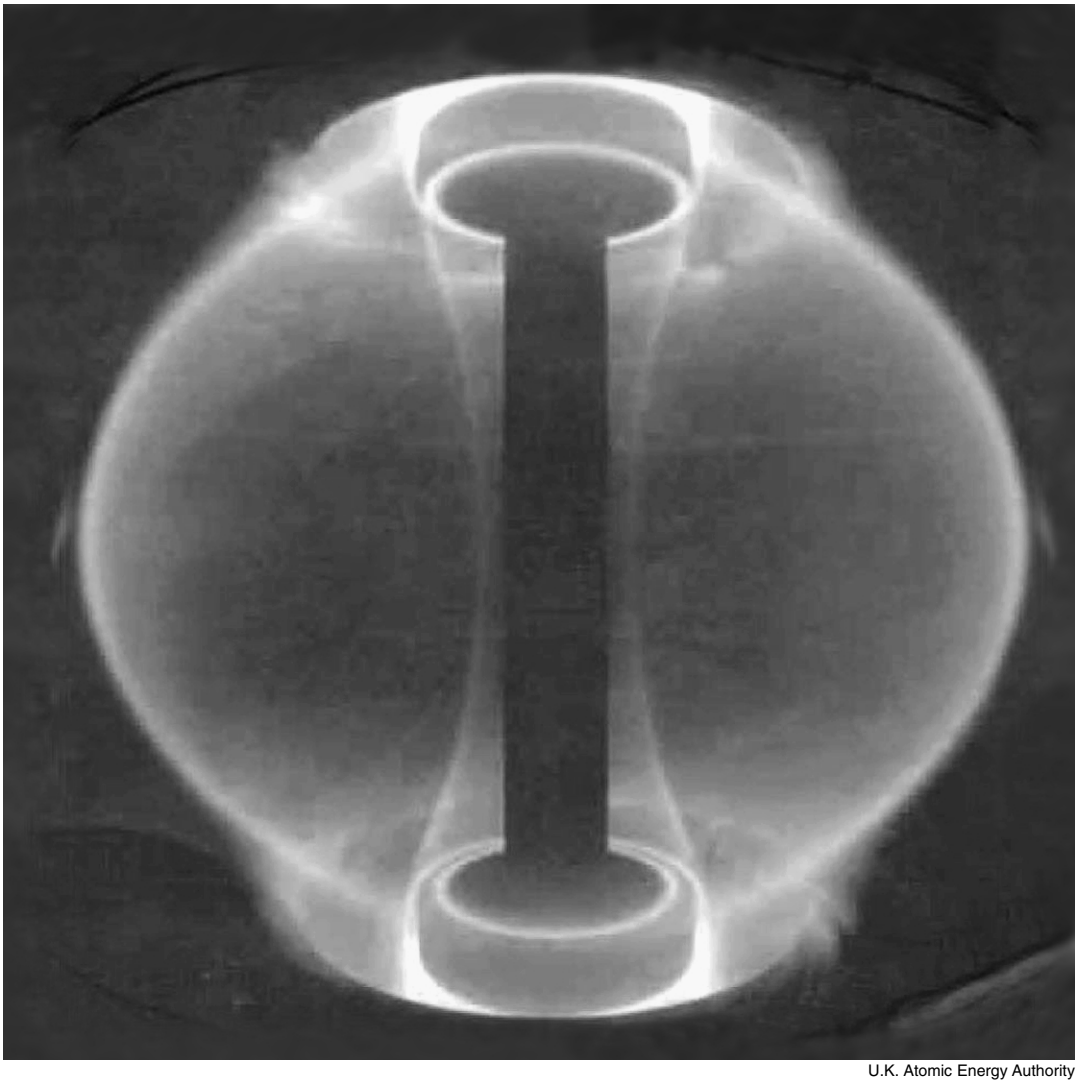
32. See Carl Gauss, "The Metaphysics of Complex Numbers," translated from *Gauss Werke,* Vol. 2, pp. 171-178, by Jonathan Tennenbaum in *21st Century,* Spring 1990. Also see "Carl Gauss's Fundamental Theorem of Algebra: His Declaration of Independence" by Bruce Director, *Fidelio,* Summer-Fall 2002, on http://www.schillerinstitute.org/educ/pedagogy/gauss fund bmd0402.html.

THE FUSION TORCH

Creating New Raw Materials For the 21st Century

by Marjorie Mazel Hecht

The fusion torch (or its lower temperature version, the plasma torch) can create new mineral resources from ordinary dirt and rock, and get rid of waste by reducing it to its constituent elements.



U.K. Atomic Energy Authority

A high temperature fusion plasma in a fusion torch could turn trash into valuable new resources. The plasma discharge shown here is the European spherical tokamak fusion device, MAST, in Culham, England.

How soon the world might run out of necessary resources and raw materials, from drinkable water to strategic minerals, should be no cause for panic, rationing, or calls for population control. We have the ability now to *create* the resources we need, using advanced technology. Conventional nuclear reactors can provide the energy to desalinate seawater, and high-temperature nuclear reactors can efficiently create hydrogen to replace petroleum fuel. The even higher temperatures available from thermonuclear fusion will provide working plasmas that can reduce garbage and waste down to its constituent elements, eliminating disposal problems; these high-temperature plasmas will also be able to "mine" strategic minerals directly from ordinary rock.

This new kind of fusion torch mining will dramatically change the relationship of man to the Earth's crust. To get an idea of what this means, think about the estimate that 1 cubic mile of ordinary rock can provide nearly 200 times the amount of annual U.S. aluminum production, 8 times the iron, 100 times the tin, and 6 times the zinc. Although it will still be necessary to find the richest possible ores for present uses, this new technology will allow us to efficiently exploit less rich ores. Furthermore, the fusion torch combined with new isotope separation technologies will ensure that we are able to make full use of all 3,000 isotopes. There are truly no limits to growth, if we allow the full development of scientific ideas and plans that date back to the 1960s, when science, and the world's population were forced off the high road of progress, onto the low-technology road.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Garbage like this could be transformed into new resources.

The Power of Plasmas

Fusion plasmas are hot, ionized gases, at temperatures of 50 to 200 million degrees, so hot that any material can be manipulated at its atomic level. (Ionization means that the electrons have been stripped from the atom, leaving it with an electrical charge.) Forty years ago, when the idea for a fusion torch was patented, scientific optimism prevailed, and the development of fusion reactors was assumed as a natural follow-on to nuclear fission. Many devices and processes for fusion were being investigated (tokamaks, stellarators, the Elmo Bumpy Torus, the z-pinch, just to name a few), and there was an excitement about the possibilities, similar to the enthusiasm about exploring the Solar System.

The development of fission and fusion was aborted, beginning in the 1970s, by an anti-science ideology (and its accompanying budget cuts) introduced into America to turn the population, and especially the younger generation, away from the idea of progress. Precisely because of the promise of both fission and fusion to transform the living standard of the entire world, and lift the Third World out of disease and poverty into prosperity, these technologies were attacked and almost buried in the same United States that developed them.

In 2006, as nuclear power begins a worldwide renaissance, it's time also to launch a "rebirth" of thermonuclear fusion in the general population. The small-minded detractors of both technologies, and the inch-by-inch pragmatists willing to wait another 50 years, need a rude and sustained shake-up: This country wasn't built by people who said, "It's impossible," "It won't work because (fill in the blank) _____," "It costs too much," or "It will disturb Mother Nature." This article aims at beginning the shake-up of those who need it, and the beginning outline of education of those who want to know more.

Thermonuclear Fusion

In fission, the breaking apart of the heaviest elements (like uranium), a tremendous amount of heat energy is released. As a fuel, uranium is 3 million times more energy dense than coal, and 2.2 million times more energy dense than oil. But fusion of hydrogen isotopes is orders of magnitude more energy dense, and more challenging to harness as a power source (Table 1).

When two atoms of the lightest element, hydrogen, are fused, the process produces helium (the second-lightest ele-

Energy Density
(megawatts per square meter)

Solar—biomass	.0000001
Solar—Earth surface	.0002
Solar—near-Earth orbit	.001
Fossil	10.0
Fission	50.0 to 200.0
Fusion	trillions

ENERGY DENSITY FOR VARIOUS SOURCES
The highly concentrated nature of nuclear and fossil energy is startling in comparison to the diffuse nature of solar energy on the Earth's surface. Even when collectors are placed in near-Earth orbit, the energy density is still 4 to 5 orders of magnitude below that of fossil fuel.

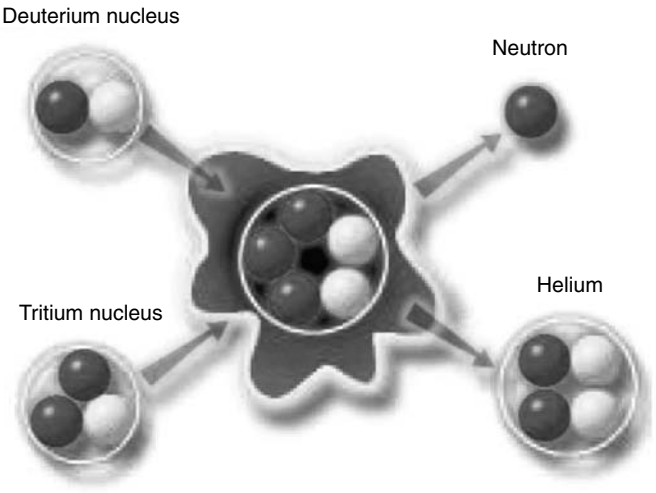


Figure 1
THE FUSION PROCESS

A fusion reaction takes place when two isotopes of hydrogen, deuterium and tritium, are combined to form a larger atom, releasing energy in the process. Fusion fuels the Sun and stars, but in the laboratory, atoms must be heated to at least 100 million degrees under sufficient pressure, to produce fusion. Other light elements can also be fused.

Source: "The Surprising Benefits of Creating a Star," U.S. Department of Energy, 2001.

ment) and "free" energy in the form of heat. For every two nuclei of hydrogen as fuel, there is one helium nucleus (called an alpha particle) produced and a specific amount of energy, which comes from the difference in mass between the input hydrogen and the output helium. (See Figure 1.)

Fusion is the process that goes on in the Sun and the stars, as the light elements collide at high speeds and high densities. The problem is how to replicate the process here on Earth. To fuse atoms in the laboratory requires very high, Sun-like temperatures—tens of millions of degrees celsius—and a means of containing and controlling the reaction, sustaining it at a steady rate over a long period of time.

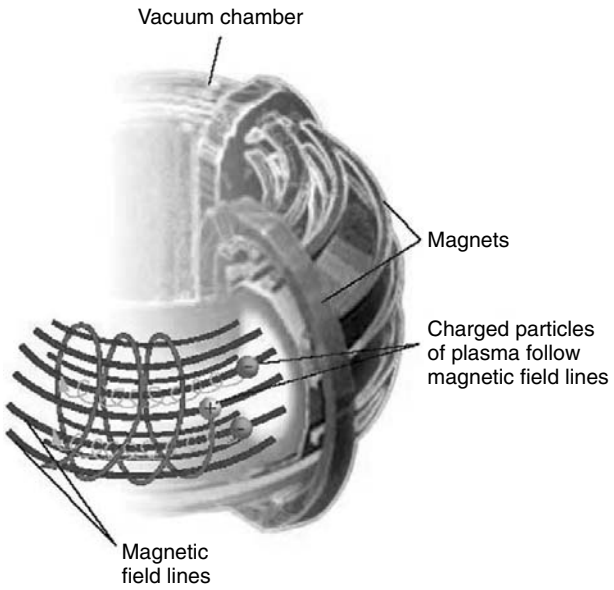


Figure 2
MAGNETIC CONFINEMENT FUSION

This diagram of a fusion tokamak shows the magnets, the magnetic field lines, and the charged particles of plasma that follow the magnetic field lines, spiralling around the tokamak. The magnetic fields "contain" the plasma.

Source: "The Surprising Benefits of Creating a Star," U.S. Department of Energy, 2001.

In both the Sun and the laboratory, ultra-high temperatures strip the negatively charged electrons from the nuclei, resulting in a highly charged gas, called a plasma. Plasma, called the fourth state of matter, is a more familiar word now, because of television screen technology. Plasma screens have two thin layers of glass, with the gases argon, neon, and xenon trapped inside; the atoms of the gas are excited to the plasma state by electric pulses, emitting color.

Since the 1950s, scientists have explored different ways of heating and confining hydrogen nuclei to fuse atoms of the heavier hydrogen isotopes of deuterium (H-2) and tritium (H-3). The ordinary hydrogen nucleus (H) has one proton, deuterium has one proton plus one neutron in its nucleus, and tritium has one proton plus two neutrons. Deuterium is found naturally in seawater, but tritium is rare, and has to be created by the decay of lithium.

The two basic methods to control fusion are known as magnetic confinement and inertial confinement.

Magnetic confinement. In this method, magnetic fields are used to "hold" the fusion plasma in place. The most common magnetic reactor device is called a tokamak, from the Russian words for toroidal (donut-shaped) chamber. The fusion plasma is contained using a strong magnetic field created by the combination of toroidal and poloidal magnetic fields (the first refers to the long way round the torus, and the other, the short way). The resulting magnetic field forces the fusion particles to take spiral paths around the field lines (Figure 2). This prevents them from hitting the walls of the reactor vessel, which would cool the plasma and inhibit the reaction.

Just as in fission, where the speed and density of fissioning atoms, and the most favorable isotopes had to be carefully determined and engineered, to create the optimal conditions for a chain reaction, so in fusion, researchers had to figure out

the most favorable hydrogen density and other conditions to produce fusion. Here is where the fun came in, designing different apparatuses to test hypotheses about sustaining and controlling a fusion plasma.

There are many tokamak research reactors around the world, including some small ones in the United States, and there was a succession of increasingly larger tokamaks at the Princeton Plasma Physics Laboratory. This increasing capability would have continued, if not for the budget cuts described below. Each successive reactor achieved higher temperatures and longer confinement times. Each reactor also made progress in solving the technical difficulties, such as heating, turbulence, and radiation (Figure 3).

The largest current device is an internationally sponsored tokamak, ITER (pronounced "eater"), to be built in Cadarache, France, with the aim of producing breakeven fusion power; that is, outputting more power than that required to create the fusion on a steady basis. The sponsors are the European Union, Japan, the Russian Federation, Korea, China, India, and the United States. The ITER's goal is to produce 500 megawatts of fusion power sustained for up to 500 seconds. ITER's predecessor, JET, the Joint European Torus) produced only 16 megawatts for less than a second.

ITER will produce net power as heat, but the heat will not be used to generate any electricity. Ned R. Sauthoff, project manager for the U.S. participation in ITER, estimates that ITER will be operating by 2016, and that commercial plants will fol-

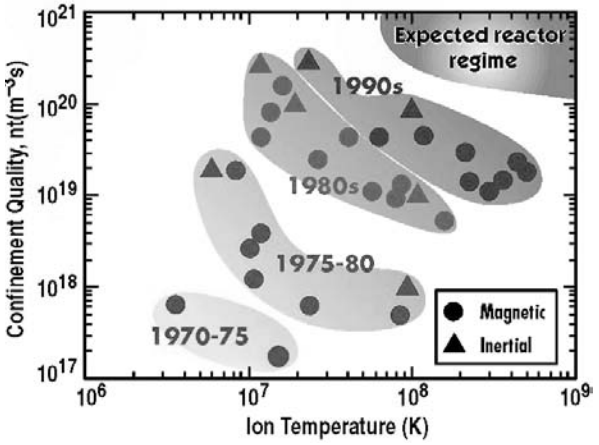
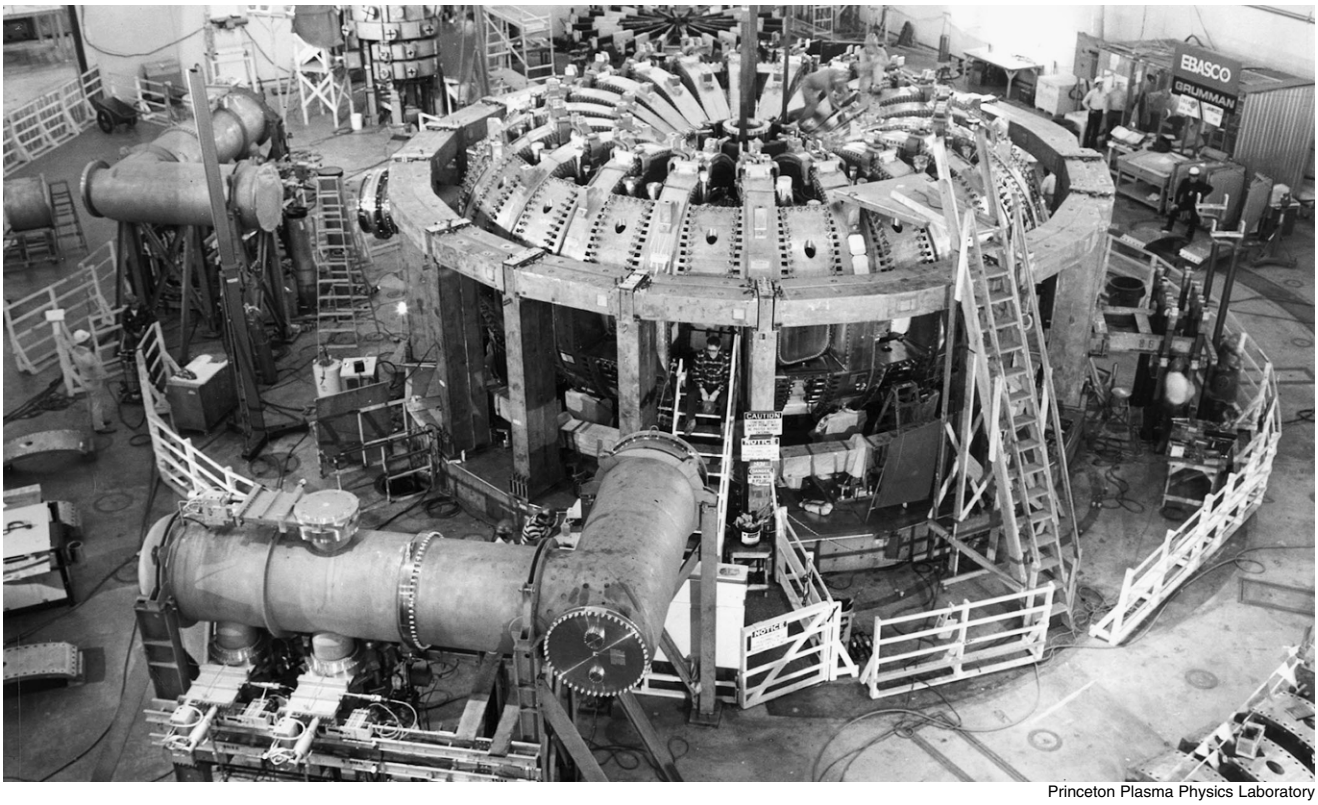


Figure 3
FUSION PROGRESS 1970-2000
Even though the fusion program was forced out of engineering and into science research, there has been steady progress in magnetic and inertial fusion, decade by decade, in the quality of confinement of the plasma (measured in plasma density times time of confinement) as a function of plasma temperature (degrees K). The conditions for reactor quality plasma are at the top right.



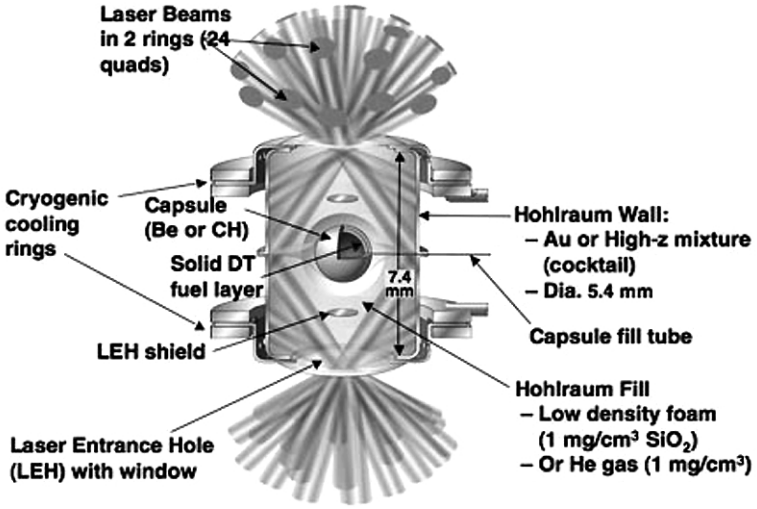
Princeton Plasma Physics Laboratory

The TFTR tokamak at the Princeton Plasma Physics Laboratory in December 1982. The follow-on research tokamaks planned in the Princeton program were not built. In a recent interview, fusion torch inventor Ben Eastlund said that he had proposed small tokamaks as the plasma supply for his fusion torch.

Figure 4
INERTIAL CONFINEMENT

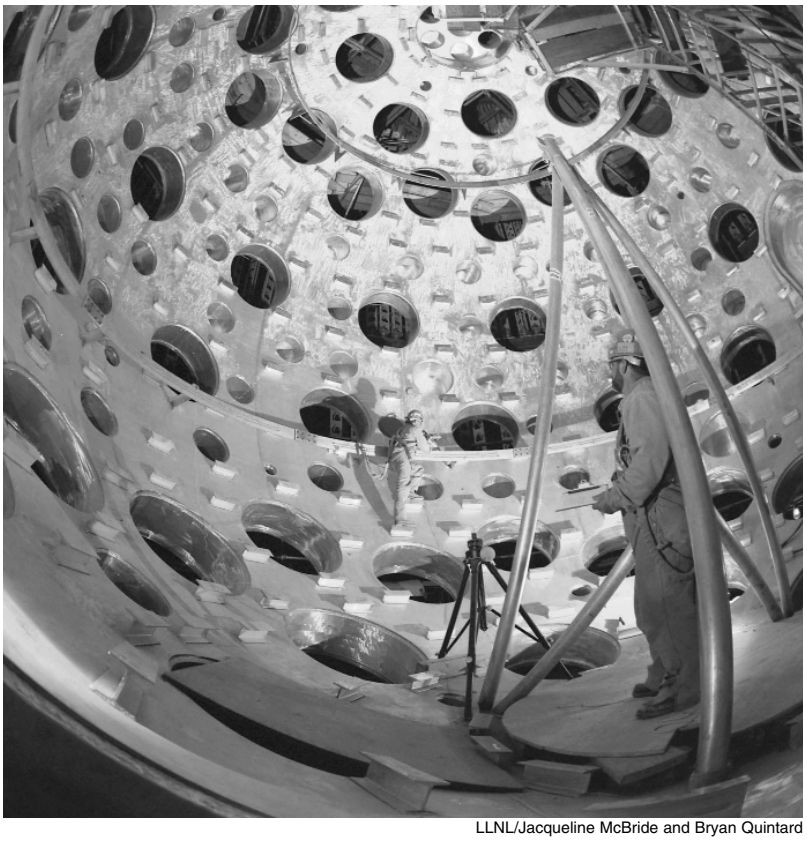
This schematic of the National Ignition Facility shows the array of laser beams focussed on the tiny pellet of fusion fuel (deuterium and tritium) encapsulated in beryllium and carbide. The laser beams compress and heat the fuel pellet in a billionth of a second, so that the deuterium and tritium fuse before the pellet flies apart. The term "inertial" refers to the fact that the atoms must have enough inertia to resist flying apart before they combine.

Source: Lawrence Livermore National Laboratory.



low by 2050. A commercial power plant would generate about 3,000 to 4,000 megawatts of thermal power.

Inertial confinement. In inertial confinement, also known as laser fusion, lasers or electron beams are focussed on a small pellet of fusion fuel, igniting it in a tiny controlled fusion explosion (Figure 4). In contrast, in the hydrogen bomb, fission is used to ignite fusion fuel in an *uncontrolled* fusion reaction. The term "inertial" refers to the fact that the atoms in the target have to use their own inertia not to fly apart before they can fuse.



LLNL/Jacqueline McBride and Bryan Quintard

Inside the target chamber of the National Ignition Facility at Lawrence Livermore National Laboratory. The fusion fuel target is tiny, but the chamber is 30 feet in diameter and weighs 1 million pounds.

The basic idea is to rapidly heat the surface of the target so that it is surrounded by a hot plasma. Then as the hot surface material "blows off" like a rocket, the fuel is compressed. The target fuel core becomes extremely dense, and then ignites when it reaches 100 million degrees celsius. As it "burns," it produces many times more energy than the input beam energy.

The United States has a large laser fusion facility at the Lawrence Livermore National Laboratory, the NIF or National Ignition Facility. Other inertial confinement laser programs are the OMEGA laser at the University of Rochester's Laboratory for Laser Energetics), the Nike at the Naval Research Laboratory, and the Trident at Los Alamos National Laboratory. There is also a Particle Beam Fusion Accelerator and the Saturn pulsed-power facility at Sandia National Laboratories.

All the inertial confinement programs provide support for the National Nuclear Security Administration of the Department of Energy and other defense programs related to nuclear weapons, as well as civilian energy and basic scientific goals. The weapons aspect makes them a target for anti-nuclear groups, who want to shut down the weapons program and anything else that has to do with nuclear, including fusion energy. The NIF also has university and industry collaboration.

NIF is the largest laser in the world, the size

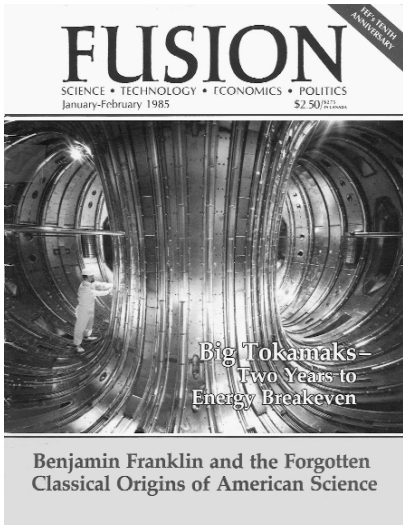
of a football stadium, and very powerful. The laser system equals 1,000 times the entire U.S. electric-generating power. Each pulse is very short, just a few billionths of a second, directed at a tiny target, 1 millimeter—the size of a BB-gun pellet. The experiments involve directing this powerful beam for just a fraction of a second at the target, and then studying the results.

What Happened to Fusion

The last 25 years of fusion research in the United States is a sad story; the fusion program became a victim of such severe budget cuts, that no engineering progress could be achieved, just research in scientific problem-solving. Yet, in 1980, fusion research had been progressing so well, with a wide variety of fusion devices, that both houses of Congress passed the Magnetic Fusion Energy Engineering Act of 1980, which mandated, in the spirit of the Apollo Program, that the United States accelerate the current magnetic fusion program (1) to put on line an engineering device by the year 1990, and (2) to put on line a demonstration reactor by the turn of the century.

The Act, Public Law 96-386, was signed into law on Oct. 7, 1980, by President Carter. The Act's purpose was: "To provide for an accelerated program of research and development of magnetic fusion energy technologies leading to the construction and successful operation of a magnetic fusion demonstration plant in the United States before the end of the twentieth century to be carried out by the Department of Energy."

The Act specified how this was to be done, and the required funding: a doubling of the 1980 magnetic fusion budget in the next seven years, starting with a 25 percent funding increase in the fiscal years 1982 and 1983.



Fusion *magazine made "fusion energy" a household word in the late 1970s and early 1980s. Here, Rep. Mike McCormack, a Washington state Democrat, addresses a Fusion Energy Foundation conference in Washington, D.C. in May 1981. The Magnetic Fusion Energy Engineering Act, which became law in 1980, was called the McCormack bill, in honor of its tireless champion.*

The Fusion Energy Foundation, launched by Lyndon LaRouche, Jr., in November 1974, was in the middle of the fight for fusion, and the Foundation's magazine, *Fusion,* which had a circulation of nearly 200,000, made "fusion" a household word in the years before the successful passage of the Fusion Act. It provided the public with an understanding of the science of fusion and of the experimental progress with different species of fusion devices.

But, the funds specified in the Fusion Act were never allocated under the Reagan Administration. The Act remained on the books, but the Department of Energy relegated fusion to be a "science research" program only, not the engineering program specified in the legislation. Like the Apollo program, fusion drew the wrath of those who said it would cost too much—with no regard for the boon to future generations of perfecting a high-temperature power source whose fuel was obtained from seawater, and which had no waste products. These critics—including, since 1989, many "cold fusion" researchers, whose research is also not funded—then complained that fusion research had gotten *X* amount of money for years, without producing commercial fusion, so why bother putting more money into a "sinkhole."

The overall problem is a profound ignorance of how a physical economy works, and, for a healthy economy, what percentage of public funds should be invested in the scientific research to be a "driver" for the rest of the economy. Without such science drivers, the economy runs into a dead end. As the United States sank further into "services" instead of production, and chiseled and "privatized" the research programs of its national laboratories, universities, and other institutions, the nation largely lost the ability to discover new scientific principles, and educate new generations of students who could move the country forward.

Without a reversal of these anti-science, anti-prosperity policies, this country will collapse into Third World status, having to import technologies perfected elsewhere. We need a crash program to regain what we lost, and ensure that we implement the thrust of the 1980 Magnetic Fusion Energy Engineering Act in the next 25 years.

The scientific shortsightedness of cutting the fusion budget was magnified in 1999, when the United States decided not to fund its part of the international collaborative fusion effort,

ITER, leaving the project to Europe, Russia, Japan, and other nations. (This decision was reversed in 2003, and the United States is now participating in ITER.) Where we stand today in fusion, is having a handful of U.S. research reactors, all inching along in national laboratories, universities, and at one private company (General Atomics), with a small core of experienced fusion scientists and a small number of younger students.

Creating a fusion reactor for a fusion economy is an example of a great project, planning for 50 years ahead, when most of the initial participants will no longer be alive. But what better inspiration for the younger generations, to work on perfecting a virtually unlimited energy source—instead of dung power.

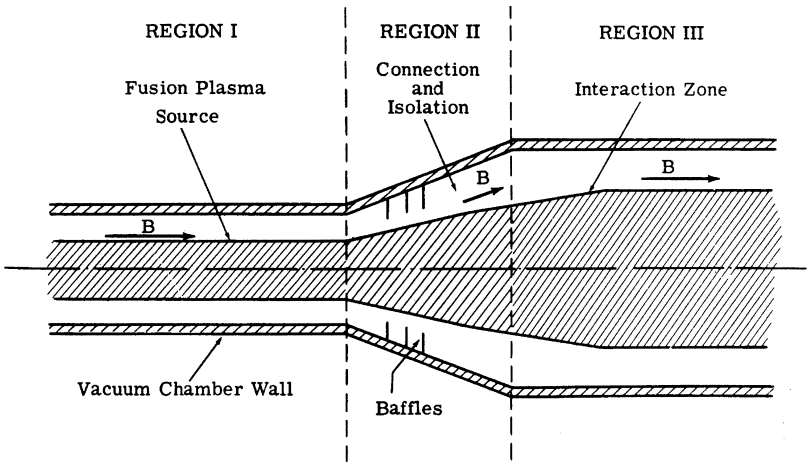


Figure 5 (a)
SCHEMATIC OF A FUSION TORCH

In this suggested configuration for a fusion torch, the plasma is generated in the first region, and is transferred through the second region, into the interaction zone where the plasma processing takes place. Region II is conceived as using just a part of the plasma produced in the fusion device, which is siphoned off and fed into the torch by adjusting the shape and intensity of the magnetic field.

Source: Bernard J. Eastlund and William C. Gough, "The Fusion Torch: Closing the Cycle from Use to Reuse," Washington, D.C. : U.S. Atomic Energy Commission, May 15, 1969 (WASH-1132).

The Fusion Torch Viewed Historically

The history of man's development on Earth can be measured most accurately by the basic concept of physical economy developed by Lyndon LaRouche: the rate of change of relative potential population density. How can human society sustain an increasing number of people per square kilometer of settled land area. The key here is the mastery of increasingly more complex technologies that allow a population to thrive, beyond the limits of the natural conditions of climate and geography. To do this, individuals have to increasingly *create* new resources, particularly energy resources, and more and more energy-dense technologies, in order for the entire society to thrive. In this way, the former limits to growth of the society are overcome.

The increase in the energy-flux density of available technologies is directly related to population growth. At some point in human history, there was no ore, because there was no energy available to turn minerals into anything other than the dirt and rock we found them in (except for the use of crude tools to fashion other crude but useful objects). The introduction of fire and the elaboration of its uses changed that situation, providing a multifold increase in energy density for smelting, turning zinc and copper into bronze, for example. Thousands of years later, another "rock," uranium, became a powerful energy source.

With each advance in energy technology—wood, coal, oil, gas, uranium, there was a dramatic increase in human population, as man made use of increasingly energy dense technologies. (See Table, page 39.) We indeed turned rocks, dirt, and other substances into energy resources. Ahead of us now lies fusion, created from a fuel of seawater, a trillion times more energy dense than its predecessors; and beyond that, who knows? Matter/anti-matter interactions? Or perhaps something else that will force more "laws of physics" into well-deserved retirement.

The fusion torch is no surprise, then, when looked at as a link in this chain of events.

In May 1969, two researchers with the U.S. Atomic Energy Commission, Bernard J. Eastlund and William C. Gough, published a booklet, *The Fusion Torch: Closing the Cycle from Use to Reuse,* which described two uses for the ultra-high temperature plasmas that were expected to be achieved with commercial fusion reactors. The first was a fusion torch that would use the high-temperature plasma "to reduce *any* material to its basic elements for separation." The second was "the use of the fusion torch to transform the energy in the ultra-high temperature plasma into a radiation field, to permit process heating to be done *in the body* of a fluid." For example, heavy elements would be added to the plasma so that it emits X-rays or other radiation in large quantities to do work without the limits of a surface that would absorb some of the energy.

Their idea, conceived in 1968, captured the imagination of many, including the national press, which reported on the fusion torch with headlines like "Space-Age Science Would Atomize Pollutant Wastes" (*Washington Post,* Nov. 26, 1969) and "Drowning in Waste? Vaporize It by Fusion!" (*New York Times,* March 15, 1970).

In the first application, the fusion reactor-produced plasma energy flux would be used for shock vaporization (the propagation of shock waves) and ionization of a solid, such as garbage or rock. Then, separation techniques would be used

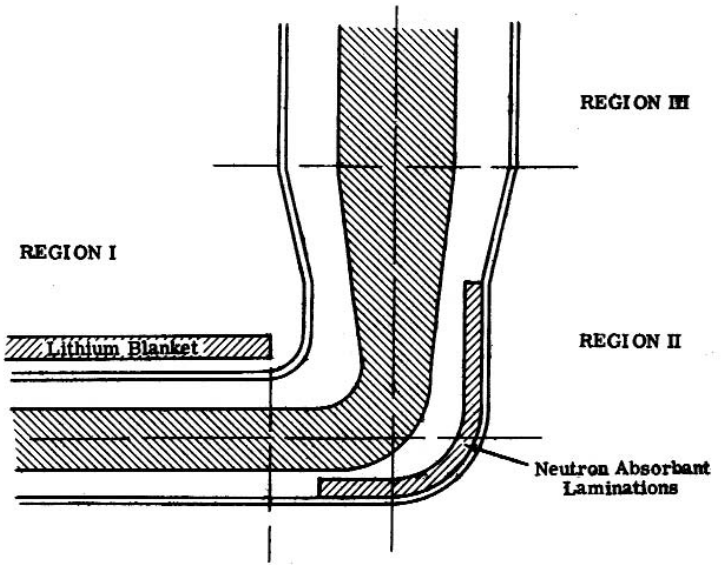


Figure 5 (b)
REFINING THE PLASMA FOR THE FUSION TORCH

A lithium blanket in Region I and neutron-absorbant laminations in Region II, remove any neutrons present before the working plasma gets to Region III of the fusion torch.

Source: Bernard J. Eastlund and William C. Gough, "The Fusion Torch: Closing the Cycle from Use to Reuse," Washington, D.C. : U.S. Atomic Energy Comission, May 15, 1969 (WASH-1132).

to "segregate the ionic species according to either atomic number or atomic mass." Eastlund and Gough noted that there were several possible separation techniques, including electromagnetic, quenching of the plasma flow, selective recombination, or charge exchange.

In the second application, trace amounts of chosen elements would be injected into the fusion torch plasma, allowing the control of the frequency and intensity of the radiation emitted. For example, the plasma could be made to output radiation in the ultraviolet range. Because ultraviolet radiation can be absorbed in water to a depth of about 1 meter, the ultraviolet radiation could then be absorbed into the working fluid, to sterilize or desalinate water in bulk, process sewage, or direct conversion to electricity (through fuel cells). This method eliminates the problem of having to transfer heat from a *surface* to the body of the fluid, which limits the process heating.

Making the Plasma Work

Eastlund and Gough present detailed ideas and mathematical equations in their 1969 paper concerning the atomic composition of the plasma, its flow velocity, and energy losses. Region II in the torch diagram (Figure 5a) is designed as the area where any neutrons produced by the fusion source (Region I), especially with the deuterium-tritium cycle of fusion, are isolated by trapping them in a lithium blanket (Figure 5b). The resulting working plasma in Region III, like the plasma throughout the fusion torch, would have its density, temperature, and flow velocity controlled by methods that were already researched in 1969.

In their 1971 paper, Eastlund and Gough present a schematic for fusion torch recycling of solid waste, which they say would fit "quite naturally into the overall scheme" of then-

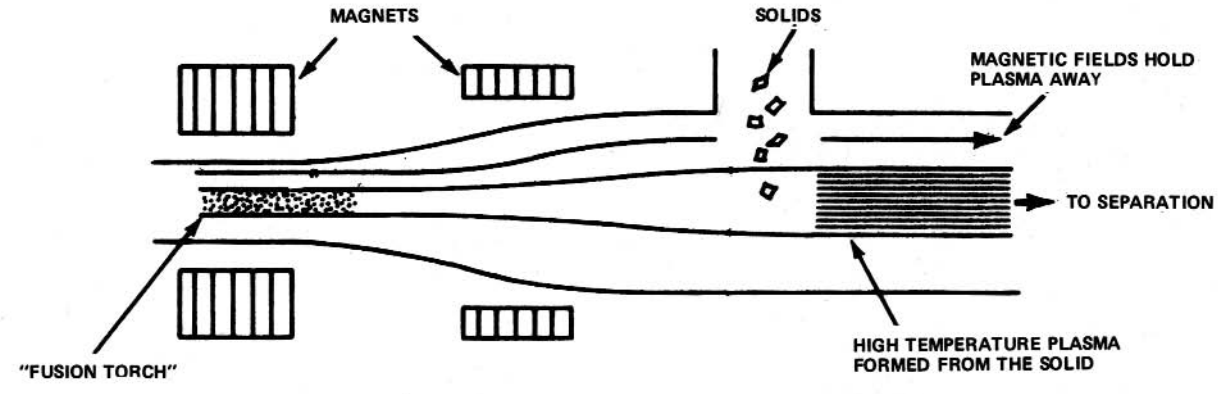


Figure 6
SCHEMATIC OF FUSION TORCH PROCESSING OF SOLID WASTE

In this suggested design for Region III of the fusion torch, the fusion plasma, controlled magnetically, flows over the injected waste solids, ionizing them, so that they can be separated out into their constituent elements.

Source: Bernard J. Eastlund and William C. Gough, "Energy, Waste, and the Fusion Torch," Washington, D.C. : U.S. Atomic Energy Comission, April 27, 1971.

planned solid waste treatment facilities (Figure 6). The solid wastes would be shredded, dried, and sorted, and then various combinations would be injected into the fusion torch plasma to be vaporized, dissociated, and ionized. The end products could then be separated out into specific elements for collection and recovery. The energy used to produce the plasma could also be recovered, in large part, because the system operates at such a high temperature.

The ionization of the solids occurs as the plasma energy is absorbed into the surface layer of the solid, producing a shock wave that vaporizes and ionizes it. This is possible only with an ultra-high temperature plasma, where the energy flux is greater than the shock speed in a solid and the energy needed to vaporize per unit volume. The resulting plasma that leaves Region III of the fusion torch would then be separated into constituent elements at lower temperatures.

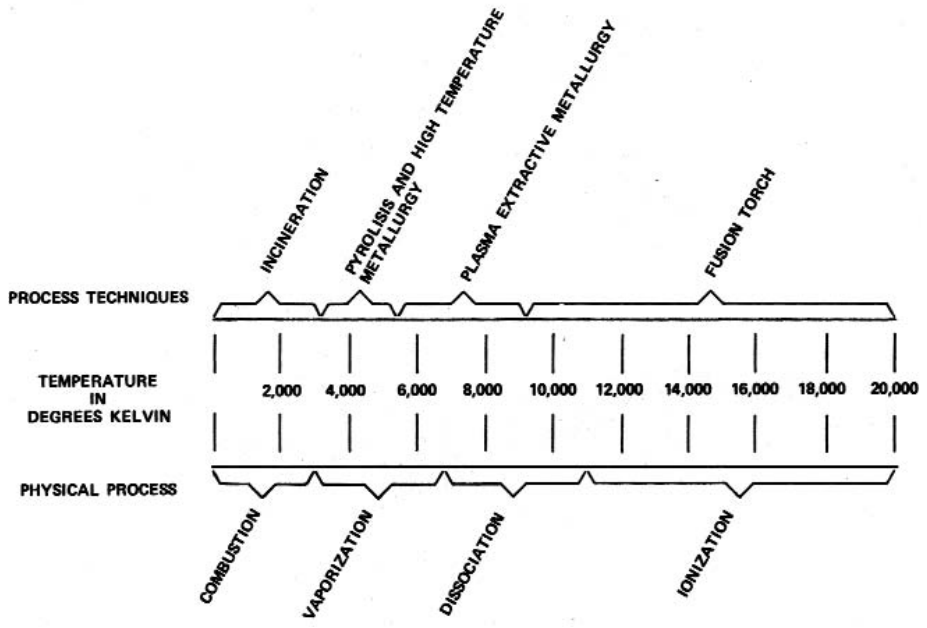


Figure 7
OPERATING TEMPERATURES FOR INCINERATION AND EXTRACTIVE TECHNIQUES

The fusion torch brings the temperatures available for processing thousands of degrees K above those for traditional methods of processing. With the fusion torch, ionization is possible, stripping the electrons from the atoms of whatever material is being processed.

Source: Bernard J. Eastlund and William C. Gough, "Energy, Waste, and the Fusion Torch," Washington, D.C. : U.S. Atomic Energy Comission, April 27, 1971.

Eastlund and Gough discuss several methods of separating the ionized solids into constituent elements, all of which could be handled in one recovery plant. Electromagnetic separation tops the list. In their 1969 paper, they note that the primary interest is in separating just a few elements with large mass differences. For example, reducing iron oxide ore (FeO_2) would require separation of iron (mass 56) from oxygen (mass 16). They note at the time that there had been advancement in plasma physics and beam handling, so that electromagnetic separation was more attractive as a technology.

Another separation technology noted, which Eastlund and Gough thought would have low capital cost and no energy, is quenching, rapidly cooling the plasma flow, by injecting a cooler gas, flowing the plasma over a cold surface, or expanding the plasma flow. This would work with ore reduction, especially high grade ore with impurities; recovery of elements from eutectics (low melting point combinations), alloys, and low-grade metal scrap; and the elimination of plastic and paper waste products. This method of recycling could be used, Eastlund and Gough said, with "modified plasma technology" already available in 1969.

Selective recombination is another separation technique, where the temperature and density of the plasma would maintain conditions that would allow some of the elements in the plasma to recombine on the walls of the torch chamber, while others were "piped away." This method is based on the ionization characteristics of the species involved.

A fourth technique suggested in the 1969 paper is charge exchange. In this method, a beam of a gas would be sprayed at the flowing plasma stream from the fusion torch, and an atom or molecule in the injected gas would replace a selected ion in the plasma. The desired combination would be collected on the wall of the torch chamber, while the rest of the material would be magnetically piped away.

The method of separation would also depend on the state into which the solid was transformed by the fusion torch. Eastlund and Gough list four different stages: (1) conversion of the solid into a gaseous state, (2) the complete dissociation of the molecules, (3) raising the temperature of the gas to the point that some of the elements are ionized, and (4) raising the temperature of the gas to the point that all the elements are ionized.

The ability to transform the waste solids into the above states selectively, makes it possible to use a combination of methods to most inexpensively reduce solid waste into its constituent elements. For example, the major heavier elements in solid refuse (aluminum, copper, magnesium, tin, iron, lead, etc.) could be ionized at a temperature of 10,000 K, and separated out, while the lighter elements (carbon,

oxygen, and hydrogen) could remain as neutral gases and handled chemically. Eastlund and Gough calculated that this partial ionization process would save 35,000 kw/h of energy.

Are there any problems in developing fusion and the ultra-high temperature plasma torch? Yes, of course there are. Plasmas are tricky to handle, a lot of energy is involved, new materials need to be developed. But these are the kinds of problems and challenges that can be solved—if one wants to solve them.

Where Do We Stand Today?

Gough and Eastlund conclude their 1969 report:

> Ultra-high temperature plasmas are available *now,* although at a cost in energy. Little thought has gone into their potential use for industrial applications, nor has much imaginative thought gone into taking full advantage of the unique properties of fusion plasmas that will be available in future controlled thermonuclear energy sources. While not attempting to minimize the large amount of research both on fusion itself and on fusion torch physics, it is entertaining to speculate on the vision this concept provides of the future—large cities, operated electrically by clean, safe fusion reactors that eliminate the city's waste products and generate the city's raw materials.
>
> The vision is there; its attainment does not appear to be blocked by nature. Its achievement will depend on the will and the desire of men to see that it is brought about.

So, where do we stand today? We don't have fusion yet, or the fusion torch. As Eastlund told the Fusion Energy Foundation back in 1975, the kind of research needed for developing the fusion torch was not going on. "What's required," he said, "is a commitment by a responsible funding agency to put some solid underpinning to the physics, chemistry, and technology" of fusion torch applications."

Thirty-five years later, the commitment to do this is still not there in the United States. But some of the technologies explored by Eastlund and Gough have been incorporated into lower temperature plasma torches that are now used in industry. Universities, the national laboratories, and many private companies have explored plasma processing, and make use of plasma torches. The plasmas are heated by microwaves or by passing a gas through an electric arc between two electrodes in a plasma generator. Figure 7 shows the operating temperatures for the fusion torch and conventional methods of materials processing.

The Russians and others have used a low-temperature plasma torch process to produce steel from scrap metal. The East Germans and Soviets developed the process in the late 1960s, and commercialized it in the 1970s. At the time, their direct current argon plasma torch method reduced the cost of steel production by $400 per ton, compared to conventional high-temperature electric arc furnaces. Also, it cut the noise level from 140 decibels to only 40 decibels. The argon plasma torch produced temperatures of 15,000° C, compared to maximum temperatures of 3,600°C for conventional furnaces using electricity for energy.

The Japanese have developed the Plasma Type Incinerated Ash Fusion System, with a demonstration plant in Chiba City to recycle incinerator ash and reduce solid waste.

Today, Ben Eastlund holds three patents for plasma processing techniques that could perform the tasks outlined in his 1969 article. Specifically, Eastlund has more recently proposed that his Fusion Torch/Large Volume Plasma Processor, or LVPP, be applied to the recycling of nuclear spent fuel from civilian nuclear plants and tank wastes left over from the Department of Energy weapons program. The LVPP would use an ultra-high temperature plasma to extract the radioactive components from bulk waste products using a "dry" process, as opposed to conventional technologies that use acids or molten metals, and a prototype could be in operation in two years. On his website (http://www.Eastlundscience.com), Eastlund writes:

> The Large Volume Plasma Processor can be used to separate the elements contained in the waste on an element-by-element basis. The non-radioactive elements can be released into the environment after ensuring there are no radioactive elements contained therein. The radioactive components would be recovered in a form suitable for conversion to industrial uses, severely reducing the volume of material slated for geological storage. Furthermore, because the 10,000,000 degree temperature of the LVPP can ionize any material, the uncharacterized nature of the material in the tanks does not present a problem.
>
> The LVPP could significantly reduce the financial risk of proceeding with cleanup of the Hanford tanks. The "wet chemistry" approach requires the construction of large facilities that need to be financed up-front. Years will pass before their operation can be assured as a success. Any problems, such as a leak, or explosion of a minor system could delay implementation and cost millions in clean-up payments. The LVPP, a relatively small system, immediately begins separating radioactive materials. The material is injected as a slurry, ionizes in 300 millionths of a second, and is separated in less than 25 milliseconds. Separated material can be removed as often as needed, continuously for many elements, to assure that there is never a dangerous inventory in the system. When the tanks have been cleaned, the LVPP can then be easily removed from the site. In fact, the tanks themselves might be processed by the LVPP.

The fusion torch, in the form of the LVPP or in other forms, has the promise of supplying the world with new resources and getting rid of our garbage and waste with no pollution. As Eastlund suggests just above, the fusion torch can even turn the radioactive waste containers into usable materials! What are we waiting for? Any true environmentalist who cares about the world should happily jump on the fusion torch bandwagon for 21st Century technologies, instead of crawling into the doom, gloom, and cold of the Stone Age.

CHINA IN SPACE

A Look at China's Ambitious Space Program

Artist's drawing of the lunar orbiter, to be launched next year in China's first deep space mission.

Chinese Academy of Space Technology

China is moving forward in space exploration—with or without the United States.

by Marsha Freeman

Throughout the 40 years of the Cold War, legions of space and military analysts in the West made a career of trying to figure out what the Soviet Union was up to in space. By the early 1990s, with the fall of the Soviet Union and the establishment of a space agency in Moscow, its civilian space programs became more transparent, obviating the need for much of the sleuthing, and creating new opportunities for international cooperation.

At about the same time, the attention of Western analysts shifted to scrutiny of China's space efforts. Like the former Soviet Union, China was carrying out its closely guarded space projects under the umbrella of the military. But China's space program became an increasing object of interest as there were indications it would be embarking on a project to put a man into space.

Although a nation can try to keep its space research and development projects secret, once a satellite is space-borne, it is visible to all. In 1999, with no prior announcement, the unmanned Shenzhou I spacecraft went into Earth orbit. Although it looked similar to the Russian manned workhorse, the Soyuz, which the Russians had earlier shared with China, differences were noted by analysts. It was clear that China was testing a spacecraft that it was developing on its own, which would, at some point, carry astronauts into space.

For the first time, Chinese space officials spoke publicly about the Shenzhou I mission while it was still under way, and the amount of information that was released to the media was almost as surprising as the mission itself. There were indications that China was opening up its space program to international eyes.

Speculation about what China was planning in space increased. China watchers, and "red scare" partisans on Capitol Hill, tried to make the case that China's space program was entirely vectored toward military technology and advantage, and that this was a security threat to the United States.

In an effort to make its intentions more transparent, therefore, in November 2000, China took an unprecedented step, and released, in English, a White Paper laying out its 20-year perspective for space development. After reviewing the accomplishments of China's space program and its plans for advances in weather, remote sensing, communications, and navigational satellites, the White Paper stated officially, for the first time, that "early in the 21st Century" China would become the third nation in the world to launch a man into space.

After four unmanned tests of its Shenzhou spacecraft, in October 2003, Chinese astronaut Yang Liwei entered Earth orbit and the history books. Two years later, a pair of astronauts extended the time in orbit and capabilities of China's manned space program.

For the next manned mission, planned for 2007, Chinese astronauts will leave their Shenzhou capsule to perform a space walk in orbit, a necessary step toward later rendezvous and docking with a space station. In April, China's Chang'e lunar orbiter will be launched, laying the basis for the manned exploration of the Moon at the end of the second decade of this century.

American space supporters, hoping that Chinese spectaculars will help galvanize American policy-makers into increasing support for underfunded U.S. space programs, impatiently complain that China is going "too slow." But China is clearly not in a "space

race" with the United States, or any other nation. When officials are asked when China will have a space station or send people to the Moon, the answer that is most likely is: "when we are ready." The reason is, that it is the *process* of developing space applications and technology, and the human and industrial resources, that is most important to China, not a particular goal.

Economic Development Strategy

On Oct. 21, 2006, the State Council of the People's Republic of China released a second English-language space policy report, of 10 pages, titled "China's Space Activities in 2006," "in order to give people around the world a better understanding of the development of China's space industry over the past five years, and its plans for the near future." Although manned flight is China's most high-profile space activity, it is not the program that garners the major level of government attention or support.

The year-2000 paper stated that "China's fundamental tasks are developing its economy and continuously pushing forward its modernization drive." One of the goals six years ago was an Earth-observation system for "long-term stable operation," including meteorological, land remote-sensing, ocean-sensing, and disaster-monitoring satellites. These programs are either well under way, or have been accomplished. As the recent paper reports, over the past five years, China has developed and launched 22 different types of Earth-orbiting satellites.

Courtesy of China Space News

Two Shenzhou astronauts, shown here in training.

Data from its remote sensing satellites are being applied to major state projects, the recent Space Activities paper reports, such as the South-North Water Diversion Project, the Three Gorges Dam Project, and the Project to Transmit Natural Gas from West to East.

By the end of 2005, China had more than 80 international and domestic telecommunications and broadcasting Earth stations, and 34 satellite broadcasting and television link stations, with the goal of giving "every village access to broadcasting and TV," and "to give every village access to telephones." A satellite-based distance-learning education network and a satellite-based telemedicine network have been established.

Six years ago, China stressed the need to accelerate the applications of space technology, by encouraging enterprises engaged in such work to help "renovate institutions and technology." This requires "spinning off" technology developed for space exploration into other industrial sectors, and the economy as a whole, "to meet a wide range of demands of economic construction, state security, and science and technology development and social progress."

In its recent paper, China reports that over the next five years, it will "accelerate the industrialization of space activities," in order to "upgrade traditional industries," or what is generally described as technology transfer. In order to do this, the paper states, China will put emphasis on "sparing no efforts for the education and cultivation" of young people. The government plans to "encourage people from all walks of life to participate in space-related activities."

China has made a great effort to bring information and the excitement about its space program to young people. The main exhibit prominently displayed inside the entrance to the Beijing Science and Technology Museum is a Shenzhou capsule. Student competitions, travelling space exhibits, appearances by astronauts, and science fairs in China are reminiscent of the excitement about space exploration in the United States during the 1960s Apollo missions to the Moon.

Answering questions from students after a presentation on China's space program in Beijing in July, Academician Ouyang Ziyuan, the chief scientist of China's lunar program, explained that China cannot be left out of the enterprise that advances great nations.

A Worldwide Enterprise

Since the start of its 1980s "opening up" to the outside world, China has embarked on a two-pronged international cooperation policy. It carries out joint projects "reinforcing cooperation with developing countries," especially "attaching importance to space cooperation in the Asia-Pacific region," while pursuing cooperation on advanced projects with established spacefaring nations.

Since its initial cooperation with the Soviet Union decades ago, China has established bilateral, government-to-government space cooperation agreements with more than two dozen nations. While cooperation with the Soviet Union waxed and waned as did political relations, China's Shenzhou spacecraft designers first learned about the technology necessary for manned spaceflight from the Soyuz, and the Chinese astronauts were trained in Russia.

As China's space program has progressed, so has the content of its cooperation with Russia. There are ongoing talks between space experts and political leaders of both nations, with suggestions that China may participate in Russia's planned mission to Phobos, a moon of Mars. Russia, it is reported, will join China in the later stages of its lunar program.

"We are currently working on the Moon as partners, and we have concluded that Russia and China have moved beyond

their previous relationship, when China was a buyer and we were a seller," Russian space agency head, Anatoli Perminov, said in September. "We have already adopted a cooperation program with China for 2007-2009. China is now a leading space power."

One of China's most successful and in-depth space cooperation programs is with Brazil—a nation also of the "south," and also embarked on a broad-ranging program of developing its own satellites and launch vehicles. In October 2003, the joint Sino-Brazil Earth Resources Satellite was launched, and an agreement to build three additional satellites is in force.

China has worked for many years with the European Space Agency on an array of projects, from instructing scientists on the use of Earth remote-sensing data, in the "Dragon Program," to the joint Double Star mission to explore the mysteries of the Sun. Over the past five years, China has signed cooperation agreements with Argentina, Canada, Malaysia, Pakistan, and Ukraine, and conducted exchanges with space-related organizations in Algeria, Chile, Germany, Italy, Japan, and Peru.

CCTV

The Chinese spacecraft Shenzhou after its return from an unmanned test in November 1999.

In 1992, China, Thailand, and Pakistan, later joined by other nations, sponsored the Asian-Pacific Multilateral Space Technology Cooperation Symposium. Then, joined by Iran, the Republic of Korea, and Mongolia, in April 1998 China signed a Memorandum of Understanding to develop small multi-mission satellites. Small satellites are an ideal avenue through which non-space countries can gain access to education, training, and basic space technology.

In October 2005, representatives of China, Bangladesh, Indonesia, Iran, Mongolia, Pakistan, Peru, and Thailand signed the Asia-Pacific Space Cooperation Organization (APSCO) Convention in Beijing. A year later, Turkey signed. APSCO headquarters will be in Beijing, with the aim of developing programs to make available to these nations the technology and applications of space development.

With or Without the United States

Ten years ago, during a trip to China, former Senator and astronaut John Glenn stated in Beijing that if the United States did not invite China to participate in the then-evolving International Space Station, China would build its own. Aside from what is necessarily gained in any collaboration on challenging science and engineering endeavors, refusing to cooperate in space as a way of "punishing" China for policies that do not meet U.S. approval, has only led China to develop its own indigenous technology, industry, and technical manpower.

Further, it has encouraged China to seek partnerships with other spacefaring nations, which it has done very successfully. Marching to its own "human rights" and "export control" drum, the United States is now the only nation of significance in space that is *not* cooperating with the world's most impressive emerging space power.

There has been prodding from Democrats and Republicans on Capitol Hill to find areas of common interest in space cooperation with China—until recently, without positive response from the Bush Administration. But pressure from Congress, the aerospace/defense industry, and space supporters, not to mention China's accomplishments in manned spaceflight, led to NASA's announcement that Administrator Mike Griffin would accept the China National Space Administration's invitation to visit its academies and manufacturing facilities, and talk with its officials.

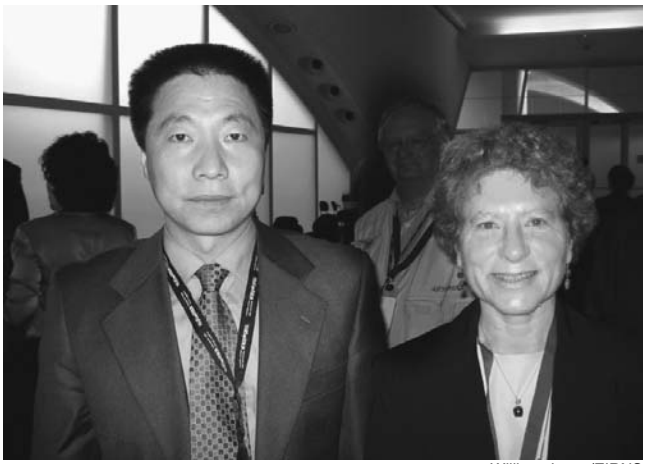
Before his trip in September 2006, Griffin was skeptical, repeating the *non sequitur* that there were still things we disagreed with the Chinese on, such as human rights. But whatever his preconceived notions about China, the Chinese, or their space program, Griffin was impressed with what China is doing in space.

While in China, Mike Griffin met with his counterpart, the head of the China National Space Administration (CNSA), Sun Laiyan; he met with the Minister of Science and Technology; he toured some of China's premier space research and design facilities; and he talked to graduate students at the Chinese Academy of Sciences.

In a press conference on Sept. 25, U.S. Ambassador to China, Clark Randt, whose father worked for NASA in the 1950s, located Administrator Griffin's visit as "another indication of the growth in our relationship with China." In a somewhat surprising statement, Griffin said that "one of my purposes here was to convey, on behalf of our nation, our congratulations to, and appreciation of, China's accomplishments in space, being only the third nation to develop its own capability to put people in space."

Although NASA did not take Chinese officials up on their offer to visit the Beijing command center where manned spacecraft are controlled, or the launch site, so as not to give the Chinese the impression that the United States is willing to put manned space cooperation on the table, Dr. Griffin said at the press conference that he "particularly enjoyed the visit to CAST [China Academy of Space Technology], seeing the facilities that have been used to develop the Shenzhou spacecraft."

"We welcome China to the fraternity of spacefaring nations,"



William Jones/EIRNS

China's first astronaut, Yang Liwei, here with the author, at the annual Congress of the International Astronautical Federation, held in Valencia, Spain, in October 2006.

Griffin said. On the question of cooperation, Griffin explained that "the problems of spaceflight, whether human or robotic, are very difficult. They are right at the edge of what is technically possible, and, indeed when nations become able to conduct spaceflight activities . . . it is a symbol of very significant technological prowess. . . . [O]ne of things that we derive from international cooperative activities is seeing how different nations and different cultures solve those problems. We learn things; they learn things . . . this *is* rocket science, and it is very demanding."

NASA and CNSA agreed to discuss sharing Earth remote-sensing data, data from each of their upcoming lunar orbiters, and from environmental and weather satellites, and then to explore the possibility of placing instruments on each other's future lunar spacecraft. The specifics of cooperation will be detailed by working-level American and Chinese space officials. More important than any particular program, the decision was made for annual high-level talks on space cooperation, to raise new ideas and have oversight over the projects and data coordination efforts that were outlined in the initial, September meeting.

At the press conference, Administrator Griffin was asked to give an example of Chinese space technology that impressed him. He provided an answer only after being goaded by the press, and apologizing beforehand for what he said would be a "geeky" answer. "For example," he said, "we saw a very nice algorithm today by which Chinese weather satellite developers correct for the apparent motion of the Earth as a result of minor shifts in the orbit of geostationary spacecraft." In fact, sharing breakthroughs and developments, and solving problems across barriers, to the benefit of all parties, and in spite of other differences, is what cooperation should be based on.

As has been observed by Russian space official Anatoli Perminov, and recently also by Mike Griffin, China has made impressive strides in space. It is now in a position to contribute to, and not just benefit from, international cooperation. And it will be going forward in space exploration, with or without the United States.

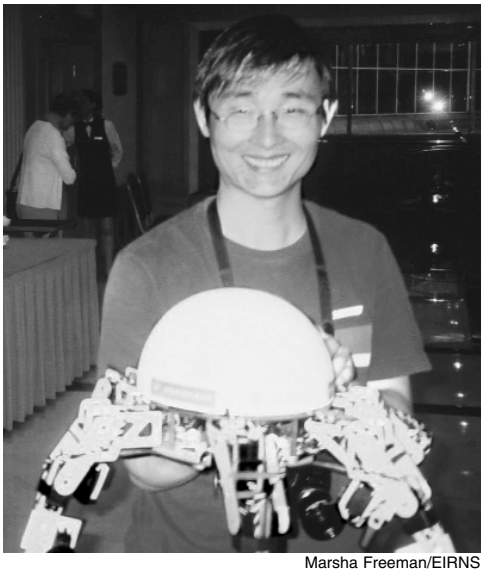
The Lunar Beijing Declaration

In July 2006, representatives of 18 nations attending the eighth conference of the International Lunar Exploration Working group in Beijing, signed a declaration committing the spacefaring nations to coordinate the upcoming missions to the Moon, to be launched in the next two years. China, India, Japan, and the United States have spacecraft in preparation, and the European Space Agency's SMART-1 spacecraft is completing its one-year lunar mission.

The Lunar Beijing Declaration affirmed that when these four new spacecraft begin their missions, "our understanding of the Moon and its resources will be revolutionized as the rich array of data from this flotilla is analyzed around the world." It proposes a series of international actions to optimize the return from the coming missions. Should the proposals be implemented, cooperation among the world's leading nations will proceed on the highest level, the exploration of the Solar System.

The delegates also adopted a proposal for an International Lunar Decade, modelled on the International Geophysical Year of 1957-1958, which promoted the study of the Earth, and during which the first Earth-orbiting satellite was launched into space. The proposed Lunar Decade would span the 2007 launching of the new robotic lunar orbiters, to the approximate 2019 planned manned return to the Moon.

One of the goals of the Declaration is to "inspire a new generation of lunar explorers." To that end, China's National Space Administration sponsored a public day during the July conference, which brought 300 students into contact with top lunar scientists and program managers.



Marsha Freeman/EIRNS

The second stage of China's lunar program will include a lander and rover. College students are competing to design the lunar robot. This model was demonstrated at the Beijing conference.

ENTROPY RUNS DOWNHILL

The Great Fool's Oil Swindle

by Lyndon H. LaRouche, Jr.

August 31, 2006

Alan Yue

Republicans (exemplified here by George Shultz, left) and Democrats (by Al Gore) are both lined up at the ethanol trough.

The spreading delusion, that the so-called petroleum-crisis can be conquered by the reduction of living plants, such as corn, to a substitute for petroleum, will go down in history with the John Law Bubble and Ponzi scheme, as one of the sorriest mass-delusions ever to plunge a modern nation into destitution and general ruin. The motive which lures credulous people into condoning such unscientific swindles, is essentially of the form expressed by those who are candid about their motives: "To Hell with society; I—me, me, me!—need the money now!"

The quickest way which modern science offers to clarify that point, is the proof by the great Twentieth-Century scientist, Vladimir Vernadsky, first, of the relative rate of increase of the Biosphere, relative to the non-living processes of our planet, and, second, the relative increase of what Vernadsky defined as the combined living and sedimentary mass of the Noösphere.

In brief: The exemplary basis for the creation of the conditions needed for sustaining human life on this planet, is the action of chlorophyll in transforming low-energy-flux-density solar radiation received near the surface of our planet, into the higher energy-flux-density forms of plant life, on which the satisfactory management of the Earth's climate, and progress of human life depend.

Conserve the environment by increasing reliance on the use of increasing high-energy-flux-density sources of power, such as nuclear-fission and thermonuclear-fusion. . . .

Increasing Energy-Flux-Density

The key to the physical organization of economic conditions of human life, is the increase of what is termed, as a rule-of-thumb, low energy-flux-density of received solar radiation, to successively higher levels of energy-flux-density, as typified by the succession of production by chlorophyll, use of water-power, burning of wood, burning of coal, coke, petroleum, nuclear-fission, and thermonuclear fusion. The relative decrease of the relative scale of the ostensibly abiotic mass of the planet Earth, to the relatively increasing mass of the Biosphere, and the increase of the mass of the Noösphere to the mass of the Biosphere, illustrate the physical principle to be considered.

The ratios of increase of Biosphere to abiotic planetary mass, and of Noösphere to Biosphere, express a fundamental principle of the organization of the known physical universe: a principle fairly identified as anti-entropy. This is also the principle of anti-entropy exhibited by the generation of the organized Solar System, with its characteristic Periodic Table, from the basis in a fast-spinning solitary Sun, with its lower state of organization, to the composition of the Solar System today.

The only basis for sustaining a modern level of human population on this planet, lies in the effects of scientific and related technological and cultural progress. That progress depends, inclusively and characteristically, on mankind's promotion of the density of useful living plant-life per capita and per square kilometer, in which trees represent a higher state of organization and quality of the climate and environment for mankind than the vegetables we grow for the food-cycle: trees absorb more of the Solar radiation!

To create a more moderate climate, promote green cover, with an emphasis on trees. At the same time, conserve the environment by increasing reliance on

the use of increasing high-energy-flux-density sources of power, such as nuclear-fission and thermonuclear-fusion today. All of these required policies, assume the common physical-economic form of increase of physical, as distinct from merely monetary capital-intensity per capita and per square kilometer. Above half of that investment in physical capital-intensity must be, presently, in the development and maintenance of basic economic infrastructure in, chiefly, the so-called public sector.

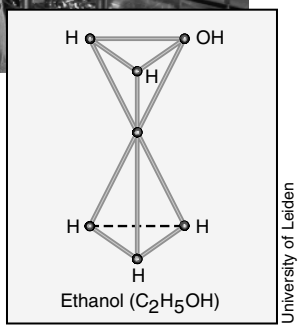
In the U.S.A. prior to the rise of the 68ers, the notions which I have just outlined above, represented conventional wisdom. With the coming into maturity of the present upper 20 percent of family-income brackets within the 50-to-65 age-interval, there was a so-called "cultural paradigm-shift" downward, away from a producer society, to a consumer society, from a physical economy, to a low-paid, either non-productive, or marginally productive "services economy."

This Baby-Boomer-led, ideological downshift in intelligence and in morality, is typified by the campaign against nuclear-fission and thermonuclear fusion as the indicated power sources for reaching into a healthy economic future. This represented the same policy of the satanic Olympian Zeus of Aeschylus' *Prometheus Bound.* The doctrine, from the Apollo Delphi cult's Zeus, to the present day, is known in political history as a characteristic expression of what was known then, as now, as "the oligarchical principle." This takes the form of the doctrine that the upper 3 percent of family-income brackets are to be served, and the lower 80 percent must slip, more and more into penury and servitude of manual, unskilled labor. Not accidentally, this is the oligarchical principle expressed by the George W. Bush Administration, and by Democrats who purse their lips in the contemplation of the buttocks of the upper 3 percent.

The tactic of the pro-oligarchical upper 3 percent and its pursed-lip lackeys, is to fool the credulous into the delusion that "fool's oil" now is a comfort-zone, the future of humanity be damned.

USDA/Photo by Keith Weller

Making moonshine: A microbiologist and a technician add starter microorganisms to pilot-plant-size bioreactors to ferment ethanol. The molecule can be conceived as two tetrahedra joined at a vertex. A carbon atom sits at the center of each tetrahedron.



Ethanol (C_2H_5OH)

University of Leiden

Ethanol: Not a Kernel of Science in It

by Laurence Hecht

Ethanol is an excellent substance to tank up on. Just don't drive on it. It slows reaction time, impairs judgment, and it's illegal. In excess, it can make you giddy, stupid, mean, sour, depressed, and violent. It might even make you President.

Here we will inform you what ethanol is, why it is a worse than stupid way to replace our oil dependency, and why development of nuclear power is the only sane way to provide ourselves an economic future.

Ethyl alcohol or ethanol (C_2H_5OH) is the second in what chemists call the homologous series of alcohols, which include methyl, ethyl, propyl, butyl, and amyl alcohol, each one distinguished from the previous by the addition of an atom of carbon and two of hydrogen (CH_2). Man has been making ethyl alcohol since long before the discovery of its chemical and structural formula. Almost any plant substance can serve as the raw material—grapes, apples, corn, grain, and potatoes are traditional ingredients.

To make some yourself, start with some store-bought apple juice which has been bottled without preservatives. Put it in a clean glass container, and let it sit several days. Yeast, naturally present in the air, will act on the fruit sugars—according to a process first deduced by Louis Pasteur—to change them into alcohol. This is called fermentation. Make sure you use a loosely fitting cover, because carbon dioxide gas is released in the process, and could explode a tightly closed container.

If you wait too long, the fermentation will go to the next stage, converting the alcohol to vinegar (acetic acid). If you stop it at the right moment, you will have an apple cider of perhaps 5-10 percent alcohol content. The alcohol will be mixed in with the sugary fruit juice. A simple way to separate the alcohol is to freeze the mixture. The

alcohol, which has a lower freezing point than the rest of the mix, will collect in a cylindrical hollow in the center of the frozen substance. One can also separate the alcohol with a still, or what chemists call a distillation apparatus. Ethyl alcohol has a boiling point of 173°F, well below that of water. By heating the mixture, the ethyl alcohol boils off first; its vapor can be collected by condensation on a cool part of the apparatus called a condenser. Both of these methods of separation are types of fractional distillation.

The Cost of Scaling Up

To produce ethanol on a commercial basis, the laboratory process of fermentation and distillation must be scaled up. Remembering that our original intention was to save on the use of petroleum products, we must therefore examine the amount of gasoline and other petroleum fuels that would go into the production of ethanol as a replacement for gasoline. First we have the production of the corn or other vegetable product which is going to provide the sugars for fermentation. Modern agriculture is a highly energy-intensive operation: tractors and farm vehicles require a lot of gasoline or diesel fuel; ammonia fertilizers use natural gas as a feedstock; irrigation requires large amounts of electrical energy; farm work also requires human physical and mental labor, which requires energy for its maintenance. Bulk raw materials must now be transported from the farm to the still, for processing and distillation, another energy-intensive process, frequently using natural gas. In fact, more than the total current national consumption of natural gas would be required to power the stills to produce enough ethanol to replace our petroleum dependence.

When all of these inputs are taken together—studies by Dr. David Pimentel of Cornell University and Tad W. Patzek of the Dept. of Civil and Environmental Engineering at Berkeley have shown—alcohol production consumes more units of fossil fuel energy than it yields when burned as fuel. Corn ethanol, switchgrass ethanol, and wood alcohol (methanol) consume respectively 29 percent, 45 percent, and 57 percent *more* units of fossil-fuel energy than they give back on burning.

If we were so insane as to attempt to replace our petroleum usage with corn ethanol (the least inefficient of the choices), it would require placing 1.8 million square miles, or 51 percent of the land area of the 50 states, under corn cultivation, according to the calculations of retired University of Connecticut physics professor Howard Hayden (*21st Century,* Spring-Summer 2006, pp. 10-11). Need we also mention that a large portion of the human population is suffering from malnutrition? Knowing that, can any moral person justify taking our productive agricultural land out of food production to feed this swindle?

The high cost of the energy inputs required for ethanol production is actually reflected in the price of the product. When all the tax credits and government subsidies are taken into account, the cost of ethanol comes to $7.24 per gallon of "imported gasoline replaced" (see http://zfacts.com for an exhaustive study). Not surprisingly, the largest financial beneficiary of the government subsidies have been the grain cartels—Archer, Daniels, Midland and Cargill—and hedge fund speculators who have recently moved in on the ethanol boondoggle.

Let us now see why nuclear power is an enormously better, and absolutely necessary alternative to the funny fuel.

How Alcohol and Gasoline Burn

Structurally, alcohols are similar to hydrocarbons which are what make up the combustible parts of coal, oil, and gasoline. The hydrocarbons form a simple, homologous series, like the alcohols. Methane, one of the ingredients of natural gas, is the simplest hydrocarbon, consisting of a single carbon atom surrounded by four hydrogens. In the 1870s, two brilliant young chemists, Joseph Achille LeBel and Jacobus Henricus van't Hoff, deduced that carbon bonds with other atoms in a tetrahedral arrangement. Thus, the methane molecule (CH_4) could be pictured as a tetrahedron with a carbon in the center and a hydrogen atom at each of the four vertices. Ethane, the second in the hydrocarbon series, consists of two tetrahedra joined at their vertices (see figure). Knowing this, its formula may be easily deduced by construction, as C_2H_6, and so forth. The alcohol series are much like the hydrocarbons, except that one of the hydrogen atoms is replaced by a molecule consisting of a combination of oxygen and hydrogen (OH).

The connection between one atom and another is called a bond. We understand these bonds today as attractive relationships between the electrons in the outer orbitals of the atoms. Their exact nature, despite much study, is not yet fully understood. However, the branch of physical chemistry known as thermodynamics has been able to create a kind of accounting system, which doesn't worry about what the actual physical geometric process of transformation is. It merely keeps track of the energy relationships, on the assumption that no new energy is created or destroyed in a chemical change.

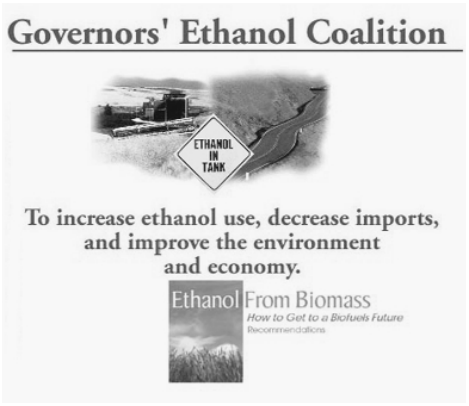
Thus, the attractive bond between the electrons is thought of as containing a certain amount of energy. When a hydrocarbon or an alcohol burns, that is combines with oxygen in the air, these bonds are broken. The energy contained in them is now converted into heat. We don't know exactly how, but we can measure precisely how much.

Heat is measured in a unit called a calorie, which was developed out of the work of Antoine Lavoisier (1743-1793) in experiments on the specific heats of the elements. It is the amount of heat required to raise the temperature of one gram of water (at a temperature of 14.5°C) by one degree celsius. Because this unit is so small, we often employ the kilocalorie, which is the amount of heat required to raise the temperature of one kilogram (2.2 pounds) of water by one degree celsius. (Heat may also be measured by the unit of work known as the joule—there are 4.18 joules in a calorie—and the British Thermal Unit (Btu) which is equal to 252 calories). Using any of these units, we can determine the amount of heat produced when a certain quantity of alcohol, gasoline, coal, or any other combustible substance is burned.

The burning of one kilogram of gasoline produces about 10,500 kilocalories. Burning one kilogram of ethanol produces about 7,140 kilocalories, about 68 percent that of gasoline. Thus, a car running on pure ethanol will require a fuel tank that is almost half again larger than a gasoline-powered

EERE/DOE

The quick-buck magical lure of the ethanol "boom" has captured the Department of Energy, elected officials, universities, and, of course, the cartels.



Governors' Ethanol Coaltion

vehicle.[1]

The Nuclear Domain

However, these relatively small differences are negligible in comparison to the heat released by nuclear processes. The fissioning of one gram of uranium releases about 2 million times as much heat as is produced by burning an equivalent weight of gasoline or oil, and 3 million times the heat produced in burning that weight of coal.

These enormous energies are not released from the chemical bonds. We are speaking now about a new physical domain. In the breaking apart of the uranium nucleus, we are releasing the much stronger forces which hold the nucleus together. Here, in a space about one-millionth the size of the whole atom, we find 92 charged particles, known as protons, each 1836 times heavier than the extranuclear electrons, which are the actors in chemical reactions. The protons are held together by some powerful agent, conventionally known as the strong force. In addition to these 92 protons, a nucleus of fissionable uranium-235 contains another 143 neutral particles about the same mass as the proton. When a uranium nucleus shatters, fragments containing these particles go flying apart at velocities up to one-tenth the speed of light.

For more than 60 years, since the operation of the first atomic pile on Dec. 2, 1942, we have known how to control this process. For over 50 years, we have harnessed the heat generated by the fission of the nucleus to produce electricity, safely and cheaply. With a complete fuel cycle which includes reprocessing, *there is no nuclear waste.*

Finn Hadansson/EIRNS

A Wall Street event on June 14, 2006 promoting the initial public offering of an ethanol company, VeraSun Energy Corp.

Nuclear is a fully renewable energy resource. It is also only the beginning. For in 25 years we will begin to commercialize an even more powerful source of energy from the nucleus, fusion power.

With abundant nuclear power, we can virtually eliminate our dependence on imported oil, without having to cover the whole nation with ethanol cornfields and eliminate our food and animal production. Nuclear will provide the electricity to recharge the batteries for electric-powered transport on the trips of under 30 miles that make up the majority of vehicle use.

Nuclear will also generate the fuel to replace gasoline for use on longer trips. With the temperatures of 700-800 degrees, which can be produced by the new fourth generation of nuclear reactors, we can easily separate hydrogen from water, using electrolysis and even more efficient chemical separation methods. The hydrogen will power fuel cells to run electric motors, or be burned in internal combustion engines. Soon, as a result of advances in fast-pulse laser machining processes, ceramic turbines, capable of operating at temperatures of 3,000 degrees and thus achieving efficiencies three times that of conventional engines, will be available.

Hydrogen Fuel

With a heat of combustion of 34,200 kilocalories per kilogram, hydrogen carries more than three times the energy content by weight of gasoline, and nearly five times that of ethanol. That is why it is used as rocket fuel. The leading problem in using hydrogen to power vehicles has been the cost of compressing it to a usable size. However, a variety of options are available and in the works to solve this problem.

The by-product of the burning of hydrogen is water. The byproduct of the production of hydrogen from water is oxygen. Releasing oxygen to the atmosphere by the industrial production of hydrogen, will avert what may be the most serious atmospheric environmental threat we face. That threat is not the release of carbon dioxide from combustion of carbonaceous fuels—for carbon dioxide enhances plant life, helps produce cloud cover, and has never been proven to increase the Earth's temperature. A real danger to be feared from the

greatly expanded use of carbon-based fuels over centuries to come, is the depletion of atmospheric oxygen. Nuclear power and the hydrogen cycle will assure the children of the next century the air they need to breathe.

As a growing fraction of intelligent young people are coming to recognize, the often sexually tinged anti-nuclear obsessions of their parents' generation have contributed in large part to the new generation's lack of access to the levels of educational, health care, and employment opportunities which Americans had come to expect. It is time for those still embracing such fantasies to grow up and admit their past errors, or get out of the way. Woodstock, Earth Day, and the rest of those youthful hijinks are a thing of the far-distant past. The nation's future is at stake.

Notes

1. Ethanol is able to deliver about the same amount of power as gasoline, because it requires less air to burn, and thus a greater portion of the gaseous mixture found in the cylinder on each stroke is made up of ethanol. Because of its air requirement, only about one third as much gasoline vapor as ethanol can fit into a cylinder of a given size.

'Satanic Sugar' in Brazil

Brazil is the world's largest sugar producer and exporter. With 13 million acres under cultivation, it is expected to produce 30 million tons for the 2005/2006 harvest, one-half of which will go into ethanol production. It is also the world's leading ethanol producer and exporter, having distilled close to 4 billion gallons in 2004, 37 percent of the world total.

United Nations/Jerry Frank

In Brazil, ethanol depends on sugar cane harvesting by virtual slave labor.

Many ill-informed people have pointed to the example of Brazilian ethanol as a model for the rest of the world. But the dirty secret of Brazilian ethanol is the cheap, almost slave, labor employed in the sugar cane industry.

The state of Pernambuco in the impoverished Northeast, and São Paulo state in the south, have historically been the sites of large-scale sugar cane production, although more recently it has expanded into the states of Rio de Janeiro, Minas Gerais, Espiritu Santo, and Paraná. São Paulo produces 60 percent of the nation's sugar cane.

In the state of São Paulo, the cost of sugar production is $165 a ton, compared to $700 per ton in European Union nations. According to a February 2006 study published by Brazil's Social Justice and Human Rights Network, workers in São Paulo state are paid 2.60 reais (about one U.S. dollar) per ton of cut cane. Silvio Donizetti Palvequeres, president of the farmworkers union in the important cane-cutting region of Ribeiráo Preto, told the *New York Times* that "you used to have to cut four tons a day, but now they want eight or ten, and if you can't make the quota, you'll be fired."

Small- and medium-sized farms produce the majority of the food for Brazil's domestic consumption; yet foreign-run agribusiness is driving them out of farming. Over the past 15-20 years, according to one study, sugar cane expansion in the poorer areas of Pernambuco and the Northeast has driven 40,000 people out of small-scale agriculture, and into urban slums.

Workers who do the backbreaking work necessary to cut 10, or even 12, tons of cane per day can earn up to R$800 a month, but then have to deduct R$400 for food and usually miserable accommodations. Malnutrition and illiteracy plague most cane-cutting areas. Workers migrate from one region to another in search of work, leaving their families behind, as there is more than one harvest season.

Where mechanization has been introduced, fewer workers are needed, as occurred during the 2001/2002 harvest in Pernambuco where 150,000 cutters lost their jobs. But because they have no alternative employment, workers are left to wander to other areas in search of work, or end up residing in urban slums or *favelas.* Job security is nonexistent, and unionization becomes impossible, given the large number of transient or temporary workers. With good reason, sugar cane in Brazil's Northeast is called "Satanic sugar."

In place of this policy of slave labor and primitive accumulation, Science and Technology Minister Sergio Resende announced in March 2006 Brazil's ambitious plan to build seven nuclear plants over the next 15 years, two of them in the impoverished Northeast. On the subject of green energy hoaxes in general, Resende wrote in a May 5, 2006 opinion piece in the daily *O Globo:*

"[T]he technological wager on renewable energies, such as wind and solar, to substitute fossil fuels, has not been found to be viable on a large scale. In every study, nuclear energy is confirmed as an alternative capable of meeting demand in the larger domain, cleanly and safely."

—Cynthia R. Rush

C_4 vs. C_3 Photosyhthesis

Continued from page 5

as far as boosting rice productivity to keep pace with population growth and land loss to non-agricultural uses.

One of the most promising approaches to give a large boost to productivity of rice, would be the successful incorporation of CO_2-concentrating C4 photosynthetic pathways into the rice plants by genetic engineering techniques.

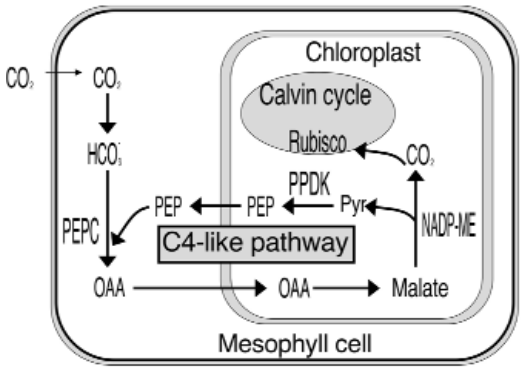
Many scientists are looking at ways to do this, and some progress has occurred with the overexpression of C4 enzymes in C3 plants, but the ultimate goal—significantly boosting photosynthetic efficiency—has not yet been reached. The main problem lies in the anatomical arrangement of C4 plants.

As mentioned earlier, almost all C4 plants break up photosynthetic activity into two cell types, with CO_2 concentration occurring in a different cell than CO_2 uptake. A few C4 plants with just one cell type have elongated cells with one end facing outward and the other to the center of the plant, allowing another sort of separation in space. C3 plants as a rule do not have those qualities of structural complexity.

Whether C4 genes in C3 rice will successfully boost productivity remains to be seen. Perhaps the easier route would be to tinker with the Rubisco protein to shift its affinity for CO_2 vs. O_2 so the CO_2 assimilation reaction drives forward more efficiently under present levels of CO_2, but that also has proved hard to achieve so far.

A MODEL FOR INCREASING THE CO_2 AVAILABLE FOR C3 RICE

Scientists at the National Institute of Agrobiological Sciences (NIAS) of Japan are inserting genes that code for C4 photosynthetic enzymes (PEPC, PPDK, and NADP-ME) into rice, in an attempt to create a functional C4-like pathway to move CO_2 into the mesophyll cell, and incorporate it into the three-carbon molecule phosphoenolpyruvate (PEP) to make the four-carbon oxaloacetate. That would then be shuttled into the chloroplast, where it would be transformed and ultimately cleaved back into PEP by way of pyruvate, releasing CO_2 to be utilized by Rubisco in the C3 photosynthetic cycle, the Calvin cycle. This diagram is adapted from a NIAS schematic.



Notes

1. Mitsue Miyao, 2003. *Journal of Experimental Botany*, Vol. 54, No. 381, pp. 179-189.

Yucca Mountain Should Be a Non-Issue In Today's Nuclear Renaissance

by Jim Muckerheide

Yucca Mountain has been shrouded in a political fog since its designation by Congress 20 years ago as the site to be studied as a repository for spent nuclear fuel. Two important facts that have not penetrated the public through this fog are: (1) Spent nuclear fuel is not "waste." It is 97 percent recyclable as nuclear fuel. (2) Radioactivity from spent fuel is not a significant hazard.

Today, as the world enters a nuclear renaissance, the United States must not sacrifice the need to build a substantial fleet of new U.S. nuclear plants to a 20-year-old error in designating spent nuclear fuel as "waste" to be buried. Nor should the nation be left to twist on the false premise that radioactivity from spent fuel and/or high level waste constitutes a significant hazard.

Radiation doses from realistic evaluations of the release of radioactivity in spent fuel or high-level waste do not pose a risk, especially when compared to the management of truly hazardous chemical and biological waste materials. Potential dispersal of this radioactivity can, at worst, produce concentrations in the biosphere that are trivial compared to naturally occurring radioactivity, which is not a hazard.

Here are highlights of Yucca Mountain history and some of the mistakes that were made (and are still being made) by the nuclear industry, the Department of Energy and its predecessors, and the Congress. Building new nuclear plants must not wait for Yucca Mountain to be operational; spent fuel can be stored safely in dry casks on or off site, and recycled into new fuel. Only small amounts of solidified wastes may require long-term disposal, if useful fission-product isotopes are recovered, and long-lived transuranics are "burned" using fast-neutron reactors.

Yucca Mountain is in Nevada, about 90 miles northwest of Las Vegas. It is the sole high-level radioactive waste repository site designated for DOE study by Congress in 1987. The site is adjacent to the Nevada Test Site, where nuclear weapons were detonated above ground until 1962, and below ground until 1992.

DOE

Yucca Mountain, Nevada, was selected 20 years ago as a burial site for spent nuclear fuel, which is not "waste" and should be recycled, not buried.

Geologic disposal was studied since the 1960s by the Atomic Energy Commission; its 1974 replacement, the Energy Research and Development Administration; and by ERDA's 1977 replacement, the Department of Energy (DOE).

From the beginning of the Atoms for Peace program of the late 1950s and 1960s, nuclear fuel was to be reprocessed to recover the 97 percent uranium and plutonium, leaving the 3 percent that consists primarily of fission products plus some contamination by long-lived uranium, plutonium, and other transuranic elements. These were to be solidified to a glass or other leach-resistant form. (This 3 percent of high-level waste can be mined for its valuable isotopes which can be used for medical, industrial, energy, and other purposes.)

A Series of Errors

Legislative proposals and hearings in the late 1970s produced the 1982 Waste Policy Act requiring disposal in geologic repositories. The DOE was to conduct a siting study to select the best locations in various geologic media, to work with the states for the siting studies. A Nuclear Waste Fund was established to receive one tenth of a cent per kilowatt-hour from every nuclear utility for nuclear-generated electricity. This fund has collected more than $28 billion in contributions plus interest, with a little more than $9 billion expended on Yucca Mountain.

Following the 1982 Act, DOE conducted a disastrous siting study, produc-

ing very costly plans for site screening, and working with states in backrooms instead of in public view. Several states ejected the DOE, including Tennessee, the home of Oak Ridge National Laboratory, and New Hampshire, the home of the then pro-nuclear engineer-governor, John Sununu, who could not defend DOE's secret granite investigations. States memorialized Congressional delegations to prevent DOE from investigating state sites.

Unfortunately, the nuclear industry did not object to DOE's assured destruction of the repository siting program. The 1982 legislation and DOE's implementation needed corrective action, which came in the 1987 Amendments. However, because of DOEs enormous costs to screen sites, Congress decided that DOE should study only one site for suitability; after that, another site might be studied. Other sites were in Louisiana, Texas, and Washington.

Granite site studies (in the upper Midwest and Northeast) were to be deferred to the next repository. So, Congress designated Nevada's Yucca Mountain site as the one site to be studied, in what is known in the state as the "screw Nevada" bill.

Nevada had long experience with the Atomic Energy Commission Nevada Test Site. Association with mushroom clouds and earth shaking had once been tourist attractions. In this new Congressional plan, spent fuel was to be carefully emplaced in the earth, to join radioactivity from hundreds of nuclear explosions, that were not so carefully placed in the earth. Yucca Mountain was also very remote from Las Vegas, adjacent to and beyond the Nevada Test Site and enormous military sites.

However, nonsensical political decisions severely contaminated the program. Interim storage of spent fuel was precluded on the misbegotten idea that "such storage would reduce the 'urgency' to select and license a repository." Yet, in a ludicrous objective to meet the time limits to move fuel from operating plants before many spent fuel pools were full (which the industry falsely argued would cause plants to shut down), DOE was directed to take the fuel by 1998. However, DOE and the Nuclear Regulatory Commission (NRC) were also directed to license the Repository for permanent disposal before spent fuel could be loaded in the repository, even though the spent fuel was to be retrievable for a long time, both for unforeseen repository problems, and because spent fuel has the enormous fuel value (mentioned above) that could be needed in the future.

Industry Failures

The Nuclear Energy Institute (NEI) and its industry-lobby predecessors have been primarily committed to support the operating nuclear power plants, not to consider building more plants. On spent fuel and waste disposal, they tried the impossible: to push DOE to meet the 1987 Congressional mandate for DOE to license the site as a repository to take spent fuel for disposal by 1998. Obviously the industry leaders never considered any realistic schedules or they would have been in Congress trying to fix these and other problems that made the program impossible.

When this schedule was finally recognized as impossible, the utilities continued to be pushed by their state regulators (because the ratepayers actually feed the Nuclear Waste Fund), and they fruitlessly continued to push DOE to open Yucca Mountain as soon as possible. Their false mantra was that all it takes is "political will" and that the DOE had to avoid causing premature plant shutdown (due to loss of spent fuel pool storage space). The industry itself even falsely claimed that dry storage casks at plants were a hazard that the public should reject—exactly the position of many anti-nuclear fear-mongers!

Industry leaders did not adequately consider the nature and magnitude of the 1970s problems indicated by the Atomic Energy Commission experience, the Energy Research and Development Administration, and the DOE in high-level waste siting. The industry also did not adequately consider DOE's failures in implementing the 1982 Waste Policy Act, and initial problems following the 1987 amendments.

Further, industry leaders did not adequately consider the geologic principles and constraints of disposing of spent fuel instead of solidified wastes, nor especially the consequences of disposing of hot fuel instead of providing for long-term cooling before placement. Nor did they consider the realities of examining and characterizing Yucca Mountain geology. Therefore, industry leaders did not take appropriate and effective posi-

DOE

Excavation of one of seven alcoves in the main tunnel of Yucca Mountain, to investigate the mountain's geologic features. The nuclear renaissance in the United States does not have to wait for Yucca Mountain to be operational.

tions with the DOE or Congress to avoid problematic conditions imposed on, and adopted by, DOE, or to adequately act in their own best interests.

Reevaluation Necessary

Today, however, there are substantial changes in national policy and program conditions, especially the renewed interest in—actually, the necessity of—building new nuclear power plants. Spent fuel management strategy must be revised accordingly.

The problem: Yucca Mountain is not imminently available, and it could be a problem if it were available. Yucca Mountain is now, again, delayed, with a new DOE schedule to submit a license application to the NRC in 2008, and an optimistic schedule to open the repository in 2017.

However, if NRC licensing were just now completed, and transportation of spent fuel started, it would be an anti-nuclear target for the radiation hysteria that is being fostered by the Federal agencies, the industry, and the media. Lawsuits would also go after many political targets of opportunity, over many years, whether ultimately successful or not.

In addition, this DOE/NRC decision would also approve a repository that is not large enough to dispose of the spent fuel that is already committed from the operating plants. Congressional authorization is only now being proposed to enlarge Yucca Mountain for the existing plants, to 120,000 tonnes. However, if Yucca Mountain is only large enough for the current plants with their extended lifetimes, and continues to be considered essential to build new plants, it begs the question of another repository for future plants.

Meanwhile, Yucca Mountain is delayed. This was most obviously caused by the Federal court finding that the Environmental Protection Agency (EPA) 15 mrem/yr total dose limit for 10,000 years, with 4 mrem/yr from a well water pathway, does not comply with the Congressional language which directed that the National Academy of Sciences (NAS) produce a report on the necessary standards. The NAS stated that the highest release would be after 100,000 years. EPA is therefore required to develop standards for releases beyond 10,000 years.

This poor Congressional and NAS language, which the industry did not adequately challenge at the time, reflects inaccurate information about radiation health effects, whereby the public and politicians believe that insignificant radiation doses are hazardous. This false perception is fostered by the many bureaucracies and industry interests that profit from the expenditure of hundreds of billions of dollars from the public for radiation protection that is not actually necessary.

Yucca Mountain project credibility is low. It is affected by the well-publicized reports of the U.S. Geologic Survey misconduct in producing data. There are many such targets in the licensing proceedings and court cases, and more should be considered as likely.

There is also uncertainty about the construction of the proposed dedicated DOE railroad. Poor DOE performance, even in simply providing the documents for the proceeding, along with quality assurance and other issues, are targets. A cadre of geologists, as well as risk analysis experts and others, is prepared to support Nevada and anti-nuclear organizations.

It is uncertain whether DOE can file a repository license application in 2008 that the NRC will find acceptable. In any event, the licensing proceeding, as conceived, is potentially unmanageable. NRC licensing will likely entertain all technical and legal resources of the anti-nuclear organizations, plus Nevada, and possibly other states and organizations, to be followed by court cases.

There can be no confidence that DOE can conduct this proceeding with the best legal and administrative capacity; nor that such best capabilities are sufficient. This proceeding would more likely be reminiscent of the worst 1970s nuclear plant licensing proceedings.

Revise Spent Fuel Policy

Therefore, national policy on spent fuel management, waste disposal, and Yucca Mountain, needs to be revised. Ideally, the industry should aggressively work with the Administration and Congress to articulate the current, default, U.S. spent fuel storage and disposal conditions as a national policy. Such a policy should reflect the following considerations:

- Spent fuel can be safely stored for many decades in dry casks, whether at reactors or central locations. Spent fuel will be stored in dry casks pending future national decisions on the need to rely on nuclear power and, therefore to

recycle spent fuel.

• Recycling spent fuel, and processing the high-level waste, as now proposed under the Global Nuclear Energy Partnership, will greatly reduce fission product and transuranic radioactivity sources, especially with transmutation. This would eliminate most of the heat source and the potential releases that are the supposed challenge to Yucca Mountain disposal.

• As the nation (and the world) rely more on nuclear power, future decisions on the schedule to recycle spent fuel will eventually depend on uranium availability. Therefore, Yucca Mountain (or other repository) would then be designed to accommodate only the associated high-level waste from spent fuel recycle. The policy should provide that if, for some reason (such as the development of fusion or a more advanced energy source), nuclear power were not to be a critical energy source, the stored spent fuel could be disposed in Yucca Mountain (or other repository), but would then have had extended cooling and radioactive decay to substantially reduce the impact on the repository.

Taking Corrective Action

The nation, and the world, must build thousands of nuclear plants this century. Current plans for new plants should be considered as initial demonstration plants which will inform future political decisions on the appropriate long-term nuclear power commitments.

We need a clear and politically adopted National Policy to store spent fuel (primarily on-site) until Yucca Mountain use and design is resolved. To inform the public and politicians, a substantial record of the *lack of* hazard from the radioactivity in spent fuel and high-level waste should be produced in support of the policy. Senators Domenici (R-N.M.) and Reid (D-Nev.) should lead bipartisan support for such a constructive policy.

The Yucca Mountain project must continue, but current nuclear power development requires deferral of its primary implementation. Licensing the repository for permanent disposal, should be pending future nuclear power and spent fuel treatment and disposal decisions. Placing existing solidified high-level waste into Yucca Mountain as tests for monitoring and retrieval, without artificial schedule deadlines, may be valuable.

Spent fuel in dry storage casks can be shown to be safe, secure, and monitored for decades, whether at or away from reactor sites, while the radioactivity is decaying, and decisions are being made on the location of fuel recycle facilities. The anti-nuclear groups concerned about the risk of on-site storage of spent fuel in pools pushed the NRC, the NAS, and the Congress, to support dry cask storage as the safer preferred alternative. That conclusion should be recognized in implementing the spent fuel and waste management policy.

DOE

A dry storage cask for spent fuel at the Surry Nuclear Power Station in Virginia. Each dry cask is 16 feet high, 8 feet in diameter, and has 15-inch-thick walls made of steel. Each cask holds 21 to 24 spent fuel assemblies.

In this mode, the U.S. spent fuel and high-level waste management program will be generally consistent with the equivalent programs in most nuclear energy nations. In addition, the Yucca Mountain program schedule will not be a constraint to the construction of new nuclear power plants in the United States and elsewhere in the world.

Nuclear Industry Must Change

Since the 1980s, the industry has supported the primary interests and objectives of the current operating plants. However, there is now an imperative to build new nuclear power plants. This changes the initial conditions. A national policy interest transcends the short-term operating plant interests. The industry must *rather belatedly* prepare for new nuclear plants.

We must undertake an aggressive effort to address the need, and to develop strategic plans for, substantial nuclear energy facilities (for electric and non-electric power applications), demonstrating dry storage safety, with time to resolve future nuclear energy and reprocessing needs. Simultaneously, we must resolve the technical questions of Yucca Mountain (while the fuel is cooling), taking Yucca Mountain off of the critical path.

Jim Muckerheide is Massachusetts State Nuclear Engineer, and President of Radiation, Science, and Health. He was a consultant to the Utility Waste Management Group addressing the ERDA and DOE high-level radioactive waste management program in 1976-1981. His previous 21st Century *articles include "How to Build 6,000 Nuclear Plants by 2050" (Summer 2005) and "It's Time to Tell the Truth About the Health Benefits of Low-Dose Radiation" (Summer 2000). Both articles are available on the magazine website.*

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WHO Brings Back DDT to Stop Malaria

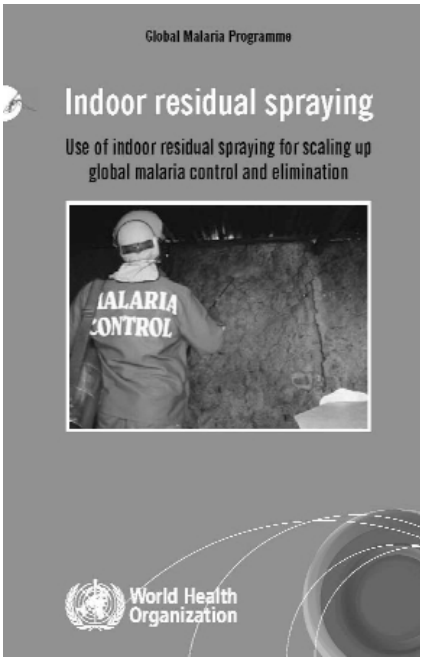
by Marjorie Mazel Hecht

The World Health Organization's announcement Sept. 15, 2006, that it will support DDT spraying on the inside walls of houses to kill or repel malaria-carrying mosquitoes is very good news. The reversal of WHO's 30-year policy against DDT brings the hope that the relentless disease, which now kills one African child every 30 seconds, can be brought under control. Malaria sickens and debilitates 500 million people a year, killing about 1 million of them. More than two-thirds of the malaria cases occur in Africa, and about 90 percent of the deaths are children under five on the African continent.

Indoor residual spraying, or IRS, involves spraying minute amounts of insecticides on the inside walls and roof of houses once or twice a year. DDT is the most effective of the approved insecticides. It is also long-lasting (it can be sprayed just once a year) and relatively inexpensive (about $5 per average five-person household). It either kills mosquitoes resting on the walls, or repels them from the dwelling. The malaria-bearing mosquitoes bite mostly at night.

For African countries now debating the use of DDT, the WHO decision will be a lifesaver. Just days after the WHO announcement, Uganda said that it will go forward with its indoor spraying program in 2007. Uganda's Health Ministry reported on Sept. 20 that spraying with DDT would help reduce infant mortality from the current 88 out of 1,000 births, to 10. Opponents had complained that use of DDT will cut into their agricultural exports to the European Union, which is notoriously frightened of pesticides. Meanwhile, 320 Ugandans die a day from malaria.

Despite the okay from the WHO, anti-DDT activists are still trying to prevent its use in Africa, on the same old spurious grounds. In Rwanda, for example, the Environmental Management Authority, some non-governmental organizations, and the U.S.-based Research Triangle Institute decided against DDT, citing "dangers."



The cover of the World Health Organization's 2006 report supporting indoor residual spraying with DDT for malaria control. "There is no justification for preventing the use of DDT for IRS based solely on fear of contamination of agricultural products. . ." the report states.

Anthony Cornel/University of California at Davis

An Anopheles gambiae *mosquito. When sprayed on inside house walls, DDT not only kills mosquitoes on contact, but also repels them, so that they don't enter the house to bite its inhabitants.*

For those countries that follow the WHO advice, results should be rapidly successful. Malaria incidence drops dramatically after an indoor spraying campaign. South Africa, for example, resumed the use of DDT in 2003, and within one year, the incidence of malaria in the worst-hit province, KwaZulu Natal, fell by 80 percent. In two years, the number of malaria cases and deaths dropped by 93 percent. As the WHO has stressed, there are no environmental effects when small amounts of DDT are sprayed on inside house walls.

WHO's Policy Turnabout

WHO appointed Dr. Arata Kochi as head of its Global Malaria Program in late 2005, with the task of assessing the WHO program and making proposals for its future work. Kochi was blunt in his criticism of WHO's past effort and in what was needed to combat malaria. As he announced at a Washington, D.C. press conference Sept. 15, 2006, "We must take a position based on the science and the data." Anticipating a reaction from a public brainwashed into demonizing DDT, he issued an appeal: "Help save African babies, as you help save the environment."

The new WHO malaria campaign has three aims: (1) prompt and effective treatment of the infected; (2) indoor residual spraying, with DDT as the most effective insecticide of those allowed; and (3) the use of bednets treated with a long-lasting insecticide.

Dr. Pierre Guillet, a medical entomologist who coordinates the WHO Vector Control and Prevention Team, acknowledged in an interview with this reporter Sept. 21, that DDT had

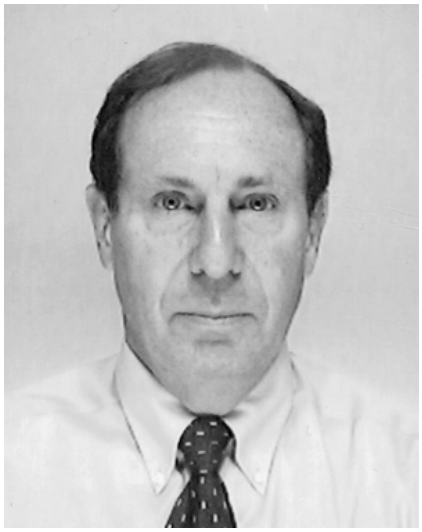
Dr. Arata Kochi, the new head of WHO's malaria division, reversed decades of anti-DDT policy Sept. 15, 2005, when he backed the indoor spraying with DDT to stop malaria: "We must take a position based on the science and the data," he said.

been out of the picture for many years, under pressure from environmentalists, who wanted an end to all pesticides. But the alternative approaches—such as "case management," "integrated vector control," and more recently, insecticide-treated bednets—did not work to control the spread of malaria, he said. Guillet has spent 17 years working on malaria control, 10 in Africa, and the past 7 years at WHO headquarters in Geneva. He stressed that WHO's policy now is to focus on areas of high malaria transmission to achieve at least 80 percent coverage of the population with indoor house spraying and bednets. "We need a very fast scale-up of these efforts," Guillet said.

"The change that has been made by Dr. Kochi is to say that if we want to seriously talk about malaria control, we have to control transmission, and to do that we need high coverage. To reach high coverage, we have to use the interventions that we know are effective, which are IRS and long-lasting bednets. They are not exclusive . . . it is the combination of the the two with the main objective to scale up rapidly coverage, in order to be effective in terms of transmission control."

Was the motivation for the ban on DDT at the WHO because of Malthusian views? Guillet said that he could not speak for the WHO as an institution. "For me, DDT is a non-issue. The issue is the intervention and the objective. . . . Today, we have to admit that DDT is the most effective and the cheapest insecticide. And when recognizing that, at a time when the genome of the parasite has been sequenced, and the genome of the major vector has been sequenced, still relying on a compound is more than 60 years old, and that has damaging effects when used indiscriminately, is a shame. And I see that, to a certain extent, as a failure of our international community to develop safe alternatives—not that DDT is not safe, but DDT is an emblematic product. . . .You cannot swim against the stream too long."

Guillet noted that the Stockholm Convention on pesticides had put DDT on the phase-out list, but with no time limit imposed. "Fine," he said, "but if we ban DDT right now, it will have more damaging effects on human health than using it. . . ."



WHO

Pierre Guillet, medical entomologist who coordinates the WHO Vector Control and Prevention Team: After 60 years of research, we know DDT is "bloody safe."

In response to my assertion that there had been no damage to human health from DDT, Guillet said that he wasn't a toxicologist, but he agreed that "There is no direct evidence of toxic effects of DDT on human health." If we haven't found any such evidence after 60 years, "It is bloody safe," he said. However, WHO will conduct studies on the effects of IRS on human health and will monitor potential side effects of DDT and other insecticides.

Guillet strongly recommended that an international partnership work on the development of new insecticides, and said that the Gates Foundation has

The Malaria Cycle

There are three types of malaria, all caused by a genus of protozoans called *Plasmodium,* the most lethal being *Plasmodium falciparum.* In brief, the *plasmodium* is picked up by a biting female *Anopheles* mosquito, when she sucks the blood of a person with malaria. The plasmodia in the blood mate in the mosquito's stomach and produce hundreds or thousands of young plasmodia, which travel through the mosquito's body, including to the salivary glands. When the mosquito bites again, it injects young plasmodia (called sporozoites) into the human victim.

These plasmodia reach the human liver where they reproduce, forming a new phase of plasmodia (merozoites), which enter the blood stream, burrow into red blood cells, reproduce, and in 48 hours, burst out to enter new blood cells, repeating the process in 48 hours.

When the number of merozoites reaches about 150 million in a 140-pound person, the victim has a typical malaria attack every 48 hours. As Dr. Gordon Edwards describes it, "When millions of red blood cells are simultaneously destroyed, the victim suffers a chill. As the cells are ruptured, toxins are released, resulting in alternating chills and fevers. If a large number of plasmodia invade the brain, death quickly follows."

The malaria cycle is most effectively stopped, when the *Anopheles* mosquito is prevented from biting people who already have malaria in their blood. This vastly reduces the incidence of new cases of malaria.

begun to do this, to improve the formulation of current insecticides and their application in vector control.

A Deadly Ban

While the fine points of previous anti-malaria policies can be endlessly debated, the bottom line is that millions of people have died of malaria as a result of the ban on DDT, most of them in Africa. and hundreds of millions more have severely suffered from the disease.

DDT was banned in the United States in 1972 on the basis of a big lie, not science. In fact, the U.S. Environmental Protection Agency held seven months of hearings on the issue, producing 9,000 pages of testimony. The EPA hearing examiner, Edmund Sweeney, ruled, on the basis of the scientific evidence, that DDT should not be banned. "DDT is not carcinogenic, mutagenic, or teratogenic to man [and] these uses of DDT do not have a deleterious effect on fish, birds, wildlife, or estuarine organisms," Sweeney concluded.

But two months later, without even reading the testimony or attending the hearings, EPA administrator William Ruckelshaus overruled the EPA hearing officer and banned DDT. He later admitted that he made the decision for "political" reasons.

Although other nations continued to use DDT after 1972, the U.S. State Department mandated that no U.S. aid could go to any foreign program that made use of a pesticide banned in the United States. As a result, malaria rates in tropical countries began to climb, turning around DDT's initial success in either eliminating or lessening the impact of the disease. Former Secretary of State George Shultz reinforced the State Department anti-DDT policy in a 1986 telegram to all U.S. embassies abroad. But in the last year, in response to Congressional hearings on the science, and pressure from constituent groups like the Congress for Racial Equality, the U.S. Agency for International Development did an about-face on DDT, permitting use of DDT.

DDT is not a panacea for malaria. Africa desperately requires economic development, including adequate public health programs and health infrastructure to keep malaria under control. This is not just a question of Africa or other tropical countries: In the rest of the world, including the industrialized West, the takedown of public health infrastructure has begun to leave even privileged populations vulnerable to insect-borne diseases. Policy has been determined by the views of those environmentalists who foolishly leave human health out of their schemes to protect a mythical Mother Nature—and mosquitoes are allowed to breed freely.

Africa Needs DDT

by Fiona Kobusingye-Boynes

Fiona Kobusingye-Boynes: "I'm just an African woman with a dream: that we finally end a disease that is wiping out the future of Africa."

I have been struck down by malaria dozens of times. The vomiting, high fevers, dehydration, headaches, joint pain, and disorientation were beyond belief.

If doctors hadn't helped me even when I couldn't pay, I would have been dead long ago—like my son, two sisters, and three nephews, all victims of this vicious disease. Like the husbands and children of women who work with me, making beautiful purses to earn money for malaria medicines. Like 50 of the 500 orphan children who attended the school that my husband and I help sponsor—all dead in a single year!

It is an unspeakable tragedy. Malaria infects 400 million Africans every year, leaving them unable to work, attend school, cultivate fields, care for their families or build our nations. It costs Uganda over $700 million annually in lost productivity, millions of hours spent caring for sick children and parents, countless potential Einsteins, Beethovens, and Martin Luther Kings.

We could end this suffering and death, if we use every available weapon—not just insecticide-treated bednets, but insecticides, too, especially DDT. Unfortunately, too many politicians, environmental activists, and bureaucrats promote programs that don't work and tell Africans they can't use DDT, which keeps deadly *Anopheles* mosquitoes out of our homes for six months or more, with just one spraying on their inside walls. . . .

One study found that indoor spraying with DDT slashed malaria rates by nearly 75 percent in just a few years in Madagascar's highlands. Indoor DDT spraying, combined with insecticide-treated curtains had similar results elsewhere in the country. Despite this life-saving success, the World Bank and Roll Back Malaria have pressured Madagascar to progressively phase out DDT and replace it with an "environmentally friendly" insecticide, even though no chemical has yet been found that is nearly as effective as DDT.

I can only conclude that, in their minds, environmental considerations and international criticism about DDT take precedence over African lives. . . . I'm not a doctor or politician. I'm just an African woman with a dream: that we finally end a disease that is wiping out the future of Africa—our precious children.

Fiona Kobusingye-Boynes is coordinator of the Congress of Racial Equality's Uganda office. A farmer and businesswoman, she is a tireless advocate for human life, human rights, and effective malaria programs. She can be contacted at fiokob@yahoo.com.

This is an excerpt from her June 2006 op ed "Africa Needs DDT: World Bank at Fault," which criticized the World Bank's failing policy on malaria.

INTERVIEW: DONALD R. ROBERTS

To Combat Malaria, We Need DDT!

Donald R. Roberts, Ph.D., an entomologist, is Professor of Tropical Public Health at the Uniformed Services University of the Health Sciences in Bethesda, Maryland. He has conducted field studies and published scientific articles on DDT for the past 40 years, in particular showing that DDT has a unique effect: It repels mosquitoes. His work was important in the Sept. 15, 2006 decision of the World Health Organization to support the use of DDT for the spraying of inside house walls to prevent the spread of malaria.

Dr. Roberts was interviewed Nov. 16 by Marjorie Mazel Hecht.

* * *

Question: Could you tell us about how you got into DDT, and especially your pioneering work with Indoor Residual Spraying, IRS.

I became interested in the DDT issue in the very early days of my career as a medical entomologist, because DDT was, of course, the big topic during the 1960s. I was interested in it, but by and large I didn't have any feelings one way or the other in terms of DDT being bad for this or bad for that, or good for this or good for that. Eventually I became seriously interested in the whole issue as I worked in the field, in malaria control and malaria ecology. In those early years, we were like the young lawyer chasing ambulances. We were working in the Amazon Basin, and outbreaks were relatively uncommon, because houses were sprayed with DDT. Anyway, whenever we would have an outbreak, we would take off to go and investigate it.

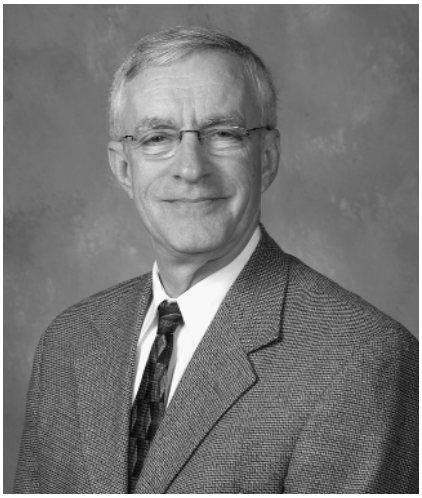
We quickly learned that we needed to get there before the spray teams. If we didn't, by the time we got there, the outbreak would be over.

Question: That fast?

That fast, instantaneous almost. I'm not saying that there would be no cases of malaria; I'm saying that there would be no malaria transmission taking place.

WHO

Anti-malarial spraying in Guyana. DDT works as a repellent, keeping mosquitoes out of the sprayed house, even if the mosquitoes are resistant to the insecticide. DDT is the only insecticide with this capability.



So the generation of new cases would end at that point in time.

I was impressed by the chemical—not by anything in the literature, not by anything in the popular press, but by my experience. So, eventually, as the opportunity presented itself, I started conducting field experiments on how DDT actually functions. And the outcome of the research was that I discovered—to my total amazement, I might say—that it wasn't functioning by killing mosquitoes. It functioned as a *repellent.* It kept them out of houses.

I actually went into the state of a recluse scientist for a number of years, as I worked on the literature, because I couldn't put my findings into the context of anything that I had been taught, or had been told. And so, I worked with the literature for a number of years, and I discovered that there were many like me—many field researchers—and you could find their papers scattered throughout the literature, dating back to the very beginning of the use of DDT. And we were all saying the same thing: DDT was functioning in ways that aren't appreciated.

So, one thing led to another, and I just stayed with it over the decades.

Question: Much to the benefit of the world—especially now with the new World Health Organization decision to

use indoor spraying of DDT for malaria control.

Well, that's what we all hope for! It has been a very encouraging change. And I think it was a very courageous act on [WHO malaria head] Dr. Kochi's part to take that position, and to go public with it. The fight is not over, because, of course, his decision has just rallied the anti-DDT folks, and so it's turning into a rather grim struggle. But, you know, you have to decide according to your own value system, what is the relevance of human health versus what is the importance of speculative harms.

Question: It's prejudice on the part of the anti-DDT folks, really—brainwashing.

Brainwashing, exactly, and it's everywhere. It's in the schools. It's in zoos. It's everywhere. And to a very significant extent, it's all false.

Question: And yet, when it's so engrained in people—the generations from the 70s on—it was drummed into them as a belief system, so it's very hard to shake it.

It's not science. To be blunt, most people know very little about the science of DDT, or the science about malaria control. But they have very strong opinions—and very loud voices. And when you see them get angry, as you mount a defense of the use of DDT, you know that you're dealing with a belief system, not science.

Question: Like many environmental views that are based on fear. . . . To go back to your early work with IRS, what impressed me was the statistics you had compiled about Ibero-America, where you can see that the countries that stopped using DDT had enormous increases in the rates of malaria incidence, and those where DDT was still used, did not have malaria increases.

Right. And where the use of DDT has been initiated or restarted, you find that malaria rates decline rather quickly, precipitously in fact.

P. Virot/WHO

A baby with advanced malaria at Garki General Hospital in Abuja, Nigeria. Ninety percent of malaria deaths in Africa are children under five.

Question: On the question of resistance, can you take up a couple of the usual objections that environmentalists raise to DDT, such as why bother to spray with DDT, because mosquitoes have become resistant to it. Yet, what you discovered is that the mosquitoes are repelled even if they are resistant.

I am a scientist, and the whole question about resistance and mechanisms of resistance is really important, and those lines of research should be pursued. But resistance to DDT—and there is evidence in the literature to back up my belief—is largely a product of use of DDT in agriculture.

There was a study carried out by Dr. Georghiou in Central America back in the 1970s, and he showed that the distribution of resistance to DDT in malaria mosquitoes corresponds *precisely* with the geographical areas in which DDT was being heavily used in agriculture. Not only did he find that its distribution was determined by the use of DDT in agriculture, but he found that seasonality was influenced. In other words, the proportion of mosquito populations and levels of resistance within a mosquito population varies by time of year, and that variance correlates with the time of the year that DDT is being used in agriculture.

So the basic mechanism that I'm talking about here is that when you put DDT on a wall, mosquitoes land on walls, and they become exposed to DDT on the wall, because they enter a house, and they enter a house because they want to bite a human being. The mosquito has an option. It can *not* enter the house, and if it doesn't enter the house, it stays away from the insecticide.

If you take the DDT and spread it broadly in the environment, the mosquito can't avoid it. The fact that DDT is a powerful repellent is irrelevant if it's everywhere; it can't be avoided.

Secondarily, DDT is a powerful contact irritant. But again, if you can't avoid it, it doesn't matter that it's an irritant. And of course, since it's sprayed everywhere in agriculture, it would wind up in pools of water, where the mosquito lays its eggs, and the selection for a resistance mechanism in those circumstances, is powerful. And so that is the basic mechanism of resistance selection that I'm talking about.

On the other hand, if you spray it inside houses, there are options; the mosquito can stay out of the house, and therefore there is no selection for resistance. But in addition, if it stays out of the house, it's not going to be transmitting disease.

WHO

Women with severe cases of malaria in an African hospital. "We've got to rebuild public health programs, and WHO capacities to direct house spraying programs," Roberts says.

Question: And so when you spray the inside walls of a house, it repels all of the mosquitoes, whether they are resistant to DDT or not.

The research that we have conducted up to this point in time suggests to us that toxic and repellent actions are entirely separate mechanisms of action. Toxicity is one mechanism of action and death is a contact response. The mosquito is not going to die unless it lands on a surface where the DDT is, and furthermore, you really do not get significant levels of mortality of mosquitoes unless they remain in contact with DDT for several minutes, on the order of 20 minutes.

Question: Isn't it part of the behavior of mosquitoes that they rest on walls for that long?

They rest. They rest before they take a blood meal, and they rest after they take a blood meal. That is part of their behavior.

So, toxicity requires contact, the absorption of the chemical. Repellency is entirely different. Repellency is a vapor phase—no contact. The mosquitoes detect it, probably through receptors on the antennae; that's my best guess. They can detect molecules of DDT in the air, and the probabilities are that they can detect a gradient of molecules. And once they detect that gradient of molecules in air, they go in the opposite direction.

Question: What do you mean by gradient?

Increasing numbers of molecules in air.

Question: So, as they approach the wall, they sense they are getting closer to the DDT and they leave.

Right. It's the same mechanism that you would use if you smelled smoke. Our sense of smell is acute enough that we can actually rely on it to direct us in a particular direction if we are smelling something. I think we're talking about a very similar kind of phenomenon here. The mosquito can detect a gradient of chemical and responds, "Whoa, I'm not going there."

Question: I think that's been very important in the decision by the WHO to begin the indoor spraying with DDT.

I certainly hope that it has been, because frankly, there's no other chemical like DDT. We know that—we've tested hundreds of chemicals.

Question: What about the alternative pesticides that are promoted, the pyrethroids, for example, to which mosquitoes have become resistant?

There is a growing problem of resistance to the pyrethroid insecticides. This problem is being taken very seriously by the World Health Organization. I know for a fact that there is great concern about it. The issue with the pyrethroids is that they're not used for public health programs alone; they are used extensively in agriculture, and so the resistance problem is not going to diminish; it's going to grow. And so there is a real need for new chemicals. There will be situations where pyrethroids have worked well in the past, but not in the future. At that point, what do they go to?

The environmentalists have mounted attacks on the organophosphates, so the organophosphates are not an optimal alternative. The environmentalists have mounted attacks on the carbamates, so the carbamates are not an optimal alternative. So what do you have other than pyrethroids?

L. Ptito-Anderson/RBM Partnership Secretariat

A bednet demonstration at an Africa Malaria Day celebration in 2004. Bednets are useful, but alone they won't stop malaria transmission. As Roberts notes, nets require "user compliance," and they provide protection primarily when people are under the net, but people do not necessarily stay under the net during the entire time that mosquitoes bite.

Question: I guess you have protection of mosquitoes at the expense of people.

That is why we need DDT. Besides, none of these other chemicals function as a repellent. Some are contact irritants, but none are strong spatial repellents like DDT.

Question: The other issue people raise is, why not use bednets, and this amazes me because of the tiny number of people who now have bednets. I'm not against the use of bednets, but they don't do the job in the same way. What do you think?

I'm not particularly eager to attack the use of bednets, because I think the bednets are useful and it's not constructive to attack them, but the problem with the bednets is the same problem you have with any personal protective measure. It's fundamental, it's basic: The problem with bednets is user compliance. People have got to be willing, and they've got to have the discipline to use the darn things every single night.

The other issue with bednets is that they provide protection primarily when you're beneath the net. And that's a limitation. People do not necessarily stay under their bednets during all the hours when the mosquitoes are out there biting. The bednet is an easy and popular

answer to the malaria problem. Bednets are receiving such an enormous push right now. So many people, and so much big money is behind use of bednets. *But* all the hype, all the big money, is not going to overcome those fundamental issues.

There is a basic principle in occupational health: The least desirable of all preventive measures is the personal protective measure. That relates to the fact that people won't comply. And so, the big push right now in malaria control, the use of bednets, defies that fundamental principle of occupational preventive medicine.

Question: Another question that's related in my view, and this is something that the anti-DDT people have said, is that "We can't do DDT, because it requires public health infrastructure." That boggles my mind. They are actually saying, we don't want to spend money on infrastructure; we don't have it, whereas we have the money for bednets. I don't get it.

It's putting the cart in front of the horse. You must have infrastructure if you're going to control the disease—any disease. You've got to have people who know something about therapeutics, about the proper treatments. You've got to have people who know something about data collecting and surveillance, making a proper determination of whether one case is malaria and another case is some viral disease. You've got to be able to distinguish between these infections. All of that requires infrastructure. You've got to know how much disease you have, how big the burden might be, before you can evaluate whether or not your control methods are working to control disease.

Question: I think a major problem is that there is no infrastructure in Africa. Here we've taken down our public health infrastructure too, but in Africa, it's abysmal.

Yes, it's abysmal, but the policies that brought about the destruction of our malaria control programs around the world were *wrong,* just flat wrong. And the people who were promoting those changes were deluded into thinking that what we need to do is empower the people to handle their own disease problems.

People can't handle their own disease problems. And you can't empower them to do so.

Question: It seems to me that policy move was an excuse for genocide—deaths in the millions over the past few decades.

It has certainly been a major global reversal in public health. No question in my mind about that. Hopefully, change is on the way. There's hope; perhaps that's all we have at the moment.

Question: I have been following the news on various countries in Africa, and they do seem to be making a fight to get back to the use of DDT.

And if it's not DDT, at least it's Indoor Residual Spraying. Because, quite frankly, I think the best of all worlds would be a combination of spraying the walls and the use of the bednets, ITNs [insecticide-treated nets]. We shouldn't exclude bednets; they should be used. But we should spray. The advantage of spraying is that a sprayed wall is the first cut. The mosquito has to get past that barrier first. If it gets past that barrier, and there are nets, maybe the nets will give the second line of defense.

Question: What do you think it would take, having been in this field for a few decades now, to get public health back to where it should be?

It takes a huge investment, and you can see there are signs that the investment is growing. That's a very hopeful change. Monies are being made available, probably not enough, but a lot more than we had before.

So, number one, it takes a huge investment, and number two, it takes investment in infrastructure. We've got to rebuild public health programs, and WHO capacities to direct house spraying programs. Additionally, we've got to stop saying "We're not going to do anything unless it's based on the community." We've got to get public health workers back into the field doing public health for the people. As opposed to saying, "No, no, we want the people to do all this."

Question: That's just an excuse for not doing it.

Exactly, it's a cop-out. If you look at the history of our efforts with dengue fever, you see a glowing example of this whole idea of community participation. Throughout the '70s and '80s, the catchwords, the hype, for dengue control, was "community participation." It was an abysmal failure. There is no success.

Question: In other fields that has certainly been the case, such as community control of education. . . .

We just need to go back to what history has shown us actually works. I have tremendous respect for the scientists of the 1940s and '50s, who were in there doing pioneer work in the field, on the ground, showing how they could go about controlling disease, and they did it. They were successful, and we have now a 30- to 40-year history of complete failure, rejecting everything that they did. And it's not as if they tried and they failed; they tried and they succeeded! And we've spent the last 30 years casting criticisms on what they did, saying, "No, we're doing it the right way, we're doing it a better way," and meanwhile disease is growing, and growing, and growing.

Question: I think the words of Alexander King give a big clue as to what happened. He said, he was for DDT during World War II—he was a chemist in charge of DDT for Britain. And then, by 1960, when he founded the Club of Rome with its Malthusian outlook, he said in a memoir that he regretted his decision to back DDT, because it had allowed such population growth in the Third World: People weren't dying of malaria, and they could live and have children. I think that's behind a lot of the anti-DDT and other kinds of public health take-down: the idea that we don't need more people, and this is a good way to get rid of them.

It certainly works! The disease and the dying are going on. Illness is high, deaths are high, and they just keep increasing. Malaria is pretty good at taking people out of the picture, so to speak.

The truth is, though, that does not solve population growth. If you're truly

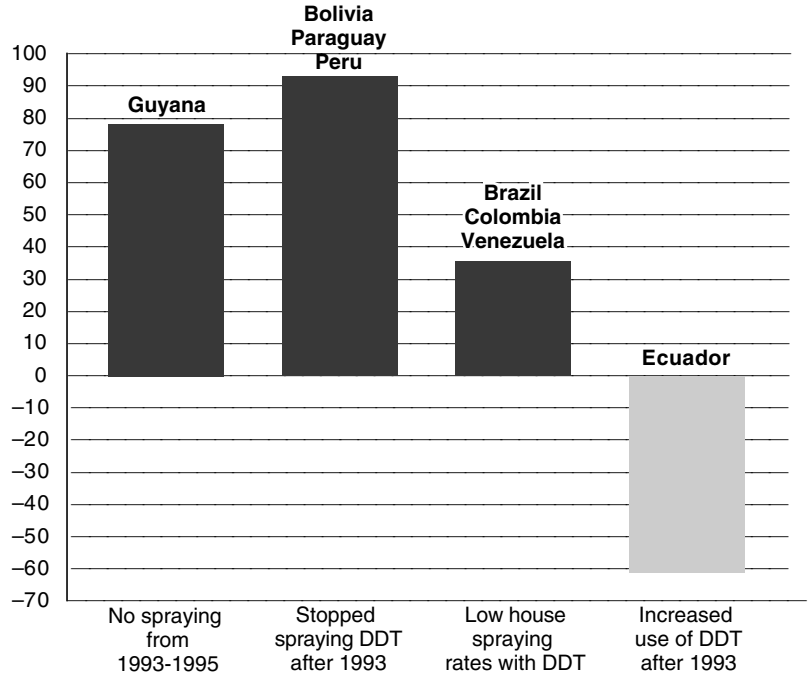


FIGURE 1
INCREASES IN MALARIA FOR COUNTRIES IN SOUTH AMERICA, 1993-1995, PERCENT INCREASE IN NUMBERS OF CASES

Source: Adapted from D. Roberts et al., *Emerging Infectious Diseases*, July-September 1997, p. 300.

concerned about population growth, what you need to do is focus on making those people wealthier.

Question: That is another way to look at it; people who have a higher standard of living tend to have fewer children, so they can raise them to have an even higher standard of living.

They tend to produce fewer children. It's like the population growth that we see in Japan and Europe. Many countries are very concerned about their *lack* of population growth. You'll also find that these are rather wealthy countries.

So, I think the people who are against DDT because it prevents disease and death, and do so from the standpoint of controlling human population, are just terribly misled.

Question: Unless they are the Bertrand Russell types, who advocated the use of disease as a killer.

I've never been able to figure out the role of that ideology within this mix of issues. I know it's out there. I don't doubt that; I just don't know how big of an issue it is.

Question: Any time I've questioned persons who are opposed to DDT, it turns out that they are Malthusians. They think that fewer people in the world would be better. There's no causality there, necessarily, but those two things usually go together. It's the same with nuclear energy and fusion. . . . They oppose it because it will lead to cheap energy and more industrialization.

It's very sick, and it's wrong—it's wrong ethics and wrong thinking.

Question: Can you talk a little about the book you are writing?

This book is about DDT. It is written to build a solid foundation of science for dealing with the questions about DDT. In the book, we try to explain how DDT actually functions to control disease transmission, and how it is, in fact, unique in the way that it functions. We explain that DDT is not a very toxic chemical, and try to put its persistence into perspective, in terms of compartmentalization, sequestration, and biodegradation.

There are lots of misunderstandings about DDT. There is a strong belief that DDT does not biodegrade; it does. It's readily biodegraded. It's biodegraded in the human body. It's biodegraded in the bodies of most living organisms. It's biodegraded by bacteria. It's biodegraded by fungi. White rot fungi can mineralize DDT. So it is ubiquitously degraded in the environment.

It is also degraded by light. It's chemically degraded. And so, when you start looking at all the mechanisms for breaking down DDT, what you really discover is that DDT is persistent, only to the extent that it is protected from all of these processes, by becoming tightly bound to organic particles in the soil, for example. In the process of compartmentalization, it becomes stored in fat. Basically DDT in a fat cell is not available for degradation. In addition, when it's in fat, DDT is not available to act against the living organism.

So, this whole concept that DDT is persistent, and that this persistence is a problem, is wrong. The fact is, the natural world is fully capable of dealing with DDT, because we are surrounded by chemicals like DDT. Degradation, sequestration, and compartmentalization are natural processes for dealing with DDT and other DDT-like chemicals. There are certain vitamins that are toxic, but they are essential to our survival. Some lipophilic chemicals will bioaccumulate, and the way nature handles such a chemical is to tuck it away in fat.

Basically that's the process of compartmentalization. If you were to take the process of sequestration and compartmentalization of DDT away, DDT would be degraded and disappear.

Question: It seems to me, from looking at experiments reported in the DDT literature going back to the 1960s, that DDT in the animals it was given to, had a kind of protective effect. In other words, the dogs who were given very high doses of DDT, did a lot better than the control group. They got

sick less and they lived longer. Did you deal with this at all?

Well, let me give you one example. I don't know that I can say anything profound about it. By and large, within a living organism, DDT becomes a neutral factor. It's neither good, nor bad; it's just there. And because it's tucked away in fat, it's biologically inert. But there are systems for moving DDT out of fat, and getting rid of it, just as there are systems for moving any other lipophilic toxins out of fat and getting rid of them.

So none of this is new to nature. We are literally surrounded and immersed in an environment of lipophilic chemicals. Some are toxic, some are less so, and we deal with all of them. Some of them are essential to our survival. DDT is not essential to our survival, but there are certainly mechanisms for dealing with it in a natural way.

The example I was going to give you: You're familiar with the robin story, which Rachel Carson described. She stated that the robin was headed for extinction because of DDT. Well, a study of many aspects of the robin story was published in 2000, and another in 2003. DDT was used heavily in apple orchards. In fact, there was probably more DDT placed on apple orchards than any other commercial crop. And so, there are these orchards in Canada where DDT had been used until 1973. There was still a lot of DDT in the soil. If you test the robins that live in that orchard, they have higher levels of DDT than any other bird recorded. And you find high levels of DDT in the earthworms.

But if you compare the populations and reproductive success of robins in the orchard, with the robins in surrounding areas that have *no* DDT, you find that the robins are doing just as well, with the DDT, and in fact, the brood and clutch size of the robins in the orchard are actually higher than the brood and clutch size of robins in areas without DDT. The difference is not statistically significant, but they are higher.

So basically, what you find is that the DDT is there, but it causes no harm, and certainly does not affect reproduction.

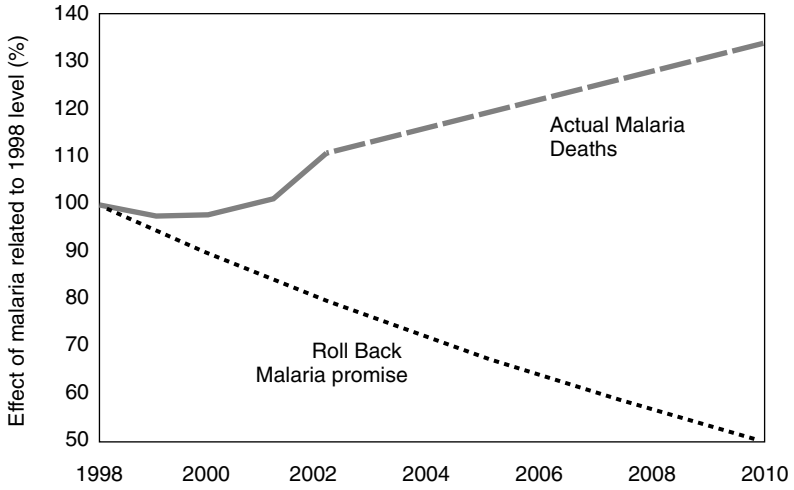


FIGURE 2
MALARIA DEATHS SINCE ROLL BACK MALARIA PROGRAM, AS PERCENTAGEOF 1988 LEVEL

The Roll Back Malaria program, a partnership of WHO and UN organizations, has pointedly avoided any use of DDT, and has been an abysmal failure. Since the RBM founding in 1998, deaths from malaria have steadily increased.

Source: Adapted from the *British Medical Journal*, May 8, 2004.

Question: I think that the robin story promoted by Rachel Carson is a complete lie, because there were plenty of robins in 1962 when she wrote her book, and later.

It was a complete lie. What she focussed on was what happened on a Michigan State University campus in Ann Arbor, and so she made all those wild claims. There were studies done and published in 1973 by ornithologists on campus, and what they showed was that Carson's data were all wrong. They saw that there were just as many robins during the time that DDT was in use as before or after DDT use. And in fact the nesting populations of robins were higher during the DDT years than before or after. But the anti-DDT people don't want to know that. . . .

Question: Can you say a little more about your book?

The goal of the book is to try to set the record straight on DDT. And, more important, to show how the use or non-use of DDT was a critical public health issue that had implications for the health of hundreds of millions of human beings. Hundreds of millions of people have been harmed by the environmentalist-activist campaign against DDT.

The outcome of the enormous propaganda machine has been to give over to the environmental organizations, like EPA [U.S. Environmental Protection Agency], UNEP [United Nations Environment Program], and many others around the world, authority, regulatory control over a critical public health issue, and they have no recognition of the public health consequences. They have authority; they assume no responsibility.

That's one of the points that we try to explain in the book—that the reason that people have been harmed is that the authority is resting in the wrong hands.

Question: And people are continuing to be harmed until we change that situation.

It should change. If there is any justice in the world, the authority over the public health insecticides will be taken away from the environmentalist organizations, and will be put in the hands of the people who have responsibility for public health—WHO, or CDC [Centers for Disease Control]. There should be

change; whether or not there will be change is an open question.

Question: It's a fight! When does your book come out?

I'm working on the eagle story right now and to be fair, and to get the science right, is very difficult. I'm spending a tremendous amount of time researching, as are my co-authors. I know more about eagles than I ever wanted to know. This is the last chapter I'm writing, and I hope to have it finished in the next two to three weeks.

Question: One last question: For years the environmentalists have been trying to come up with reasons that DDT is "bad"—whether it's shrinking crocodile penises or hurting the development of Mexican-American children (the recent California study).[1] They are just trying to find *something,* but to my knowledge, they have never found anything in DDT harmful to human health. Can you comment on the University of California study on DDT and infant development?

I think the California study falls into the same category as many of these studies. Basically it comes down to the existence of large data sets, and the numbers of large data sets are growing. We are dealing with statistical manipulations, looking for correlations with a large number of variables, and you set your probability for statistical significance at 5 percent, and well, one out of twenty columns of data is going to give you a significant result; that's 5 percent. And I think that's what is happening, There is some weak association, and with a large data set, it may give them a statistically significant finding, and they go with it.

Somebody else comes along, and has a different large data set, and they find that, no, it just doesn't work out that way. Those are the problems that we are dealing with: One study finds an association and another study doesn't. It is a search for something harmful from a chemical that we can detect in extremely small quantities. And it's often there, so it's a good target.

Occasionally somebody gets a hit, and they go to press with it. Through this process, we also run into the bias against negative results. If you do a study that duplicates the Eskenazi study [the University of California study of Mexican-American infants], and you find no association, your chances of getting that paper published are extremely small, because it's a negative result. That's a bias in the whole process of publishing scientific studies, and it's real. There's no figment of imagination here. If you've got a negative result, that result is just not very helpful.

If we had 10 studies, and they all showed the same thing about developmental effects, you might reach the point that you can say, there's something real in this association. I'm talking about well-designed, well-performed scientific studies all showing the same result. Then you might say, well, let's look at it. Now, just because studies show a developmental effect, does that mean DDT is not good? In my opinion, it doesn't mean that at all. What you have to do is take a look at what is harm versus benefit.

If you've got a population where you're losing 100,000 babies to malaria a year out of a population of 20 million or so, boy, you'd better have some serious, serious harm coming from the use of that chemical if using it will save 100,000 lives.

Question: What the study showed was so inconclusive, that at a certain point of the infant's development, the child was one or two months behind. That's meaningless, really.

It's particularly meaningless when you realize that it's very possible that even if there were an effect, it could disappear over the next two or three years of development.

Question: And how many other things are so much more important in terms of a child's development?

The true significance of that paper was not the science, in my opinion, but that the authors stepped over the line, and made the suggestion that the results of their study should be taken into consideration by those countries looking to use DDT for malaria control. In my opinion, the authors were over the line because they knew nothing about malaria or the benefits of DDT. For them to cross the line and say that those countries should look at their study results before making a decision to use DDT is, I think, unacceptable—scientifically and ethically unacceptable.

Question: It's also unacceptable that it was picked up and ballyhooed everywhere, including in the science press with the same intent.

Notes

1. Brenda Eskenazi, Ph.D. et al. "In Utero Exposure to Dichlorodiphenyltrichloroethane (DDT) and Dichlorodiphenyldicholorethylene (DDE) and Neurodevelopment Among Young Mexican American Children," *Pediatrics*, Vol. 118, No. 1, July 2006.

Seattle LYM Conduct Between the Notes At Superconductivity Conference

by Wesley Irwin

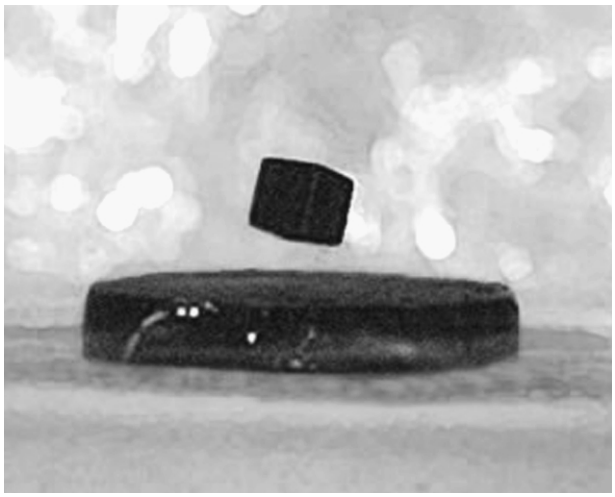
LaRouche Youth Movement organizers attended the week-long Applied Superconductivity Conference in Seattle, Washington, Aug. 27-Sept. 1, to interject some scientific and economic reality, and to learn more about the amazing technology of superconductivity. We found an open response from hundreds of scientists, who need our help in keeping science alive. We happily discussed solutions to the breakdown of the U.S. science orientation, and the ongoing global economic breakdown.

Superconductivity is one of the most fascinating scientific discoveries of the 20th Century. This still largely unexplained property causes certain materials, at very low temperatures, to lose all resistance to the flow of electricity, thus enabling a variety of new technological applications. Its development could revolutionize our use of electricity, making possible higher efficiencies than previously imagined.

SCIENCE and the LaRouche Youth Movement

Discovered in 1911, by Dutch physicist H.K. Onnes, superconductivity was first demonstrated in cooled mercury metal. Through the 1900s, many other materials were found to be superconductors at temperatures below 23.2 kelvin. These materials are referred to as low-temperature superconductors (LTS), while those discovered decades later are known today as high-temperature superconductors (HTS), and are used at temperatures above 23.3K.

In 1986, J.G. Bednorz and K.A. Muller made an enormous breakthrough, discovering copper oxide-based ceramic materials that could be superconductors at temperatures as high as 35K. This was followed by another revolutionary discovery in 1997 by Dr. Paul Chu, who found a superconductor functioning above 77K (about –196° celsius), which is the boiling point of liquid nitrogen. (Dr. Chu was one of the scientists we talked with at the conference.) Since Chu's breakthrough, worldwide research has uncovered oxide-based superconductors with critical temperatures as high as 135K, which offer tremendous potential for improving the efficiency of electricity.



Lawrence Berkeley National Laboratory

This permanent magnet levitates above a cuprate high-temperature superconductor (in what is called the Meissner effect), because superconductivity repels a magnetic field.

Transforming Electrical Transmission

Today's application of superconductivity technology is potentially all encompassing for the electric world. HTS wires, for example, are capable of carrying currents that are more than 100 times higher than those carried by conventional copper wires of the same dimensions. HTS power cables can transmit 3-5 times more power than conventional copper cable of equivalent cross section. Unlike oil-cooled electricity transformers, HTS transformers, cooled by liquid nitrogen, pose no fire risk, and are capable of operating at twice the overload capacity of conventional transformers. Some of these cutting-edge wire and cable technologies are already being successfully implemented in Albany and Long Island, New York, and in Columbus, Ohio.

In the transportation sector, HTS is being studied closely by the U.S. Navy, among others. In fact, in 2000, the U.S. Navy announced that it would eventually migrate toward an all-electric fleet! Electric propulsion systems more fully integrate a ship's total energy usage, and HTS motors and generators operate at one-third the size and weight of their conventional copper-wound predecessor, in addition to running more quietly.

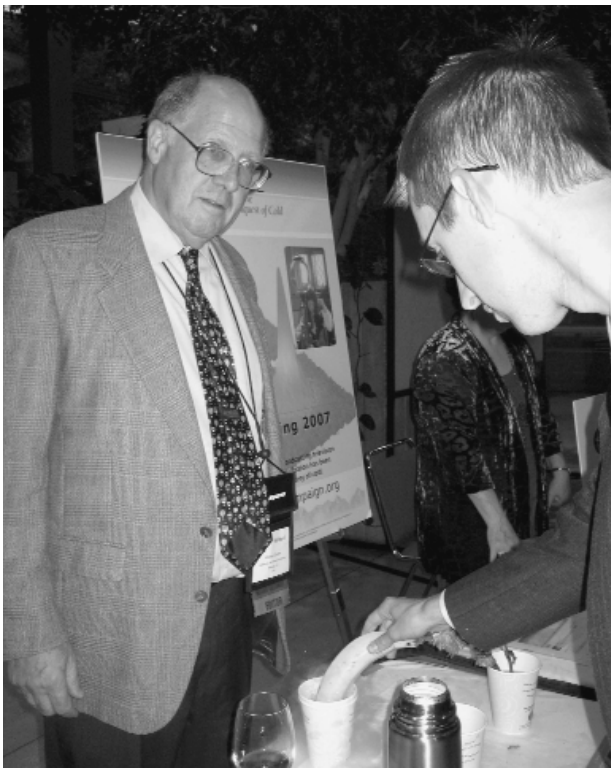
Perhaps most exciting is the potential advancement of transportation systems through HTS application to magnetically levitated (maglev) trains, which, by utilizing superconducting magnets, are able to make trains safely "fly" above their tracks with zero rail friction; the opposing force of the giant HTS magnets causes the train to float. Magnetically levitated trains have thus far attained top speeds in excess of 500 kilometers per hour.

The scientific optimism associated with this amazing maglev technology was conveyed by the LYM organizers at the superconductivity conference, with the idea of building international maglev systems to transport physical goods, people, and cultures around the world.

Other applications of superconductivity have already made their mark. Medicine has been forever changed through the initial breakthroughs in HTS. Magnetic Resonance Imaging (MRI) requires HTS for the magnets needed for precision diagnostic imaging. Conventional magnets cannot provide the field values required for MRI, which relies entirely on a superconducting magnet.

In NMR (Nuclear Magnetic Resonance) spectroscopy science, LTS materials are being utilized to create progress in drug discovery, biotechnology, and genome and material science. NMR spectroscopy is even used in such areas as the determination of the chemical structure of extraterrestrial matter in meteorites, as well as the flow of matter in a variety of Earth materials.

In high-energy physics research, superconducting magnets are essential. The Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory in New York, which smashes heavy ions together at very high energies, has two concentric rings which are made up of 1,740 superconducting magnets that contain more than 1,600 miles of superconducting wire. The Fermi National Laboratory in Illinois has a similar device, which accelerates protons and anti-protons to 99.9999% of the speed of light, then smashes them together, to investigate what particles are produced.



Chris Jadatz/EIRNS

Author Wes Irwin dips a banana into liquid nitrogen at a cryogenics display at the superconductivity conference. When hit with a hammer, the super-cold banana was smashed into pieces, as if it were made of glass.

Future Technologies

Most exciting may be the application of superconductivity science to nuclear fusion power, and space exploration, both subjects that LYM members have been researching, including tours of science facilities and special projects, to help push mankind off planet Earth, and into our natural role as gardeners of our Solar System, and even the outer regions of our galaxy.

One of the largest scientific research projects in history, the International Thermonuclear Experimental Reactor (ITER), is the test model for what will become the first electricity-generating power station based on magnetic confinement of high-temperature plasma. This new fusion power device will require 1.8 million pounds of superconductors to help generate the high magnetic fields needed to confine and contain the high-temperature plasma, which reaches temperatures of 250,000,000° C—hotter than the Sun!

Superconductors are under development for a whole array of space-related applications, including magnetic actuators, magnetic refrigeration, space-based magnetic plasma confinement, and even magnetically assisted propulsion. Just imagine a magnetic propulsion system on Earth capable of launching space shuttles into space, free of the burden of giant fuel containers. This would be ideal for continuous flights to Mars! All these potential developments are achievable in the near future—if the LaRouche movement succeeds in implementing a policy for science-driver economic cooperation across Eurasia, and then the rest of the world, in the coming period.

A Question of Political Will

The onrushing physical economic breakdown of the increasingly privatized infrastructure in the United States, has created a crisis situation: Old neglected power lines are catching on fire, energy grids are susceptible to frequent shutdown, and entire cities are facing possible blackouts for hours, days, or even weeks, as power cables are pushed beyond their thermal limits. This brings us to the crossroads at which superconductor technology is not a mere "convenience," but rather is one of a number of very real, life-or-death investment decisions for the U.S. Congress in its next session. Unfortunately, the Cheney/DeLay Republican-controlled Congress voted not to increase funding for superconductivity research, which is hovering currently at a mere $35 million a year, a ridiculous amount for a research field that holds such promise for the physical economy, and which has produced five Nobel Prizes in physics.

Dr. Alan Lauder, the executive director of the Coalition for the Commercial Application of Superconductors (CCAS), which was a major sponsor of the Applied Superconductivity Conference, said the amount of money being put into research and development should be *doubled* out of immediate necessity alone. Lauder stated that if you take a look at a picture of what was running underneath the ground of major U.S. cities in 1906, and look underneath the exact same streets in pictures taken in 2002, the "failing infrastructure" of today is, "literally, the same as it was back then!" "The fashion of the men's clothing changed in the picture, and that's about it," Lauder stated.

The director of the Oak Ridge National Lab's Electricity Delivery Program, Robert Hawsey, stressed that superconductivity science needs government funding, because it is too big for the private sector to handle on its own. Hawsey said that if it weren't for FDR's Tennessee Valley Authority infrastructure program, which required a national political fight on economic policy, he wouldn't be living and working in Tennessee today. The issue of increased funding in the field is completely political, he said.

Hawsey, who is also the head of the Renewable Energy Program at Oak Ridge, was adamant that the world has to move to massive nuclear power production. However, under current levels of funding, he said, the United States will be able to produce just a handful of nuclear plants over the next decade, at best.

Siri Martin/EIRNS

Seattle LYM members Chris Sandford, David Dobrodt, and Linda Vu in discussion with a superconductivity exhibitor (at right).

In this discussion, and others, it became clear that although problems associated with the collapse of science infrastructure were widely recognized, there were little or no hypotheses being generated about the method of physical economic thinking needed to solve the crisis.

LaRouche Youth in Dialogue

LYM members Siri Martin and this author were able to have discussions with some of the world's most renowned scientists involved in superconductivity. What stood out to many of the scientists we spoke with, was that only a minuscule number of youth attended the event, and the level of scientific competence and interest we had in such a broad array of scientific fields.

Dr. Stephen Gourlay, the director of the Accelerator and Fusion Research Division at the Lawrence Berkeley National Laboratory, said that he, like many of his colleagues, know that there are not enough young scientists who want to work in these fields. Gourlay concurred that part of the problem in United States was the shift from a producer- to a consumer-oriented economy, that has taken place over the past four decades. He happily arranged to set up a tour for the LYM of the fusion research facility at Berkeley. We told him about the LYM work on Kepler's discovery of universal gravitation, and on Vernadsky's work on biogeochemistry, and Gourlay (like everyone else we talked to at the conference), said that to restore the scientific tradition of the United States, the shift must come from government. He joked ruefully about how the lack of funding (the fusion research budget is peanuts) means that we'll always be 30 years away from fusion power.

Victor Yarba, a Russian nuclear physicist working now at the Fermi Laboratory, who decades ago made three original breakthroughs in nuclear power research, was even more adamant about the role of the youth in the United States. "You're the future! You're the ones who must do it!" he exclaimed. We told him about our work on rediscovering the discoveries of Mendeleyev's Periodic Table and Vernadsky's conception of the Noösphere. He became very excited, but then expressed great sorrow at how the United States used to lead the world in science, but now that tradition is almost dead.

Yarba has trained more than 200 other Russian scientists who are now working in the United States. He excitedly took all of our literature and wanted to stay in touch. In the science field, as with most everything else of real physical value, the United States is currently importing quite a lot, and producing very little.

The last day of the conference featured an "open to the public" session, and all the Seattle members of the LaRouche Youth Movement attended, having discussions with the superconductivity scientists, and playing with their experiments; the liquid nitrogen was especially fun. We were by far the largest group of young people there, and were very effective in engaging many of the scientists on the difference in method between Leibniz and Newton. We also intellectually fought with others over the Second Law of Thermodynamics, challenging these scientists on the self-evident reality of the Universe's anti-entropic, self-developing nature, which is an idea that flies in the face of all the teaching of modern physics textbooks.

A 'Solarian' Symphony

We distributed more than 100 copies of *21st Century Science & Technology* magazine. For many of us, the conference was a glimpse at what a culture based on discussion of beautiful scientific ideas could actually be like—a world in which current conceptions of reality are based not on immediate sense experiences, like those perceived by higher ape species, but rather on the scientific conception of what you want your life to have contributed to humanity's development, 50 years down the road from the time your biological existence ends. Because of the rigorous science and music curriculum pursued by the LaRouche Youth Movement, we were able to uplift the discussion in some cases to that more truly human level, by providing the overarching idea necessary for beautifying the composition of the conference itself.

The largest roadblock for the application of superconductor science today, comes from a Baby-Boomer-dominated Congress, and a highly intellectually challenged President, who both, in varying degrees, represent the thinking quality of the U.S. population. For those who claim ignorance of conceptions of physical economy, the LYM will be there to give scientists, Congressmen, and citizens, the needed pedagogical illustrations, through their own ongoing work on Kepler, Vernadsky, and Bach, to help compose a cultural symphony of undeniable joy and optimism that will radiate out for generations to come. In doing so, we may become the zero-resistance conductors of mankind's future solar symphony.

INTERVIEW: DR. STEPHEN GOURLAY

Science Today Needs A 'Grand Vision'

Dr. Stephen Gourlay is the director of the Accelerator and Fusion Research Division at the Lawrence Berkeley National Laboratory in California. He was interviewed by Wesley Irwin on Sept. 12, 2006.

Question: What goes into accelerator and fusion research?

Our job is to do the things that can't be done in industry. We don't compete with industry. Government funds a lot of things in that category, and sometimes that's the only way we get them done. We support high-energy physics, so we develop cutting-edge technologies to further the means of high-energy physics: high-energy accelerators, new techniques, more effective ways of accelerating particles.

Machines are getting very big nowadays, so we're trying to get the cost down. We may be pricing ourselves right out of the market in terms of science, if we can't come up with clever new ways to do the job we need to do, and so we have a considerable effort focussed on that.

In the fusion area, we utilize accelerator technology to do inertial fusion using heavy ions. There's also inertial fusion using lasers, which is the basis of the National Ignition Facility at Livermore, but our approach is to use heavy ions, which is complementary to that.

The accelerator technology there has to be extremely reliable . . . and it's something that takes a lot of money to do because accelerator technology is very expensive, and to take the steps we need to take is going to require a much larger investment by the government than they've been willing to make at this point.

Question: What magnitude of investment would be sufficient to carry out the research that needs to be done in the fusion area for the coming century?

I think we need to take a broad-based approach—that's the one I favor—which includes our participation in ITER. I think for a lot of reasons ITER [the International Thermonuclear Experimental Reactor] is a good thing to do. First of all it's international cooperation, which I think the United States needs to do more of to develop our expertise along with the rest of the world in new scientific endeavors. And after all, energy is a global problem. But we also need to invest broadly in our approach to find out what the best technology will be.

I believe the current R&D budget for fusion in the U.S. is about $290 million per year, and if you tripled that, we'd get off to a pretty good start. That sounds like a lot of money but compared to some of the things we've been spending money on—and also considering the consequences for the success of that program—it's pretty small.

Photos courtesy of Lawrence Berkeley Laboratory

Dr. Gourlay (right) with a student.

Question: What do you see as the current state of science in the U.S. at this point, and what direction do you think we ought to move in to get more youth involved?

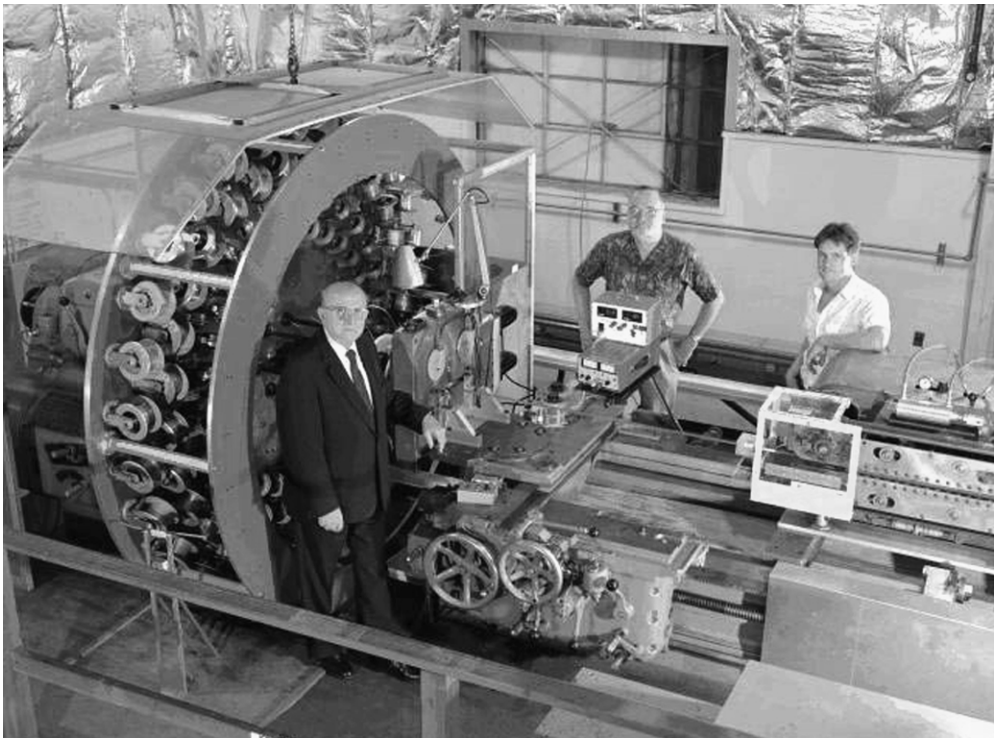
Well, that's a tough one. Clearly, the number of students and the interest in science has been falling off for quite some time, and—this is my opinion, but I think it's fairly based—science doesn't get the respect that it used to. People have forgotten that after World War II, our economy was based on science research and influx of talent from other countries around the world, and now that flow is heading more outward than inward.

SCIENCE and the LaRouche Youth Movement

People will still come here to become educated, but many of our graduate students are from foreign countries, and instead of staying here and applying their skills, they go home. The number of American students is dropping quite a bit. I know in one of our programs we rely on students from Italy. We just can't find the interest here to pursue these things.

So, I think it really goes back to how people view technology and science, and I think it's taken a backseat to the "Me" generation, trying to make money instead of make progress.

Question: Certainly that idea of progress was a key characteristic of the Franklin



Lawrence Berkeley National Laboratory

The superconducting cable of the Advanced Light Source at Lawrence Berkeley Laboratory.

Roosevelt era, where we were building massive infrastructure and had that greater sense of productive vision and mission orientation. What role does nuclear fusion have in giving people that sense of mission that we once had?

I think it's extremely ambitious, and an extremely difficult thing to do. We've been trying for a long, long time, and the saying is, "nuclear fusion is 30 years off and always will be 30 years off," and part of that is because the investment and perhaps the focus has not been optimal.

SCIENCE and the LaRouche Youth Movement

I think the way to move forward is to have grand visions, and people are afraid to even propose that these days, because they may get shot down for asking for too much money. But really, a vision, even if it's large-scale, is what drives everything beneath it. I think we lack grand visions for things.

Question: Have you researched the possibility of fusion applications to a future U.S. space program?

If you are referring to these rocket motors and so on, I haven't looked much into that.

Question: I know that the idea that Kennedy had was to use nuclear fission rockets instead of the giant propane tanks. With nuclear fusion rockets, you could make trips from Earth to Mars in a number of days as opposed to a matter of months.

I know in pursuing the development of a certain technology with a specific goal, that you learn a lot of things along the way that can be pursued in many different areas. That's the beauty of basic research. When you set a goal that's far enough out there, and pursue that goal, it generates a lot of new ideas, and a new technology can generate so much more along the way, that in some cases the original goal becomes secondary to the things you get out of it. That's the case in many areas of technology development. So, it's possible that it could contribute to fusion propulsion, but it's hard to say.

Question: If we were to apply nuclear fusion science to something like the running of magnetically levitated train systems what does that mean in terms of the potential power output?

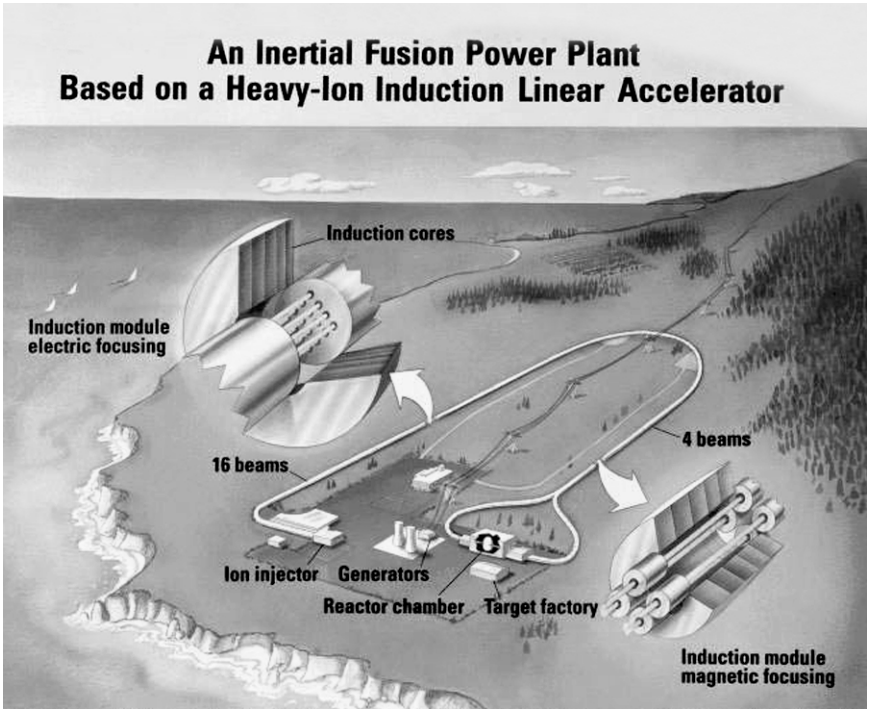
It depends on what your point of view is on how it should be developed. It's got to be something that's a combination of high-power localized nuclear power stations for instance, and solar, bio, wind, and hydro, depending on what region you're in, the population density, and so on.

This is something that again requires a vision for the future. You've got a lot of people working on individual pieces of this, but I haven't seen an organized approach to this whole picture. What's the grand vision? Ask where do we want to be 50 years from now, 100 years from now?—and start to work in that direction. Berkeley Lab is heading that way with a major new initiative called Helios, to develop ways to convert solar into carbon-neutral forms of energy.

Question: With some of the clean nuclear fission plants being developed today, and with nuclear fusion, is there any reason for the world not to go nuclear?

Not in my opinion. I think these problems can be solved by a combination of technologies. Another important aspect, of course, are the regulations that have to do with this. We can't even get Yucca Mountain licensed in this country. The public utility regulators need to consider life-cycle costs in making approvals of new power plants, and we need to get the public utility officials to put construction costs in their rate base to help pay for it; it's really not that much when you consider what we're getting for it. It has to be approached from both sides—the government side and the technology side—and meet somewhere in the middle. They have to work together to solve the problems.

Question: Do you think the initiative to build several thousand new power plants across the world in the next 50



Lawrence Berkeley National Laboratory

Artist's drawing of the components an inertial-confinement fusion power plant, using a heavy-ion induction linear accelerator as a driver. If you tripled the current fusion budget, "we'd get off to a pretty good start," Gourlay said.

years or so, could come from the private sector alone?

That's difficult to say. It would take somebody with a lot of money and a lot of vision to do that. It's possible, but I think what's holding these people back are the regulations that need to be worked out more appropriately in terms of getting the job done, solving the problems, instead of a black or white situation. I think that a change in the regulations could spur that kind of development, but right now I don't see it happening.

Question: Wouldn't it also take quite a bit of government credit to build large-scale projects of that magnitude?

It would, yes.

Question: What do you see as the future of science in the United States if we take the approach of what some of us in the LaRouche Youth Movement are doing in working to master the ideas of Kepler, Gauss, and Riemann and other scientists who have made fundamental breakthroughs in geometry and physics? Do you think that there's still hope for the United States if a policy of scientific progress and optimism were reintroduced, or do you think at this point with the situation in the world, that we're going to necessarily be relegated to a second-class power as a nation when it comes to science?

Well that's a difficult question to answer. I'm seeing signs of recognition of a problem in terms of science and technology, and the American Competitive Initiative is in the right direction. I think that the visionary people will recognize the importance of science in our future, and if they can't do it in the United States, if the United States doesn't make itself a place to do science and develop technology, then these people will go elsewhere, just the same as people used to come to the United States. I'm optimistic that the United States will have a large turnaround here shortly—I hope.

Question: Maybe a return to Franklin Roosevelt's ideas on economics, with government funding of these projects perhaps on a more massive scale?

Well, the U.S. does spend a lot of money on science, but not as much as it could; that's for sure. There is still tremendous untapped potential. What I'm seeing is that it's more and more difficult to spend that money effectively. There are more and more people who are involved. We're reviewed all the time, which is a necessary part of it, but there are different levels. I think the government is willing to invest heavily in science, but it needs the support of the constituency. Again, it goes back to our culture. Do they value science and what it can do for you?

Question: Do you think our citizens today have less of a sense of our productive potential in science as a method of discovery?

I think the awareness has decreased quite a bit, and you see more interest in astrology. . .

Question: And gambling?

Yes, things like that. It's not clear to me how it got that way.

Question: Well, hopefully with the work you're doing and the help of others we can change that.

INTERVIEW: DR. DON GUBSER

We Have to Get Youth Excited About Science

Dr. Don Gubser is the Head of the Material Science Division at the Naval Research Laboratory in Washington, D.C. He also teaches at George Washington University. He was interviewed on Sept. 12, 2006 by Wesley Irwin.

Question: What do you do at the Naval Research Lab?

The Naval Research Laboratory is the corporate laboratory for the Navy. We have multi-spectrum areas of research, but one of those areas is in material science. I'm in charge of the material science division at NRL which deals with a whole range of materials, from structural materials, to worrying about ship's steel, trying to make new steels which would be more resilient to blast, to some very sensitive electronic devices which can be used for sensitive communications.

My particular area is in superconductive materials, which can be used for new power sources and energy-saving devices on ships. Looking at the fundamental aspects, we are a more basic research laboratory, trying to stay in touch with the science, and understanding how that science can be applied to Naval applications. We are not an engineering laboratory, building motors, or electronic circuits, etc. We're more focussed on the materials that may lead to advances in those applications.

Question: How much of the NRL funding comes from the government, and how much comes from the private sector?

Very little from the private sector. I would say our laboratory is about 95 percent government-funded. About 90 percent is funded from military sources and 5 percent from government sources.

Question: You mentioned the work in changing the internal composition of some of these Naval engines. Are there any other projects you see on the horizon for materials research development?

Some of the more exciting areas are in nano-crystals. Nano-science is one area where we're trying to exploit the unique properties of the nano-scale to develop new sensors, new photovoltaic devices.

We're also looking at using material systems, to do some functions which a normal material won't do, for instance, putting embedded electronics into a composite structure—using composites not just for structure, but as structure and property together.

I would say the materials integration into a materials system is a very exciting area we're moving into, as well as nano-science, exploiting the uses of small-scale materials.

Question: Have the current Congressional budget cuts affected your research?

My only concern is a longer-range, general one. I have not seen the science budget in my particular laboratory increasing at the rate of inflation of doing science. So it's not a budget cut; it's just a constant little annoyance that each year we seem to be going down by a percent or two in buying power, and over the long term, that can have a significant effect. In general, the funding has not kept up with the inflation of doing science.

Question: What do you see as the potential for economic cooperation in the world for some of the superconductivity and other technologies that you are specializing in?

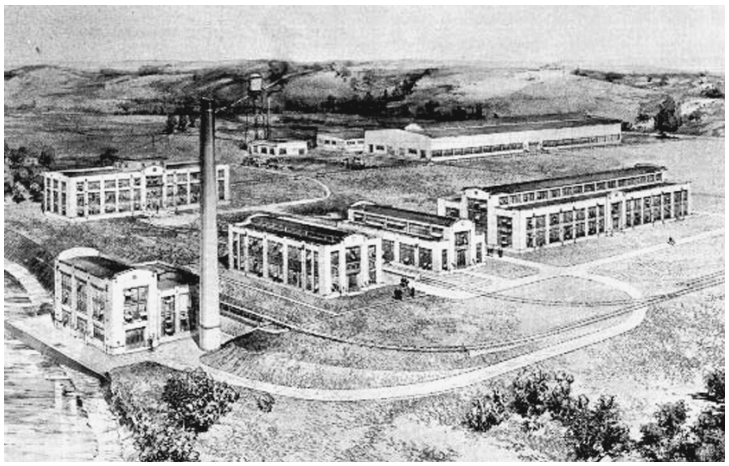
George Carruthers/NRL

Students at a Naval Research Laboratory space science workshop learn to operate a sounding rocket ultraviolet spectrograph.

I can answer that with two different hats. Firstly, with large scale applications of superconductivity, you're talking about such things as fusion energy, and that's the ITER [International Thermonuclear Experimental Reactor] project. That can't go on without international cooperation, and that certainly is what's happening.

I think the superconductor supercollider, which did not have international funding, is an example that you can't have these large international projects without sufficient funding and collaboration.

On the military side, collaboration is somewhat more restrictive because of the classified nature of certain military projects. . . .



The original site of the Naval Research Laboratory in Washington. Congress, acting upon the recommendation of the Naval Consulting Board of the United States, under the chairmanship of Thomas Alva Edison, appropriated funds for the establishment of a naval research laboratory in 1916. Construction began immediately, but was not completed until 1923.

Question: What about the development of naval propulsion systems? In particular, the development of magnetic propulsion to launch objects into space and so forth, as a launching system.

If you're talking about ship propulsion with magnetohydrodynamics—which is passing currents through seawater in the presence of a magnetic field—although it's technically feasible, it's a very inefficient way of doing it and it probably would not happen, even though there are some small demonstrations.

If you're talking about launching projectiles across in a rail-gun type manner, the Navy is working on rail-gun technology. In this division, what we're focussing on most is the wear and tear of the rail, since we're the materials division.

In fact, probably one of the biggest problems with the rail gun, is that you're passing very high current through a very high speed, moving contact, and it's tremendous wear on the sliding rails. I think the science is definitely there and is very feasible. The Navy believes it is very feasible.

It's a matter of whether we can solve some of the materials-related problems in this new regime of high-speed sliding contacts. It's something we're working on. It's a very exciting future, and I'm bullish on it.

Question: It's sounds great! Other scientist I've spoken with at the conference commented on how the U.S. has slipped in various science fields, including in recruitment of youth. Do you see that same sort of phenomenon in your field, and if so, do you have any proposals for reversing the process?

At NRL, we populate our science staff by hiring people from a post-doctorate pool. We get post-docs from universities, and we get a fairly good number of post-docs, although we're finding a larger and larger percentage of those are not U.S. citizens. This does create a problem, specifically in the Navy, or the military in general, where you need a higher level of clearance.

I also teach at George Washington University, and in my classes the predominate number of people are foreign born. I've noticed in the past 20 years that more and more students in training are foreign-born and now, recently, a lot of those are going back. Although at this moment, we're still able to hire the people that we need, I do worry about that in the long term.

How do we excite the U.S.-born to get into some extremely exciting areas in science across the board, from superconductivity, to electronics, to propulsion? It's a very exciting area, and it's difficult to reach some of the younger people. You probably have to reach them in high school or even in junior high school to get them excited. . . .

One of my best lectures was when I described to my class what I did as a scientist at the Naval Research Laboratory. I described the excitement of the field I was in, what was going on, and in fact I got an applause at the end of the lecture. It really reached out to the class. . . .

As far as reaching youth, let me just tell you a story: I used to go to my children's grade school class—they'd want some scientist to go in and talk to them—and I used to bring in liquid nitrogen and throw liquid nitrogen on the floor and do all sorts of cryogenics demonstrations. The class loved it!

One day I was exercising at the NRL gym, and a person came up and introduced himself to me and said: "I was in your science class. The reason I went into the science field was your scientific demonstration. It got me so excited I just went on into science."

That really made me feel good, so I said above, "junior high or high school," but maybe even younger, because this is a guy I talked to when he was in the first or second grade!

Question: It certainly seems that when youth are involved in doing the actual hands-on experiments and reliving the discoveries for themselves, it creates a much better dynamic in the classroom to actually develop knowledge than merely memorizing something out of a textbook.

I've been in the scientific field now for 40 years, superconductivity for most of that time, and I've been at the Naval Research Laboratory for 38 of those years. I have felt fulfilled in science. It has been truly exciting. I have had some truly exciting moments when I have discovered things. I enjoy telling people about it, and it has been a very rewarding career.

I certainly would like to stimulate a lot of other youth to go into this area because they can have great satisfaction if they dedicate their life to it.

INTERVIEW: GLORIA FARLEY

Discovering America's 'Old Country' Roots

Courtesy of Warren Dexter

Gloria Farley:"Hard evidence [of Old Country influence] is not scarce in America, it is just not known by many and is not accepted by most in academia."

Biographical Sketch

Gloria Farley was born October 21, 1916, in the hilltop home of her parents in Heavener, Oklahoma. Her father, Dr. Matthew A. Stewart, was of Scottish descent. He had come to Heavener, then in Indian Territory, in 1902, as a pioneer physician. Her mother, Eunice Virginia Upchurch Stewart, of English descent, was a postal clerk before her marriage in 1911.

Gloria quit college after only one year to marry J. Ray Farley, of Miami, Oklahoma. They lived in Missouri for two years and in Ohio for eleven years before returning to Heavener to raise their two small sons, Scott and Mark. They built a brick home next door to her mother's home, on the same hill where Gloria was born.

Gloria encountered pre-Columbian artifacts as a young girl, and spent 54 years as an adult pursuing the history of pre-Columbian transoceanic contact with America. After her husband became an invalid, Gloria had to balance support for the family with her historical interests. She has recorded over 300 pieces of evidence that Old World people were in early America. Most of this evidence consisted of translatable inscriptions in 20 ancient scripts, plus related petroglyphs.

Much of the evidence was published in 1994 in her book *In Plain Sight: Old World Records in Ancient America* (Columbus, Ga.: ISAC Press). Gloria has also published 95 articles and delivered more than 80 lectures in the United States. At age 86, she was still writing and lecturing.

—Alan Gillespie

EDITOR'S NOTE

This interview by Alan Gillespie was published in the Epigraphic Society Occasional Papers, ESOP, *Vol. 24 (2006), and is reprinted here with permission. Gloria Farley died on March 18, 2006, and an obituary by Julian Fell appeared in the Spring/Summer 2006 issue of* 21st Century.

Question: Mrs. Farley, you are nearing completion of a second book. What is its title? When will it be published, and what topics will it address?

It will be Volume II of *In Plain Sight,* and I hope it will be finished soon. Every time I think I have it finished, along comes something new and wonderful which must be included. It will contain more of everything that is in Volume I, plus two new subjects that I think are important: "The Early Chinese in America," and "Indian Relationships."

Question: What events kindled your interest in epigraphy, and when did they occur?

I unconsciously became an epigrapher as a skinny girl at age 12, when I was shown what I would eventually name The Heavener Runestone. At that time, the locals called it "The Indian Rock." This was in 1928. The site was in the wilderness, in a deep ravine on Poteau Mountain. It was only about 2 miles from Heavener, but there were no trails or paths leading to it. When, at age 14, I saw a runic chart and realized that the Heavener symbols were runes, I tucked this fact back in my mind and thought about it often. In 1948, I read about the Kensington Runestone, and I then sent a copy of the Heavener runes to the Smithsonian.

Question: How do you work in the field? What is your methodology? What do you look for?

When I was still able physically to work in the field, I followed any hint from anyone on where to look. I climbed cliffs and crawled in caves all over America, from New England to California. I cor-

rectly recorded all I found with photographs, tracings, and, if possible, with latex molds and plaster casts. I searched for any inscriptions that were not in English, as well as related petroglyphs.

Question: How did you become involved in the Epigraphic Society, and when was this?

I had been working with Dr. George Carter of Texas for years, and I sent him a puzzling inscription in 1975. Dr. Carter forwarded it to Barry Fell at Harvard University. Dr. Fell received it with enthusiasm, so I sent him many more recordings, to his delight.

Farley on a cliffside by the Cimarron River in western Oklahoma, near the discovery of an image of Cernunnos, a Celtic god.

He invited me to Harvard to attend, in September 1975, a joint meeting of the Epigraphic Society, New England Antiquities Research Society (NEARA), and the Early Sites Research Society (ESRS). They arranged to give me 10 minutes to speak. From that time I had many new colleagues, and worked hand-in-hand with Barry until his death in 1994.

Question: You made your first appearance in the pages of *ESOP* in 1976. Barry Fell eventually named you as Director of Exploration for the Epigraphic Society. When did he do this, and for what did he thus distinguish you?

I think it was in 1977. By 1978, the Field Exploration Committee consisted of me and John Williams. [*ESOP* Editor's note: in 1977, John Williams held this post alone]. This listing continued until 1992, when I was listed alone. Barry said that I was in this position because of the large number of sites and petroglyphs that I had found.

Question: The Epigraphic Society logo is adapted from a petroglyph you discovered. Can you tell us about that discovery, and do you think the depiction on the seal is accurate?

The seal of The Epigraphic Society is a somewhat abstract copy of a ship petroglyph near the bottom of Spider Rock in southeastern Colorado. Dale Murphy, then a young geologist with my exploration party, saw it first. We made a latex mold as proof against later criticisms and adverse opinions. My drawing of the 22-inch ship, which was published on page 23 of my book, is slightly different than the seal because, in the interest of clarity, I drew all the ropes as more narrow than the ship lines. The plaster cast shows that all the lines are actually of the same width.

Question: This is the second time you have mentioned latex molds of petroglyphs. You say that these offer proof of what was on the rock, but others have sharply criticized the practice as destructive to the rock. How have you answered these critics?

Of course we never attempt to take a latex mold of any stone that is friable. When Dr. Clyde Keeler and I were accused of damaging the Anubis panel [Figure 1] by making a latex mold, we also made other molds in the cave, but received no criticism for that. Many visitors were taken to Anubis Caves, without the owner's permission and not by me. The damage caused by these visitors is unknown, and uncriticized. However, the importance of the Anubis Caves would never have been ascertained if Clyde and I had not made the latex molds and several casts.

Question: The photograph [this page] shows you in one of your field explorations. Can you tell us the story behind the photo?

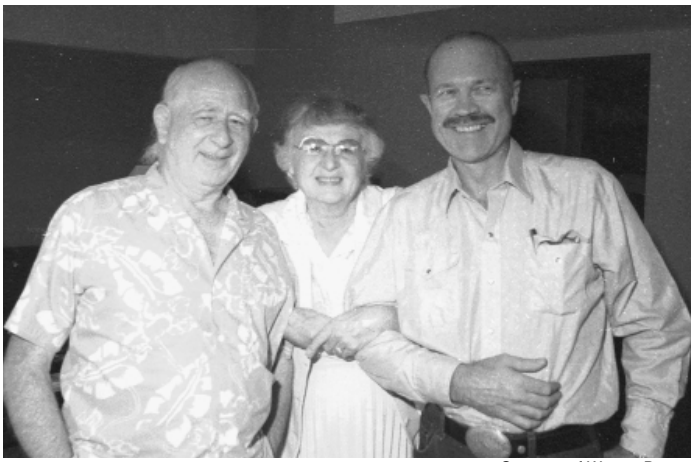
The photograph shows me walking in

Figure 1
ANUBIS

The Anubis drawing from the Anubis cave site. Anubis, the Egyptian god of the underworld, is usually depicted as a man with the head of a jackal.

Source: Courtesy of the Epigraphic Society

triumph, even with a cane, on a cliffside by the Cimarron River in western Oklahoma, in 1979. We had just discovered the image of Cernunnos, the Celtic god who wore antlers and was always associated with a horned snake. I had recognized him, and copied an inscription below him. The inscription, which consisted of dots, turned out to be in Bricren Ogam, which Barry Fell could translate.



Courtesy of Warren Dexter

Farley with Dr. Barry Fell (left), founder of the Epigraphic Society, and Dr. Norman Totten, Epigraphic Society president.

Question: As with many larger-than-life figures, Barry Fell provoked many different and strong reactions from different people. In particular, his scholarly message was anathema to some academics. You knew Barry Fell for many years. Do you have any insights into why some scholars reacted so violently to what he had to say, to the point of *ad hominem* attacks?

I do not understand the motives of the violent attackers, unless it was fear that Fell's new understanding would undermine their own published work.

To illustrate what Barry had to endure, I will relate what happened at a symposium in Atlanta, Georgia. This was at a meeting of the Southern Historical Association, on Nov. 12, 1976, and I had presented a program there. I listened to a panel of four professors about "New Scientific Dating Techniques," and afterwards approached the Egyptian specialist, Edward F. Wente of the University of Chicago, and handed him a plain 8×10 photograph of the Pontotoc Stone (page 83). He took one look and said, "All I can tell that is Egyptian is the design of the Sun disc and rays of the Sun," and told me to show it to the other three professors.

Their reaction was immediate and intense. They asked, "Is this stone from ancient Lebanon?" "No, Oklahoma," I replied. Their interest turned to derision. I said, "but it translates!" "By whom?" they asked. "Dr. Barry Fell of Harvard University." The tallest of the three said, "His book is hogwash!"

I answered, "How could you possibly know? His book is not yet published." The man said, "I admit to bias and prejudgment."

I walked away without ascertaining if he was a Near East specialist. Fell never would let me publish this account, saying that if I did not know who said it, it was "hearsay." But I think the story should be told, for it is typical of what Barry Fell had to endure.

Question: You told us that your introduction to epigraphic matters was essentially accidental, through the inscribed Heavener Runestone located near your hometown. What was it about the runestone that fascinated you most?

What fascinated me most at age 12 was the fact that the Heavener Runestone [Figure 2] stood vertically like a huge stone billboard; 12 feet high, 10 feet wide, but only 16 inches thick. Across its western face were plainly pecked, in a straight line, the eight large symbols, like an advertisement.

What could it say? As there was a stone shelf on the back, Mr. Carl F. Kemmerer, father of my chum, lifted me up to the top, where he said I clung to him in a death grip. I believed at the time that it had been made by Indians.

Question: The Kensington Runestone is perhaps better known than the one from Heavener, in part because of its long history of charges of fraud. Yet linguistic evidence compiled and analyzed by Richard Nielsen appears convincing that it could not have been manufactured in 19th Century America. Do you find the archeological information surrounding the Kensington runestone useful in your studies, one way or the other?

The fame of the Kensington Runestone made Americans aware of the meaning of the word "runestone," which made the research on the five

Figure 2
THE HEAVENER RUNESTONE

The Heavener Runestone in Oklahoma, which got Farley interested in epigraphy when she first saw it in 1928.

Source: Gloria Farley, *In Plain Sight.*

Oklahoma runestones easier for the public to understand.

The Kensington Runestone has been disputed since its discovery in 1898, clutched in the roots of a large tree. It has at last been fully authenticated, largely through the knowledge and efforts of Dr. Richard Nielsen of Houston. Dr. Nielsen also translated the Heavener, Poteau, and Shawnee runestones in 1986, and he has been my close friend ever since. He was assisted by Scott Wolter of Minnesota, and they both lectured at the Heavener Runestone State Park on June 19, 2003. They will take the Kensington Runestone to Sweden where it will be exhibited for three months. Of course, I have followed the entire history of the Kensington closely, and rejoice that it is now fully authenticated and accepted.

Question: If the Norse were in Minnesota and in Oklahoma, they must have visited the New World repeatedly. Why were they here, and how far do you think they explored the New World?

The Norse were explorers in widely separated places: Greece, and the Volga River in Russia, as well as the Atlantic seaboard, and there is no reason that they could not have ascended the Mississippi and explored all its tributaries. Possible runestones have been reported in other states, not yet proven.

To my five Oklahoma runestones, I would like to add another stone I recorded in western Arkansas on March 21, 1971. It is only 7 inches tall with four runes on the top edge, and I have always believed that it is a tombstone. Nearby is a circle of stones which seems significant.

I took the then-current Oklahoma State Archaeologist to the site but he only marvelled that I could relocate such a small stone on Wildcat Mountain, near Hackett, Arkansas. At my request, he drilled near the stone, but not, in my opinion, where a body might lie. Although I have reported this find to people who should be concerned, nobody is interested. I think the four runes must be a name.

However, when Dr. Richard Nielsen and Scott Wolter were in my home on June 19 and 20, 2003, they seemed very impressed by what I had to offer. They believed that I may have located a Norse grave, and intend to pursue this information.

Dr. Nielsen was excited when I showed him the photograph of a petroglyph of an eight-legged horse that had been found in central western Colorado near Montrose. I had suspected it might be the eight-legged horse Sleipner ridden through the sky by the supreme Norse God Odin, according to Norse mythology.

Courtesy of Warren Dexter

Farley with the Pontotoc Stone, found in Oklahoma.

Richard not only confirmed this but also said it was astonishing and important, and evidence that the Norse got to Colorado. I had found three images of Sleipner in literature from Gotland.

Question: When did you come to believe that the New World had been visited by other pre-Columbian travellers?

In the years that I pursued runestones, I kept finding inscriptions that were not runic, which I correctly recorded and filed. It was in July 1973, when Earl Syversen of California and I were hoping to find a runic inscription at Picture Canyon in southern Colorado, that we were astonished to find a third of a mile of both, writing and pictures in stone, but none of it runic.

I then realized for sure that there had been other Old World travellers here. I also knew the exact site of the grave of a pagan Celt, and once had permission of the Oklahoma owner to excavate. The 7-foot inscription above it indicated it was a grave and even gave his name.

But the Oklahoma Archaeological Survey expected me to raise $132,000 for a 70-day excavation.

Question: Archaeologists have criticized epigraphic evidence of Old World contact, arguing that somewhere there should also be Old World artifacts, and lots of them. For example, evidence of Norse presence in Newfoundland was widely ridiculed until the 11th Century Norse structures were excavated. Is the perception that there is no archaeological evidence elsewhere justified?

Of course artifacts exist! I published 18 in my first book, in the chapter "Made in America." Critical archaeologists and anthropologists just do not know this, or have no desire to know, which is a pity.

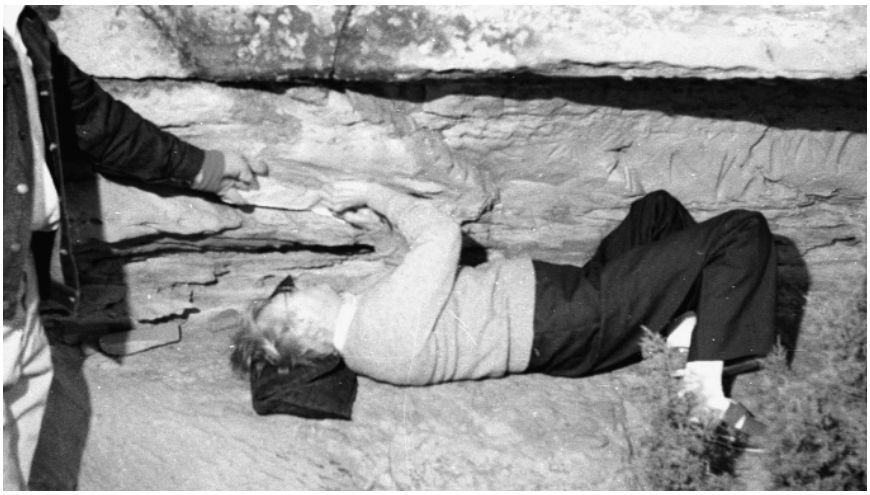
I know the owners, have photographs, and many plaster casts. One section of my forthcoming book will be called "Portraits in Stone," faces and heads of Old-World people. In addition, to three already published, I am adding probably ten more and will see three more next week. I own an amazing 14-inch stone head which is Celtic, found in Oklahoma. All who see it say "Wow!"

I intend to give it to the Oklahoma State Historical Society, which wants to inherit my vast collection of research items, including 4,000 slides, about 2,000 photographs, a room full of tracings, and a library of about 800 books.

Question: Many, perhaps most, mainstream historians and archaeologists have a hard time giving much credence to evidence of Old World, pre-Columbian visitors to the New World. Why is this?

Because they have already published otherwise and think it would be fatal to their careers to renege on their former beliefs. What Ph.D. is going to say, "I was wrong, and that self-educated female is right?"

Question: The Epigraphic Society was established to provide a forum for the



Courtesy of Warren Dexter

Farley in the field. She was an intrepid explorer and careful documenter.

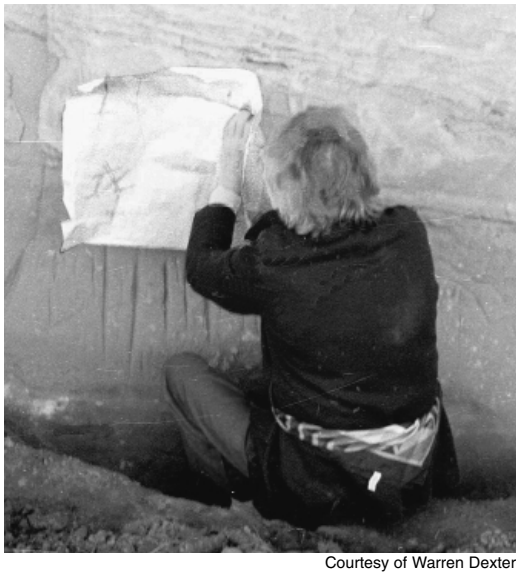
presentation and discussion of just such evidence. Do you think it has some kind of duty to persuade mainstream scientists and historians, above and beyond its charter? If so, how should it go about achieving this goal?

The Board is aware of its duty to the public, and that Fell's intention was far beyond the publishing of *ESOP.* So I should not be asked to advise the Board what to do, when, and why. If I could venture just one word, I would say "publish!"

Question: One of your integrating concepts has been that Old World exploration of the American interior took place along waterways. What is it that led you to this idea, and how have you used it to organize your explorations?

Almost all evidence of the presence of Old World people which I have recorded is found along waterways, because the shining unpolluted rivers which were deeper then, were the only means of transportation in ancient America. This method of following rivers and their tributaries was a guarantee that the travellers would never become lost in a vast new continent, they could always backtrack.

I always record the nearest waterway to any site. Most of them trace tributaries to the Arkansas or Mississippi rivers, or to the Atlantic or Pacific coasts. Sometimes, evidence is found at the very end of a waterway, which is a small branch or a spring, tributary to a creek,



Courtesy of Warren Dexter

tributary to a river. They leave something at this end before they return to their raft or ship. Southeastern Colorado, and the Texas and Oklahoma Panhandles, are replete with evidence, because the sources for the Arkansas River in Colorado, the Cimmaron, North and South Canadian in extreme northwest New Mexico, the Red River in the Texas Panhandle, and the Rio Grande in central New Mexico, all together occupy just a small portion of the map.

Question: You have found many petroglyphs depicting a figure that you identify as "Tanit," a Carthaginian deity known as Astarte to the Phoenicians [Figure 3]. Indeed, you have found this theme depicted so often that you are quoted as stating that Tanit has "found you." What did you mean by this, and why do you think this has happened?

As the ancient people in America left petroglyphs of their gods, this was very helpful in identifying their cultures. When I found the first petroglyph of Tanit in Colorado, I did not know her. After Dr. Fell identified her as the Carthaginian Tanit, I began a study of the varieties of her image in literature. So when I saw her on the ceiling of a stone chamber in Vermont, I jerked on Dr. Fell's jacket and pointed up.

He said, "Only you could find the second Tanit." I eventually found, all the way from New England to California, 10 of the 16 I published from America. The other 6 were contributed by friends who heard of my work. I also published 36 comparisons from the Old World, including many from Africa. Volume II of *In Plain Sight* will include four more, from Ohio, Louisiana, Colorado, and Wyoming.

Through the years, it seemed uncanny how I kept seeing so many images of her in widespread places, plus pages in so many books.

Question: You and your colleagues had uncovered evidence you say comes from a veritable hodgepodge of Old World visitors from various times and cultures. Summarizing your lifetime of experience, what do you think explains this variety? What is your quick version of the history of pre-Columbian contact?

Contrary to most historical records, seaworthy ships filled with Old World people swarmed both the Atlantic and Pacific Oceans, even before Christ. One of these voyages, by the Chinese in 2225 B.C., is proven because they returned to China and left records of America, some of which still exist.

Why did they travel? Some for economic reasons like trade, some for curiosity to find out what was beyond the rising and setting Suns. Why do we want to travel? The same human reasons.

Question: What is the oldest evidence you are aware of?

This is a tricky question. Do you mean evidence I have found, or evidence that

Figure 3
THE OKLAHOMA TANIT
A petroglyph of the the Carthagenian god Tanit.
Source: Courtesy of the Epigraphic Society

I have read about? That includes some statements that are very difficult to accept. Every time we pick up a newspaper or magazine now, or watch television, there is new evidence. We diffusionists are finally winning.

The oldest evidence in my own research, the Granby Idol, was accidentally excavated in Colorado in 1920 [Figure 4]. I own three original photographs of it made before 1923. This 66-pound Chinese effigy cannot now be located. It was supposedly donated to a museum in St. Louis.

A plain inscription on its belly has been identified as pre-Shang oracle script. The Shang Dynasty was 1600-1050 B.C.

Question: If an outsider were to read all the literature on Old World pre-Columbian contact, he or she would quickly form the opinion that much in the New World has an Old World origin. For example, the Yuchi may have come from the Indus River, Ethel Stewart would have the Athabascan peoples arrive as refugees from Genghis Khan, the Mesoamerican pyramids must have a common origin with Egypt, and so forth.

What is your "take" on this situation? Why is it that Old World influence is seen in so many aspects of New World life, yet hard evidence of Old World contact seems so scarce?

Hard evidence is not scarce in America, it is just not known by many and is not accepted by most in academia.

I am privileged to have been a part of this. I attended, by invitation, the Yuchi "Green Corn Festival" for 12 hours. A long account of this will be in my next book. In the seventh month (July) they live for a week in booths, exactly as described in the Book of Leviticus in the Bible. Some of my personal friends were Yuchis.

I knew Ethel Stewart, and am familiar with her account of the escape to America from Genghis Khan of the Dene and Na-Denes of Asia, and her description of the Dene "Demi-House God with Pointed Snout."

In 1982, I had climbed a steep mountain in Colorado and recorded a panel of script and the image of a mouse with pointed snout wearing a crown. After a lot of research, this will be in my next book, and perhaps in the *Midwestern Epigraphic Journal.*

Question: Some have accused elements in the Epigraphic Society of racism towards Native Americans, precisely because they seem to see an Old World explanation for all aspects of Native American society. Do you think this charge has any basis? You must know many Native Americans yourself, especially because of your chosen avocation. How do they view this issue?

It is certainly not true that the Epigraphic Society is guilty of racism toward the Native Americans.

To expand my answer about Indians and racism: my Volume II of *In Plain Sight* will contain several important and long sections about evidence of the intelligence of the Native Americans, and their relationship with then Old World people.

I have even recorded an artifact, an Egyptian sphinx found buried in an Indian site. I am told that my article about this will be published in Volume 24 of *ESOP.*

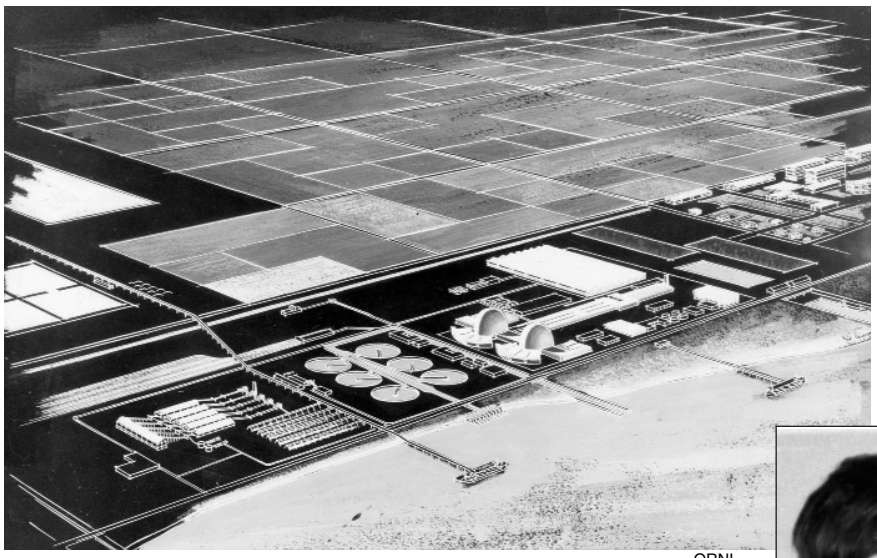
Barry Fell visited the Micmacs, tried to work closely with the Cherokees, and listed three Indian names in his Department of Amerindian Studies in *ESOP,* Vol. 5 (1978). I live in Oklahoma, which means "Home of the Red Man." My grandson is part Choctaw.

We are so integrated that we do not give a thought as to which of our friends may be Indian, their tribe, or what fraction of Indian blood they are.

Question: Let's bring this discussion back to you. Your career has been long and inspirational to many. What advice do you have for those who follow you? What preparation did you have for your career? For example, have you learned any of the ancient languages of the people whose traces you have sought?

My advice for diffusionists? Learn to see what you are looking at. Do not waste your time reading fiction. I had no preparation for my career. My 100 college hours did not even include ancient history, and I was lecturing before I took a speech course. No courses were presented anywhere in epigraphy.

Figure 4
THE 'GRANBY IDOL' FROM COLORADO
This is a drawing of the 66-pound Chinese effigy, found in Colorado, which has an inscription on its belly identified as pre-Shang oracle script. The Shang Dynasty was 1600-1050 B.C.
Source: Courtesy of the Epigraphic Society



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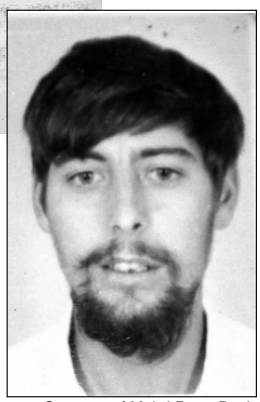

Courtesy of Mohd Peter Davis

A 1969 design for a nuplex, an agro-industrial complex powered by two 1,000-megawatt nuclear reactors, which would produce electricity for local residents and industry, and desalinate 1 billion gallons of seawater per day. Inset: Peter Davis in February 1969 was a fresh 26-year-old biochemist and had just completed a 4-month overland journey from England to Australia with his brother John. "With just £900 between us for the entire trip, we experienced firsthand the harsh realities of the Third World countries. However, I was entirely optimistic that most of the Medieval poverty, diseases and hardship we had witnessed could be solved or greatly alleviated with a sensible application of the science and technology I had been taught and the grand science missions I knew were in the pipeline."

Biosphere Technology In the Nuclear Age

by Mohd Peter Davis

Nuclear power for energy production is undergoing a welcome renaissance as country after country announces plans to build nuclear power stations. This marks a return to the science and sanity of the post-World War II era of my youth. I am now able put my own late 1950s to late 1970s experience as a budding scientist into much better perspective, by diligently studying, over the last four years, the outstanding intellectual material in the weekly magazine and quarterly science journal published by the movement founded by American statesman and physical economist, Lyndon LaRouche, a political follower of Presidents Abraham Lincoln and Franklin D. Roosevelt.[1]

My generation grew up not only with the horror of nuclear weapons, but also with the optimism of nuclear power. As youth we were inspired by Atoms for Peace and Nuplexes (nuclear-powered industrial complexes) which heralded abundant supplies of cheap electricity for domestic and agro-industrial use, and unlimited desalinated water for the Green Revolution in agriculture to feed the world and green the deserts. Science and technology further dominated the world with air travel, space exploration, DDT, penicillin, and polio vaccines. There seemed nothing that science could not handle to make the world a better place for all human beings on Earth.

I embraced this scientific optimism and was inspired in particular by a science book which proved that life could not exist on our nearby planets, given their prevailing physical and chemical conditions.[2] This began a lifelong interest in the evolution of life on Earth and potentially other planets in the universe. At 16 years of age, I was recruited from school to the nearby Pfizer research laboratories, part of an ultra-modern terramycin antibiotic factory in Sandwich, England, which had been recently built by the American parent company. The pay, the working conditions, the five-day week, the five-week Christmas bonus, and the opportunity for further education while working, were light years ahead of any other job I could have gotten in my economically depressed part of England (I now know that this was all part of the American postwar efforts to rebuild and remoralize Europe, based on the advanced industrialization that took place in America under President Franklin Roosevelt during World War II).

Terramycin was one of the second-generation antibiotics, and followed the spectacular medical and entrepreneurial success of penicillin, the miracle drug which dramatically cured a wide range of bacterial diseases that had afflicted humans throughout history. By 19 years of age, I was part of a pioneer research team combatting viruses, the next great mission for medical research, designing the biological methods for mass screening old and new organic compounds as potential new drugs against viruses.

Virus Theory of Evolution

By the age of 26, after moving to Australia, and after years of struggling to reconcile the great wealth of new experimental findings with the prevailing concept of viruses, I began to break out and develop a virus theory of evolution.[3] I could see that there was circumstantial evidence coming out of the world's laboratories that viruses were the agents for

transferring genes between species. I saw viruses as travelling genes, contemptuously ignoring the species barrier which kept the genetic material tightly guarded within each individual species. In my mind's eye I could see viruses swapping genes between the species as the driving force of evolution.

The exciting new field of genetic engineering was really not so new after all, but the brilliant technological exploitation of a process which had been occurring on Earth for perhaps billions of years. Viral transfer of genes, rather than the old dogma of random point mutations, explained why a bacterium could become multiply resistant to penicillin and to many other new antibiotics soon after they came into general medical use. The problem with this quite simple virus concept was the preoccupation in the scientific and medical community with another concept, which regarded viruses as agents of diseases such as polio, which had caused so much death and suffering to children. There was an underlying hatred of viruses, and a determination to wipe them off the face of the Earth. Viruses were seen as non-living alien invaders and lethal enemies of the cell.

However, this head-on, warlike approach to viruses, which had been so successful against bacteria and tropical diseases like malaria, was doomed. The evidence was piling up that viruses were normal and natural residents of every cell. They were not aliens; they belonged in cells, even though they went visiting extremely frequently. To eliminate viruses would require the extermination of all life on Earth. Viruses as agents of disease was secondary to a much more fundamental and essential role in the evolutionary process.

The Unity of Life

Life on Earth was not really a hierarchy as we had been taught. All the millions of species of animals, plants, insects, and microorganisms were interconnected by a wide range of discrete viruses. All species were equal but some were more complex than others. Beneath the tremendous visual diversity of species that so awed the early naturalists, there existed at the subcellular level an amazingly similar biochemistry (my chosen field of study). Indeed, at the subcellular level, all species are broadly identical: The internal organs of the cell are similar; they share the same biochemical pathways, almost identical enzymes, and they reproduce DNA, RNA, and proteins in virtually identical ways.

Courtesy of Mohd Peter Davis

Honeycomb thermal comfort housing, a new Malaysian invention by Architect Mazlin Ghazali (right) and Mohd Peter Davis, will allow nature and modern agriculture and industry to be integrated into nuclear-powered cities built along the routes of the Eurasian Land-bridge, long proposed by the LaRouche movement.

The general conclusion from experimental biochemistry and genetics is that once we get inside the cell, all cells are basically the same. The biochemistry of the much-studied bacterium *E.coli* tells us the essentials about the general housekeeping of each cell in all the other millions of different species on Earth. My virus theory of evolution explained how this similarity came about. It was the consequence of the constant spreading and sharing of genetic material by viruses throughout the millions of species.

What was driving life to adapt to the ever-changing Earth was not so much the slow natural selection of point mutations caused by crude chemical and physical forces in the external environment, but the everyday, healthy activity of the viruses as a natural part of every living cell, reproducing, escaping from the host cell and spreading to other cells and other species. Each species was not an island unto itself, but a part of a complex web of living matter on Earth consisting of millions of distinct species, all genetically interconnected by a wide assortment of viruses.

What an advantage this gives to all species! Consider new genetic material originating in a single cell of a single species; a rare mutant gene (coding perhaps for a novel enzyme to break down the penicillin molecule), or a new cluster of existing genes (coding perhaps for a new biochemical pathway capable of extracting energy by metabolizing a new chemical in the environment). The new genes along with the essential viral genes get packaged into hundreds of daughter virus particles, which escape from the host cell, spreading to neighboring cells and potentially, by innumerable hops via other viruses, to all other species on Earth, and ending up integrated into nuclear DNA passed on to the next generation.

The process might be complex, but the idea was simple. New genetic information is acquired, not directly from the environment, but from other living cells. Thus, a new genetic invention by one cell gets multiplied, transmitted, and

tested throughout the living world. New genes or combinations of genes are spread by viruses in a complicated way much like new ideas spread throughout the human population.

Recovery from Environmental Catastrophe

The living matter on Earth can respond to a changed environment, both locally and globally, with incredible speed. Life on Earth is able to recover almost instantly from environmental outrages, including, for instance, our completely novel man-made antibiotics, or, on the larger scale, the quite frequent meteorites and ice ages which, according to the fossil evidence, have caused numerous mass extinctions of species over the last few billion years.

The everyday activity of viruses, combined with the great overproduction at each generation, generates a continual supply of new species. Under stable environmental conditions, the new species rarely get a foothold and are wiped out by natural selection. However, with an environmental change or catastrophe, the competition from existing species is greatly diminished, and the new freak species get their opportunity to blossom.

Following a natural catastrophe such as a meteorite collision with Earth, or an ice age which can exterminate most of planetary life, the Earth is very quickly repopulated with a dazzling array of old and new species. The fossil scientists have termed this process—where long periods of species stability are interrupted by a global catastrophe, followed by the dramatic emergence of totally new species—as punctuated evolution.

Of course, there is almost no difference in the biochemistry and genetics of the set of species before and after the catastrophe; the two sets just look different, like the caterpillar turning into a butterfly. Life on the planet can take an extremely heavy depopulation, and even a loss of, say, half of the species, but simply shudders for the duration, and eventually marches on with a mixture of old and new species, as if nothing had happened. Thus, life on Earth has a tremendous resilience and continuity, and has survived every catastrophe for perhaps 4 billion years.

Now stand back from this intellectual discourse on viruses and evolution, and observe a quite ordinary 16-year-old boy maturing into professional adulthood and challenging scientific orthodoxy. This is creativity. Youth in general, if given an intellectual and experimental working environment like the one I was given, and provided they are willing to work hard and study well, quite naturally become very creative and can truthfully challenge deeply held beliefs, fundamentally changing the way we think about the world. This natural human creativity comes not from special people, but from special conditions which a good society must provide to guarantee its own well-being and future survival.

Australasian Pastoralist's Review, from the Loir Collection, Adolph Basser Library, Australian Academy of Science

In this 1893 cartoon, Australia's rabbit king is flanked by two banners, "King Bunny for ever" and "We hold the land." The rabbit population explosion, decimated ground cover, leading to the demise of many native species and the destruction of cropland. It was the virus used to kill 600 million rabbits in the 1950s that gave this author food for thought about the potential dangers of viruses.

The Dark Side

I soon realized, with my enlightened view of viruses, that their dark side was far more dangerous than we had ever suspected. It still gives me nightmares. I was working in Australia alongside the scientists responsible for the biological control of rabbits using myxovirus. Rabbits who were innocently introduced in the 1850s, had gone wild and completely overrun Australia, eating out the continent and threatening the sheep and cattle industries on which Australia's well-being depended.

My fellow CSIRO (Commonwealth Scientific and Industrial Research Organization) scientists told me that in the 1950s, myxomatosis wiped out 600 million rabbits, 99 percent of the rabbits in Australia. The CSIRO biological control program had rescued the wool and meat industries and was a national institutional hero. CSIRO was proud of its achievement, but I was horrified, and started to ring the alarm bells: What was stopping a species-specific virus from similarly wiping out 99 percent of humans?

I dug around and discovered that the 1918 influenza pandemic (the Spanish flu) had killed 20 million human beings, some now say 100 million,[4] when the world population was one third of today's. Clearly, viruses serve to naturally control "overpopulation," maintaining the diversity of species and preventing any species from overrunning a territory. As the out-of-control rabbit population in Australia demonstrated, it was just a matter of time. A virus with mutated genes or a new combination of existing or recombinated genes would sooner or later emerge, and with surgical precision, wipe out the overpopulated species without touching the other species.

This new understanding of the virulence of viruses was shocking in view of the huge increase in the human population made possible by modern agriculture and industrialization. Since any dreams of eradicating viruses were now foolish, we were obliged to stay one jump ahead with vaccines, drugs, public health measures, and better ways of living.

We could no longer tolerate the mass poverty and unhygienic living I had witnessed in my overland journey from England to Australia on a very tight budget, seeing how the "other half" lived: Fellow human beings in the gutter; all the problems of poverty quite solvable with a sensible application of existing science

and technology, and the tremendous developments I knew were in the pipeline. Unless we dramatically improved the standard of living and hygiene to the level of the Western countries, the Third World countries, with rapidly growing populations, but wallowing in the Middle Ages, would serve as an ideal incubator for a human viral pandemic.

Given the promiscuous mixing and marrying of genes between viruses and hosts, another 1918-type virulent influenza virus could suddenly appear, spreading round the world in two weeks, given modern air travel. But influenza virus is infuriatingly changeable, and new varieties appear faster than we can design new vaccines and produce them in chicken eggs. We had to radically change our strategy. The world's scientists had to cooperate as never before to develop the research and the industrial capacity to mass produce and administer a range of vaccines for the entire world population within weeks of a virulent strain emerging.

I had worked all this out and campaigned for it in the late 1970s to early 1980s. But it fell on deaf ears and it did not happen. Instead, a lot of this basic research on viruses was closed down (along with other areas of governmental basic research deemed "non-commercial"). I was transferred to research in sheep nutrition! Only in the last year or two, with the spread of avian influenza, have the world's scientists taken human pandemic influenza seriously by coordinating their action and demanding government support.

We lost a golden opportunity and surrendered a 25-year head start.

The Anti-science Agenda

My example is part of a much larger problem which must be fully aired by older scientists with similar stories of opportunities lost. However, this turn away from science was more than just a foolish mistake. It is becoming very clear from the fully documented work conducted by the LaRouche movement, that another agenda has been operating for at least 45 years, which has crippled science and technology around the world.

In the early 1960s, in the midst of the exciting and progressive development of science and technology in all fields, along comes journalist Rachel Carson with her bombshell book *Silent Spring* denouncing DDT as a catastrophic threat to birds and wildlife.[5] By the mid-1970s, DDT, the spectacularly successful chemical controlling mosquitoes and the diseases they carry, such as malaria, had been banned, despite the finding of an international nine-month American judicial inquiry of the Environmental Protection Agency that DDT was completely harmless to birds, wildlife, and human beings.

Other fear campaigns from a new breed of Green environmentalists were coming thick and fast, undermining the public's confidence in science and technology: Nuclear power was "dangerous" and "polluting," and all radiation was "harmful." Based on computer linear projections, the Club of Rome declared the world was about to run out of resources, caused by overpopulation—the old battle cry of the anti-human Malthusians. The term Spaceship Earth came into general currency, evoking the fear that we must ration out the resources.

Meanwhile, American Secretary of State Henry Kissinger enacted the National Security Study Memorandum 200, declaring that the development of Africa by Africans would deplete our resources, and advocating sheer evil: the control of population by American domination of the world food supply.[6]

In this backward march to the Middle Ages, science and technology became rejected, and research programs were shut down. The 1968 student revolts against America's Vietnam War also adopted a profound anti-science, anti-development philosophy. The problem was "too many children gobbling too many resources," the students said. We needed "zero population growth." The Earth was exhausted and the human population had exceeded the "carrying capacity" of the land. We had to give up industrial society and go back to nature, to a post-industrial society. It was all part of a fear campaign to destroy scientific creativity, and it was highly successful.

Back to Science and Sanity

For the last 35 years, we have foolishly succumbed to this evil nonsense and allowed science to be abandoned, adopting in its place a nonproductive service society based on speculative money that has consciously neglected to replace and develop the infrastructure and productive capacity essential for the general welfare of the population. This is suicide.

To support 6.5 billion human beings on Earth, and hopefully many more, each enjoying a decent standard of living without which we cannot control diseases, we must urgently return to the nuclear power and science of my youth. Then, we must make the scientific leap to nuclear fusion and re-create what the Sun does in fusing together hydrogen isotopes to produce unlimited energy and the lower elements of the periodic table. The first fusion reactor, recently agreed to be built in France with the support of top nuclear nations, can become commercial in 25 years.

While nuclear fusion is being geared up, we still need nuclear fission, the splitting of the uranium atom in the now 100 percent safe, commercially available modern nuclear reactors, to belatedly supply the world with cheap electricity and desalinated water.

We also need to build the larger high-temperature nuclear reactors which crack water at 800°C to produce hydrogen, as a replacement for gasoline to run cars, trucks, and planes. This will phase in the hydrogen economy and allow fuel to be produced in many countries, instead of transporting oil—a bulky, low value commodity—halfway round the world, tying up the world's ships and ports.

Once the political will exists to go nuclear and mass produce nuclear power stations, the present problem of what to do with the spent nuclear waste will solve itself. No longer does it have to be dangerously stored on land, frightening the life out of everyone. It becomes very economical to completely recycle the nuclear waste in breeder reactors, to produce even more fission fuel. The nuclear waste is turned into a valuable nuclear resource, thereby capturing a much higher percentage of the energy locked up in uranium.

This is energy production and energy efficiency on majestic scale, totally eclipsing the fossil fuels (see Table 1 on fuel and energy density comparisons). Well before the uranium reserves will ever run out, the mini-Sun nuclear fusion reactors, which will be commercial in 25 years, will begin to take over completely from fossil fuels. We can then stop burning and squandering our remaining valuable reserves of oil, gas, and coal, and stretch out their use for a higher purpose, as the chemical feedstock for the plastics

Table 1
FUEL AND ENERGY DENSITY COMPARISON

1 gram **fusion fuel:** Fusing atoms (deuterium & tritium isotopes of hydrogen), ca. 2030

= 3 grams **Uranium fuel:** Splitting the atom

= 9 tons of **Oil:** Fossil fuel

= 11 tons of **Coal:** Fossil fuel

= 42 tons of dry **Wood:** renewable fuel

Table 2
SOURCES OF ENERGY THROUGHOUT HUMAN HISTORY
(Animals rely on sunlight for warmth and food chain)

- **Renewable: Stone Age and Agricultural Man**
  wood fire for warmth and cooking
- **Fossil Fuels: Industrial Man**
  coal, oil, and gas for cooking, electricity, transportation
- **Uranium Fuel: Nuclear Man,**
  20th Century *splitting atom for electricity and desalinated water*
- **Hydrogen Fuel: Thermonuclear Man,**
  21st Century *Fusion, building a Sun on Earth—unlimited energy*

and other industrial materials required by every human being.

Vernadsky's Biosphere

The LaRouche movement's adoption and distribution in English of the little-known work of Russian biogeochemist Vladimir Vernadsky (1863-1945) puts the whole environmental issue, including sustainability of resources and nuclear power, into proper scientific perspective.[1] Vernadsky's lifetime work explained the 4-billion-year development of the Biosphere (the envelope of living matter and its thick crust of dead fossils surrounding the Earth, including the oceans and atmosphere) and the unique role that human beings now play in its further development.

Vernadsky discovered that mankind, through the mastery of science and technology, had become by the 20th Century a creative geological force (the Noösphere), far more powerful than living matter itself for shaping the Biosphere. Man's creativity has enabled the human population to now grow several thousandfold, to more than 6 billion, compared to the natural carrying capacity of the Earth of just a few million for higher apes.

However, the expanding human population is increasingly living off the stores of Earth's fossils (the 1- to 2-kilometer crust of dead bodies of all the different species deposited over several billions of years). These biological fossils required to sustain mankind include not only the oil, gas, and coal, but also minerals which get recycled through living organisms, such as iron, copper, zinc, and so on, and also the products of previously living matter, the water and oxygen.

Particularly over the last 50 years, the drinkable water and oxygen have been seriously depleted. Some 20 percent of human beings are living on fast-disappearing underground fossil water left over from previous ice ages.

Oxygen is being consumed faster than it can be replaced by photosynthetic trees, plants, and microorganisms.

The easy deposits of basic minerals required by modern society have been mined out. We can no longer get minerals on the cheap. We have to dig deeper and mine the oceans, using ever more advanced technology.

The Earth's super-concentrations of minerals are in the remote Arctic regions of Siberia, and will require "space-habitat" mining cities and maglev trains to transport the ores to the centers of population for new cities and industrial complexes. To pay for these more expensively mined minerals will require a world population with a higher standard of living and a decent wage. The billions of human beings barely surviving on a few dollars per day cannot afford to buy the mineral and energy resources they need to survive.

However, the human population will sooner or later run out of essential resources if we rely solely on the dead products of living matter in the Biosphere (see Table 2 on sources of energy throughout human history). They are nonrenewable, in the sense that what took billions of years to form by living matter is now being consumed in centuries by modern man.

There are only two solutions. The first solution (or more aptly the final solution) is the "Back to Nature" advocated by the Green environmental movement. This is really the depopulation program of fascism: Reduce the "useless eaters" by war, famine, and disease. The 40-year genocide in Africa is the dress rehearsal for the rest of the world: Reduce the present 6.5-billion population to a globalized world of under 1 billion, living under primitive feudal conditions and ruled by a privileged elite, as envisaged by Hitler's International SS. That will stretch out the resources.

Back to Science!

The only alternative to this evil is a "Back to Science" approach. To sustain the present world population and allow the population to grow with sensible family sizes means that we have to urgently start *producing* the basic requirements of human existence, not simply harvesting them from the Biosphere. This means rejecting the anti-nuclear back-to-nature environmentalism of the Green fascists and winning over the bulk of their supporters who do have a genuine concern for defending and improving the environment.

We must out-green the Greenies with a sane scientific approach to the environment, based on universal human need. We must replace the fossil fuels and produce the energy for electricity and drinkable water, and produce the hydrogen for transportation and the oxygen for life. We must transform the elements and do what the early alchemists could not do: Turn lead into gold.

The Vernadsky/LaRouche transformation of the elements will fuse together the basic hydrogen-atom building blocks at 3 million°C to form the useful elements in gigantic quantities. All this advanced production, of course, is a daunting task, and will require a scientific and technological leap, driven by international crash science programs of the type that got man to the Moon.

We need to re-create on Earth our own miniature Sun, bringing nuclear fusion and its products to fruition in the 21st Century. It will be a coming of age for mankind, where we become self supporting and able to give back to the Biosphere the resources we borrowed while reaching maturity.

Biosphere Technology

With abundant nuclear-desalinated water now coming back on-stream, we have the essential ingredient for greening the deserts. The Biosphere technology now being pioneered by Universiti Putra Malaysia can produce in the natural greenhouse environment of Malaysia, not just millions, but *billions* of 4-year-old nursery trees in polybags every year, year after year, on a sustainable basis. Shipped in containers, these nursery trees can transform near-worthless deserts and arid lands into green oases with cooler livable cities, agricultural land, and Nupexes, as envisaged in the Atoms for Peace program.

From Vernadsky's grand scientific view of the Biosphere, we can begin to see the great potential of the Malaysian rainforests, home to the world's oldest and richest source of biodiversity, as serving as the Earth's "Noah's Ark," which regularly repopulates the planet with living species, following the frequent major and minor ice ages. These dramatic climate changes are caused during the Earth's orbit around the Sun, made more complex by the gravitational interference from other planets.

During ice ages, land-based life is almost totally exterminated, except for a few pockets of equatorial rainforest, and lies dead and buried under hundreds of meters, even kilometers, of ice. The Green environmentalists cannot, or will not, see this big picture, and fret over a few endangered species and imagined global warming, accusing man's sinful development for destroying the environment. As the glaciers melt and recede, the survivors of the ice age, the millions of species crowded into the rainforests, start to recolonize the sterile continents.

The mighty reproductive power of each species, described in Vernadsky's book *The Biosphere,*[7] is an unstoppable force, and starts greening the Earth and reestablishing a complex food chain of interdependent species. The Biosphere gets replenished with living species, and the percentage of living matter on Earth increases dramatically over very short geological times, around 20,000 to 100,000 years (50,000 years ago much of North America was covered by one kilometer of ice).

Biosphere technology, based on Vernadsky's scientific concept, aims to greatly speed up this natural recolonizing process, accomplishing the same task in perhaps 100 years.

Courtesy of Mohd Peter Davis

This tree, Leptospermum poligaliflium, *grows very slowly in the Australian deserts but grew to this height from a seed in just 18 months in the perfect Malaysian rainforest climate. Billions of trees per year of any desired species can be propagated in polybags in Malaysian nurseries and shipped in climate-controlled containers to "Green the Deserts," a key mission of the 1950s-1960s "Atoms for Peace" program to provide copious quantities of desalinated water.*

Instead of depleting the Biosphere, we can dramatically speed up its regeneration and increase the percentage of living matter on Earth, for the benefit not only of human beings, but every other species on Earth. Mankind becomes in the 21st Century the caring Manager of the Biosphere. This is a whole lot better than the doom and gloom coming out of the Green environmental movement.

Commercializing Rainforest Biodiversity

The micro-climate created by rainforests—high rainfall, high humidity, plenty of sunlight, and all-year-round temperatures between 25-35°C—provides the ideal natural greenhouse conditions for maximum production of biomass.

Trees in Malaysia and the Amazon countries grow really fast, which permits economical mass production in polybags, suitable for export anywhere in the world. As a purely theoretical calculation, Malaysia could produce 14 billion 4-year trees per year on a sustainable basis, using the 12 million acres of plantation land, and without touching another acre of virgin forest. This gigantic production of 3-meter-high nursery trees, planted 6 meters apart, could green all the world's deserts in 37 years!

The forests of the world, lost necessarily to agriculture, can be re-created with nursery trees grown in Malaysia, as modern intensive agriculture liberates grazing land and land now used for backyard farming. Production of sheep, goats, cows, cattle, and pigs under intensive conditions in hygienic animal houses, similar to modern biosecurity chicken farms, will liberate vast areas of grazing and agricultural land, and minimize the emergence of new diseases.

Synthetic forests can be created and repopulated with mass-produced wildlife. Instead of endlessly complaining about the loss of wildlife to urban development and poachers, let us give nature a helping hand and mass produce wildlife. The illegal poachers, raping the rainforests, which support only very low densities of higher animals, have nonetheless opened up lucrative markets for wildlife for exotic food and medicines. Let us kill their markets with far lower prices, by mass producing the desired species outside of the virgin rainforests.

What a splendid prospect for those genuinely concerned for the environment and the wildlife. Malaysia can be transformed into the tree factory and wildlife-production center for the world,

Wild fruit and berry trees from the rainforests, considered "rubbish species" by the British colonialists in Malaya, can be planted at 100 trees per acre in dense urban areas to create a complex ecosystem for Honeycomb towns and cities. The trees provide a home for birds, insects, and small wildlife to reproduce while the wild fruits and berries provide their food. Perhaps several hundred species of birds and semi-tame animals can safely coexist with human beings in urban areas.

When supplemented with food supplied by urban residents, any desired wildlife population density can be reached, including that of "endangered" species. Science can out-green the Greenies, disproving yet again their false Malthusian belief that the land has a fixed "carrying-capacity" for each species.

Courtesy of Mohd Peter Davis

putting the 12 million acres of rubber and oil palm plantation land to much better, higher value use. We estimate that the mass production of nursery trees, for new towns and cities and for greening the deserts, can generate 25 times more wealth per acre compared to palm oil, Malaysia's golden crop.

Presented with this economic prospect, who will be prepared to defend the old industries of rubber and palm, run under the poverty-generating British plantation system? Opening up long-term markets for Malaysian-produced nursery trees and wildlife will generate the wealth to completely eliminate rural poverty and propel Malaysia to an advanced industrialized nation.

Other countries in Africa and South America blessed with rainforests can follow Malaysia's example.

As the new cities and the deserts/arid lands (25 percent of the Earth's landmass) become landscaped, suitable semi-tame wildlife species can be introduced to bring urban populations back into daily contact with nature. Now a radically more optimistic world environment program is possible, based on the production of the enormous natural biodiversity contained within the rainforests.

Currently, we use very few species. Only about 15 species of animals (former wildlife) have been commonly domesticated for meat production. The British colonizers deemed only 55 species in the Malay Rainforest commercially useful as timber species, and classified the remaining 3,000 trees as rubbish species. Perhaps a few thousand wild plant species have been artificially selected historically as agricultural crops. This number of species commonly produced and used by man is trivial compared, to the total number in the Biosphere.

Estimates vary from 2 to 100 million, but the most commonly quoted estimate for the number of species on Earth is between 30 and 50 million. Each and every plant, animal, fish, insect, and microbial species is a precious renewable resource of the Biosphere, for present and, especially, future generations.

It would be insane to let any species perish. In fact we should be doing all we can to artificially produce new species. Once a market for a particular species exists, it can be sourced from the rainforest and mass produced on the already cleared land in modern nurseries, specialized plantations, wildlife production centers, and fish and insect farms.

The general techniques for mass producing any species are already well established, and well within the scope of classical scientific disciplines such as botany, zoology, animal production, agriculture, forestry, fisheries, and so on. Given a market, creative scientists working alongside creative entrepreneurs will very quickly find economical ways to produce any species from the rainforest. The mass-produced live species are then available to a host of established industries such as landscaping, herbal medicines, drugs, vaccines, food products, cosmetics, industrial chemicals, biocomposite building materials, and so on.

For newer industries based on biotechnology, immunology, tissue culture, and genetic engineering, the availability of any species in large quantities opens new horizons for supplying world markets with high-value, high-technology products.

Malaysia and other rainforest countries can enjoy a very prosperous future. This is a lot better than the free-trade British Plantation System supplying rubber and palm oil at rock bottom prices, which have kept too many generations of human beings in poverty as semi-slaves.

New Hygienic Cities

Slum living with backyard farming, which characterizes the living conditions of about half the world's population, is the ideal incubator for the emergence of a human virus pandemic, threatening not only the poor, but civilization itself. For a world returning to sanity, this means rehousing up to half the world's population in modern hygienic towns and cities, providing cradle-to-grave medical care, and establishing intensive agriculture in bio-security farms.

For the last decade at Universiti Putra Malaysia, we have been directly addressing the need to urbanize the population in developing countries, and see the need for 500 million modern dwellings.[8] Malaysia has considerable practical experience to offer, having successfully urbanized 65 percent of a three-fold-larger population, since independence from the British nearly 50 years ago. (Green Malthusians

please note: This increase in population was accompanied, not by poverty, but by a big improvement of every measurable sociological parameter).

However, serious mistakes have been made (overheated houses, alienation from nature, a lack of public transport, and the trap of low-cost housing) but these have been carefully analyzed and do not have to be repeated, as other developing countries urbanize their populations.

Our Honeycomb solution, invented by a creative Malaysian architect, is a highly land-efficient and radically new town planning concept based on interlocking hexagons.[9] New Honeycomb housing developments are being commissioned by several state governments in Malaysia.

All houses, now in a price range affordable for the entire working population, starting with young married couples, are arranged in cul-de-sacs, clustered around small child-friendly neighborhood parks designed to bring nature and a sense of community back to urban living. The houses are energy efficient and designed to stay cool in the tropics without air conditioning, while the trees shade the roads and cool down the outdoor environment.

More than 100 wild fruit trees per acre can now be planted from a huge selection of tree species. (A Malaysian nurseryman, James Kingham, shown in photo on p. 91, in just 10 year's exploration of the rainforest, has collected, propagated, and commercialized 800 new species of fruit and berry trees.) These fruit/berry trees will provide a complex food chain in Honeycomb housing areas, and support a high density of birds, insects, and even small wildlife specially bred and semi-tamed for free living in urban areas.[10]

We are now designing largely self-sufficient Honeycomb cities, using industrialized building systems, and we look forward to working with collaborators for incorporating a city nuclear power plant for domestic power, water, industry, and agriculture. Our present task involves designing prototype livable towns and cities with their own economy, tailored to the local climate and culture, while satisfying the needs of all sections of the population, including the need for future generations to upgrade the technology.

The Honeycomb concept does away with the grand geometric city designs imposed on the landscape, and is particularly suitable for preserving the cultural heritage of existing villages and towns while growing a city into the surrounding countryside, following the rivers and contours of the land. Each city will therefore be unique, with its own identity based on its earliest history, geography, landscape, and industries, and will fit neatly along the route of the Eurasian Land-Bridge, long advocated by the LaRouche Movement.

Green Insanity

The Green environmental movement boastfully flaunts its "self-sufficient" and alternative solutions, consisting, not of modern cities for the world's poor, but fairy-tale villages fed by organic farmers and powered by solar panels on sunny days, windmills on windy days, and biofuel after harvests. The windmills, the biofuel, and solar panels, advocated by the Green environmentalists as the renewable alternative to fossil fuels, are not really alternatives at all. They all consume more fossil fuels to manufacture than the energy they produce.

The current American campaign for ethanol biofuel to replace petrol is a good example. To supply all the ethanol (a renewable biofuel) required to replace America's consumption of oil (a nonrenewable fossil fuel) would require planting an absurd 50 percent of the American land mass with corn.

Two leading American scientists writing in the *Washington Post* July 2, 2006, and in other publications, demonstrated that the entire U.S. cropland, if used to grow corn for ethanol production, would produce only 15 percent of the American gasoline requirement. This option would leave America without domestic food production capability, for human or animal use.[11] The massive corn production advocated will greatly accelerate the depletion of ground water, threatening human survival.

It gets worse; only the sunlight is free. The fertilizers, farm machinery, transportation of the corn, its industrial fermentation to ethanol, and its transportation to the pump will consume more gasoline than America currently uses! Biofuel is the equivalent of eating babies to solve human malnutrition.

This madness, combined with all its other stupid technologies and shutdown of the nuclear industries, will take mankind back to feudalism and crash the population from more than 6 billion to less than 1 billion. Seen from this perspective, the Green alternative is merely an alternative word for genocide.

The LaRouche publications have exposed how Rachel Carson and her environmentalist followers, who now occupy the top government and influential positions in the Western world, fooled most of the people most of the time over the last 40 years. The Green environmental movement has a lot to answer for and can be discredited; those who followed out of genuine concern for the environment can be won over.

This evil movement, which did all it could to destroy scientific creativity, can and must be broken up as the world comes back to its senses with a nuclear renaissance that intersects with Vernadsky's concept of the Biosphere. We share Vernadsky's optimism: The future is in our hands. We will not let it go.

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Notes

1. A wealth of original articles used in this essay is published in the LaRouche political weekly *EIR* (*Executive Intelligence Review,* Washington, D.C.) and the quarterly magazine *21st Century Science and Technology.* Links to recent nuclear and Vernadsky articles are on the homepage of the website http://www.larouchepub.com. This website also has a Google search engine of archived publications.
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4. J.M. Barry, 2005. *The Great Influenza. The Epic Story of the Deadliest Plague in History* (New York: Penguin Books).
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Nanotech2006

Highlights of Eurasian Biotech Advances

by Cloret Ferguson

Nano-drug delivery, supersensitive bacteria sensors, and *in vivo* nano-detection systems were some of the nanotechnology advances reported at the Eurasian session of the Nanotech2006 conference held in Boston last May. This session was sponsored by the U.S. nonprofit Civilian Research and Development Foundation, which promotes scientific collaboration primarily between the United States and Eurasia.

Dr. Svetlana Gelperina, a leading scientist of the Russian Center of Molecular Diagnostics and Therapy in Moscow, presented the "nanoparticulate drug delivery system," that she and her team developed. The system is capable of overcoming the blood brain barrier (BBB), one of the greatest impediments to effective treatment of deadly brain tumors, such as multiforme gliomas. This breakthrough employs the use of an injectable, nanoparticle-bound form of doxorubicin, used in its "free form" as a conventional chemotherapy drug.

Designed in the injectable, nanoparticulate state, the new type of doxorubicin proved highly effective in producing long-term remission in more than 20 percent of the tested animals, whereas in the control group, all animals died within 20 days. The surviving animals were dissected after three months, and showed "no signs of tumor growth at necropsy."

The treated population of laboratory animals had intracranial glioblastomas, an extremely malignant type of brain tumor. In the United States alone, human deaths from this type of brain tumor range from 12,000 to 15,000 patients per year. (Aside from brain surgery, a very limited number of alternative treatments exists for brain tumors of this type.)

Innovational use of nanoparticles is a noninvasive form of drug delivery to the brain. Another benefit of the nanoparticle-bound drug, which Dr. Gelperina discussed, is that it "is characterized by a significantly improved toxicological profile, being less toxic for [the] heart and testes."

A PET Replacement

In the area of nano-diagnostic technologies, Dr. Yuri Babich, of Ukraine's Institute for Applied Problems of Physics & Biophysics Research Center in Kiev, unveiled a unique replacement for PET (Positron Emission Tomography) and X-ray mammography. The new technology, called Dermal/Transdermal Multiparameter Electrodynamic Imaging (DMEI), is able to detect, identify, and visualize malignancy and its structure to below 1 millimeter in size *in vivo.*

DMEI noninvasively visualizes *in vivo* "dynamics of integral biochemical parameters at tissue, cellular, and subcellular (mitochondrial) levels" in healthy and diseased states. It can produce a mapping of micro-metastases, and detect mitcochondrial abnormalities in cells surrounding the central tumor site.

No such capability has been registered with conventional diagnostic methods, such as PET and X-ray, which may have very poor or no spatial resolution. Usually, PET can only detect tumors greater than 2 millimeters in size. Patients allergic to radioactive diagnostic agents may also find DMEI beneficial.

The technology also utilizes extremely low intensity electromagnetic fields.

The DMEI inventors argue that this new technology costs several orders of magnitude less than that of other well-known methods, an importatnt side benefit. It is also promoted as being an uncomplicated and fast investigational procedure.

Net-shaping with Nanopowders

Tomsk Polytechnic University's Research and Development Centre of Advanced Technologies (Spectr) is directed by Dr. Oleg Khasanov, who addressed the topic of "Nanopowder Net-shaping for Manufacturing Nanostructured Ceramics." Although, the process of "net-shaping" may involve several techniques, in general it refers to manipulating material without significant loss or wastage, by avoiding machining.

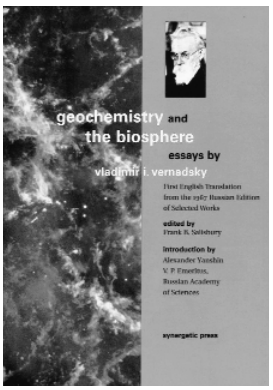
The Spectr method applies a powerful ultrasonic vibration (PUV) that "resonates" with the nanopowder-compacting process, eliminating the use of binding agents. Also, the Spectr collector technique "involves specially designed molds, where active and passive shaping-surfaces are combined in one shaping-member of the mold." This mold design reduces the die-wall friction (the resistance that must be overcome to move one surface over another surface).

The result is a complex variety of required shapes composed of compacted nanopowder of uniform density, without gradients of internal stress. These hinder grain growth, warping, and other distortions during the sintering process.

Applications for use of nanostructured ceramics include: the High Temperature Superconductor Crystal (HTSC) shields of magnetic fields; ceramic Superconducting Quantum Interference Devices (SQUIDs) for magnetometry; the cable industry's wire dies and moving rods; the electronics and communication industry's precision dielectric cases of Radio Frequency duplexers; and end seals and impellers of gasoline pumps for tractor and automobile engines. There is also a wealth of potential applications in the nuclear and aerospace industry.

Vernadsky and His Biosphere

by William Jones



Geochemistry and the Biosphere: Essays by Vladimir I. Vernadsky
Ed. Frank B. Salisbury
Santa Fe, N.M.: Synergetic Press, 2006
Paperback, 427 pages, $49.95

The publication in English of a new volume of writings, *Essays on Geochemistry and the Biosphere,* by the great Russian-Ukrainian scientist Vladimir Vernadsky, should be viewed with great interest, and not only by those active in the scientific fields with which these essays deal. It is also to be hoped that the publication is a harbinger of more to come in English from the Vernadsky writings.

The work of this towering giant of Russian science has been woefully neglected here in the West, and particularly in the United States. Ironically, much of Vernadsky's work was picked up during the 1970s by representatives of the environmentalist movement, who then tried to draw similarities between Vernadsky with their own particular back-to-nature Gaia philosophy, virtually turning him on his head, and obfuscating both the content and the intent of Vernadsky's lifework.

The publication of more of Vernadsky's own writings in English should help to set the record straight on this point. A major step in correcting this distortion of Vernadsky has been the writings of economist and statesman Lyndon LaRouche on the work of Vernadsky, and his introduction of the work of Vernadsky into the LaRouche Youth Movement, which has created recognition of the true significance and import of Vernadsky's work by a much broader segment of the American public than ever before.

The present volume, a translation of a work published in Russian in 1967 under the title *Biosfera,* includes several essays by Vernadsky on the subject of geochemistry, as well as his final editing, in the last decade of his life, of the third edition of his groundbreaking study, *The Biosphere.* This volume gives the reader a good sense of the range of Vernadsky's thinking in various fields of science.

His chapter on the "History of Geochemistry," depicts how this discipline, with which his name has been most prominently associated, evolved out of the field of chemistry and soil science. The period of Vernadsky's education at St. Petersburg University, 1881-1890, was undoubtedly one of the most fertile periods in the history of that institution, with some of the greatest scientific thinkers of the country located there, including names like Mendeleyev, Butlerov, and Dokuchaev, who served as mentors, and as an inspiration to young students like Vernadsky.

The lecture halls were always filled when Mendeleyev lectured, Vernadsky relates. "We entered a new and wondrous world during his lectures, as if released from the grip of a powerful vise." Vernadsky also relates how the St. Petersburg department of mineralogy promoted a more dynamic view of chemistry, concentrating not simply on the chemical composition of the Earth's mantle, but also on the dispersion of the chemical elements, their "migrations," deep into the Earth's crust over geological time.

Here already we see some of the first indications of Vernadsky's own groundbreaking theory of how living matter itself, through such chemical and atomic "migrations," actually forms the outer crust of the Earth's surface. Here Mendeleyev also played a key role. "In [Mendeleyev's] *Principles of Chemistry,* the problems of geochemistry and space chemistry were not only fully described, but were also often dominant," Vernadsky writes in his historical essay.

The other intellectual influence on the young Vernadsky was Vasilii Vasilievich Dokuchaev, who held the chair in mineralogy at St. Petersburg University, and on behalf of whom he would often undertake expeditions in various parts of

Courtesy of Synergetic Press

Vernadsky (second row, third from right), along with a good part of the faculty at Moscow University, shown here in 1911, when they resigned in protest of repressive measures imposed by the Stolypin government against the Education Ministry.

the Russian Empire. Dokuchaev's *The Russian Black Earth Region,* the result of a seven-years-long labor, also brought Vernadsky a greater understanding of his beloved Ukraine, where he conducted expeditions under Dokuchayev's direction, examining the soil of the region.

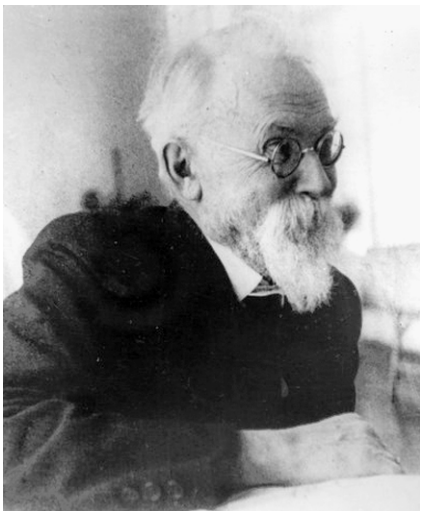
Later in the years of the Russian civil war, Vernadsky, who had fled to the family estate in Ukraine, was doing his own studies in the Ukrainian countryside. Already at this early stage, seeing the economic devastation that was caused by the civil war and revolution, he predicted that because of the lack of investment in the agricultural sector, this most fertile region would again be facing a situation of famine.

'Father of the Soviet Nuclear Program'

In the same historical essay, Vernadsky also touches upon the important role of radioactive elements in the Earth's crust, a phenomenon on which he placed great significance. From a trip in the early part of the century, looking in Central Asia for radioactive elements, and later, from the work he would accomplish with the Curies at the Radium Institute in Paris, Vernadsky placed great interest in this "new physics." By 1909, he had established a radiological laboratory in Moscow, and later, in 1922, he set up a Radium Institute, modelled on that of the Curies in Paris. Vernadsky also established the first cyclotron in the Soviet Union at the Radium Institute, on which Igor Kurchatov and other leading figures in the Soviet atomic bomb program would get their initial training.

Early on, Vernadsky realized the tremendous benefit mankind would receive if it achieved mastery of the power of the atom. Like others knowledgeable in the field, he was also aware of its tremendous potentially destructive power. In his opening speech at the Radium Institute, Vernadsky said: "Soon man will have atomic power at his hands. This is a power source which will give him the possibility to build his life as he wishes. Will he be able to use this force for good purposes and not self-destruction?"

During the twenties and thirties he kept well abreast of the field, meeting with Otto Hahn, Lise Meitner, and Arthur Sommerfield in Germany; Frederick Soddy in Montreal; and the Curies in Paris. It is something of an irony that



Courtesy of Synergetic Press

Vernadsky as a member of the Presidium of the International Geological Congress, in Moscow in 1937.

Vernadsky would first learn of an American atomic bomb program through an interpretation from the *New York Times* in 1943, sent to him by his son, George, who, after the Bolshevik Revolution, emigrated to the United States, where he became a professor in Russian history at Yale University. George had attached a note to the clipping with the message to his father: "Don't be late!"

After receiving this, Vernadsky formed a troika with two of his closest collaborators, to work out a program for the development of atomic energy. This led to the formation of the Uranium Committee, which would later chart the course of the Soviet atomic bomb program. Illness and old age (Vernadsky was then in his eighties), did not permit him a major role in the development of the bomb, but he was often consulted on aspects of the program. His pioneering role in the field really makes him deserving of the title "father of the Soviet nuclear program."

In the essay "Chemical Elements in the Earth's Crust," Vernadsky deals with the actual chemical composition of the planet, utilizing the research conducted in the United States by F.W. Clarke at the Carnegie Institution, which he had visited on a trip to the United States in 1913. Here he is on very familiar ground, studying particular instances of the chemical dispersion of certain elements from the biosphere into the Earth's outer mantle.

In the essay "Carbon and Living Matter," Vernadsky deals with the study of the hydrocarbons and petroleum deposits. In the context of the alleged "oil crisis" so much bandied about today, the essay of Vernadsky may have more than a passing interest. He holds firmly to the predominant theory that hydrocarbons will only be found as the remains of fossils, that is, they are a result of the decay of living matter, a theory which has been questioned in the work of the late Cornell University astrophysicist Thomas Gold. As Vernadsky himself indicates, Mendeleyev, also, thought that there may well be a non-organic origin of oil.

The third edition of *The Biosphere,* published in this volume, may be of some interest to the readers of the earlier edition, published in English. The years of his editing this edition were those in which he was expanding on his early theories, always reconceptualizing and reformulating many of his central hypotheses on Man and the Universe. Some of this is reflected in the changes he made in the last edition of that great work. But those well-versed in the 1926 edition will feel themselves on rather familiar ground in reading this last edition.

Vernadsky's 'Political' Mission

But, it was not only purely theoretical scientific work that Vernadsky was engaged in, in those years. Rather, he saw his scientific work as his major contribution to the progress of humanity. Although more restricted during the Soviet years in his direct political activity, he felt that his work in science and education was his major contribution in the development of the species, of the Noösphere.

Already in his student years, Vernadsky was involved in politics. Some of his closest friends in those liberal circles of his student days, a small group of friends that called themselves "The Brotherhood," would later wind up in a variety of political formations, populist "narodniki," or communists, or followers of the philosophy of Leo Tolstoy. Vernadsky chose another path, devoting himself, as a "cavalier of science" to the natural sciences as a means of promoting the welfare of the people.

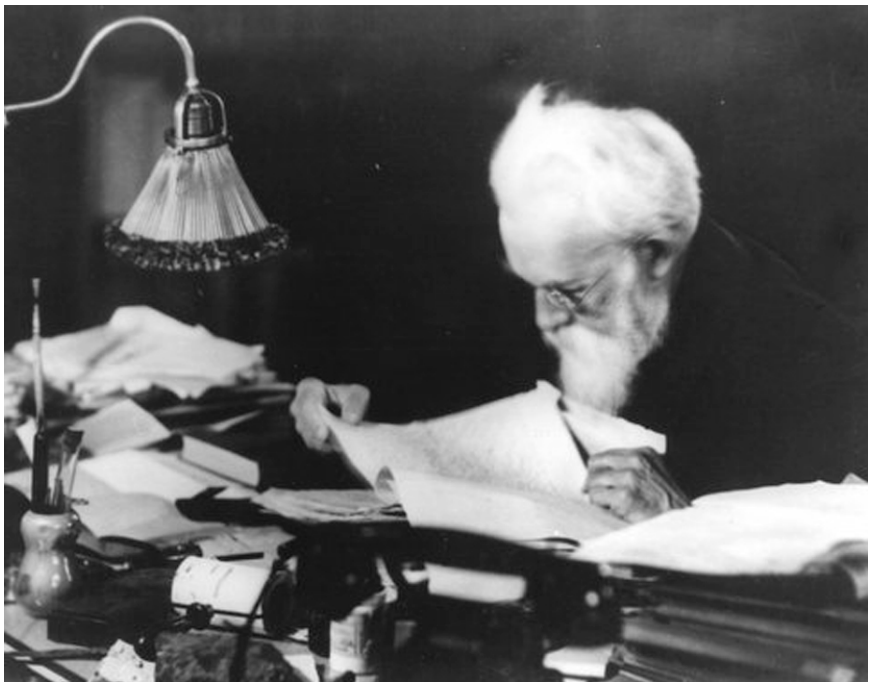
During the time of the 1905 Revolution, Vernadsky played an impor-

tant role in the formation of the Constitutional Democrats, (Kadets). When some extremely repressive measures had been imposed on student activity during various phases of that 1905 period, Vernadsky was one of those who went to speak with the Premier, Sergei Witte, in order to help mitigate those measures. In 1911, he, together with a good part of the faculty at Moscow University, resigned in protest of repressive measures imposed by the Stolypin government.

In 1915, during World War I, Vernadsky was involved in setting up the Commission for the Study of the Natural Productive Forces of Russia (KEPS), with the task of investigating the strategic resources and raw materials at Russia's disposal, a project that had been close to the heart of his old teacher Dokuchayev. The significance of this body was recognized by V.I. Lenin, who decided to retain it in the new Soviet Republic.

When the Bolsheviks took power, a disillusioned Vernadsky left Moscow for Ukraine, where the civil war was raging. He spent some time doing research in the countryside, setting up the Ukrainian Academy of Sciences, to which he was elected as head. Later, during World War II, when Vernadsky was evacuated to what is today Kazakhstan, he similarly gathered together the scientific layers there, and set up another Academy.

Both his son and his daughter chose to leave the country rather than stay under the rule of the Bolsheviks. Vernadsky elected to return to the Soviet Union. Not that he had any sympathies with the Bolshevik leadership, but many of his friends were still active in the Russian academic world, some of whom had become communists. More than any other concern which propelled him to make what must have been a difficult decision, was his firm belief in the power of Russian science to revive a beleaguered nation.



Courtesy of Synergetic Press

Vernadsky in his office in Moscow, in 1940.

Biogeochemistry Is Born

Although he stood in undisputed mastery of his own fields of expertise, in mineralogy and geochemistry, many of his bolder hypotheses and fundamental writings on the nature of the universe went largely unpublished. Vernadsky was accepted as a scientific genius of sorts, but one often attacked and viewed generally by the mandarins of dialectical materialism as an "idealist" and a "vitalist."

In something of a master-stroke, Vernadsky created an entirely new field, biogeochemistry, and established an institute around that study in order to have a forum in which his own notion of the formative role of the biosphere in the chemistry of the planet, also frowned upon by the authorities, might be studied without repercussions.

His most farsighted writings criticizing the prevalent notions of Euclidean space and time in physics, as defective for understanding the phenomena that were being investigated in the biological sciences, and calling instead for the application of a Riemannian, rather than a Euclidean, geometry, went totally beyond the ken of the guardians of "Diamat," and were either suppressed or printed in scholarly journals with a very limited circulation.

In the essays presented here, Vernadsky also outlines the two principal premises on which his life's work was based. The first is the principle of Christiaan Huygens, that life exists throughout the universe and not simply here on Earth, a thesis which Huygens developed most succinctly in his 1698 book, *Cosmotheoros.* His second fundamental premise was based on the thesis of a 16th Century Florentine doctor, Francesco Redi, which said "All life comes from life."

This was an implicit denial of the theory of abiogenesis, as well as spontaneous generation. Neither the evolutionists nor the creationists would be happy with Vernadsky. But he simply could find no scientific basis for either of these hypotheses, attributing them both to religious or philosophical principles, rather than to scientific study of the phenomenon of life.

Appended to the *Essays* (as probably they were to the 1967 Russian edition of *Biosfera*), are Vernadsky's short but powerful theses: "Some Words About the Noösphere," published in *21st Century,* Spring 2005, these short notes would be familiar to readers of this magazine, but little has hitherto been said about their origin.

Vernadsky was to have elaborated on his concept of the Noösphere in a third part of his final work, "The Chemical Structure of the Biosphere and Its Surroundings." That chapter was never written. In many respects, the "Some Words" represents his most elaborate view of the topic, although the concept, if not the term, which he borrowed from Edouard LeRoy, permeates most of his work from his student days. But for Vernadsky, "Some Words About the Noösphere" really represented a post-war program for the world.

In 1943, there were celebrations on the 80th birthday of Vernadsky. He

received the Stalin Prize and an award of 200,000 rubles. As was customary, he sent half of the sum back to be used for the war effort. He also penned a note to Stalin: "Dear Joseph Vissarionovich, I request that 100,000 rubles of the prize named for you, which I have received, be directed to defense needs, wherever you see fit. Our cause is just, and at the present time it spontaneously coincides with the onset of the Noösphere—a new state of the domain of life, the Biosphere—the foundation of a historic process, when the human mind becomes an enormous geological planetary force. Academician Vernadsky."

Later that year, when he had completed "Some Words About the Noösphere," he sent his article to two addresses: to the editorial board of *Pravda,* and, to be sure, to Stalin personally.

Here is what he wrote in an accompanying note: "Borovoye, 27 July, 1943. Dear Joseph Vissarionovich, I am sending you the text of my article, which I have simultaneously submitted to the editors of *Pravda,* and which it would be useful to publish in the newspaper, because I identify a spontaneous natural process, which will ensure our fundamental victory in this world war. In the telegram I sent you, donating to the Red Army half of the prize named for you, which I received, I indicate the significance of the Noösphere. With deep respect and devotion. V. Vernadsky. I am sending you the article, because I don't know if it will be published." The article was never published in *Pravda,* nor is Joseph Stalin known to ever have replied—or received—Vernadsky's note.[1]

The 'Book of Life'

The volume before us gives a tantalizing look at the powerful mind of a great scientist, but it leaves one looking for something more substantial, an elaboration of ideas that are only touched upon in these essays. We are encouraged to hear that the same publisher is considering also translating and publishing another book-length study by Vernadsky, *Scientific Thought and Scientific Work as a Geological Force in the Biosphere.*

Having read parts of the Russian edition of Vernadsky's final, and not fully edited work, *The Chemical Structure of the Earth's Biosphere and Its Surroundings,* I have great hope that this book, which Vernadsky himself considered the culmination of his life's work—"the book of life" as he called it—will also soon find the light of day in an English version.

In this work, Vernadsky does not simply expand on an earlier text, as he did with the various versions of *The Biosphere,* but rather approaches the entire issue from a somewhat higher standpoint, from the point of view of the Cosmos as a whole, incorporating all the new ideas that he had developed in the last decades of his most productive life. Vernadsky viewed this final work as his equivalent to the great "Cosmos" that final work of his beloved scientific forebear, Alexander von Humboldt, whose books had impelled the young Vernadsky on a career of science.

While *EIR* and *21st Century Science & Technology* magazine have published two parts of a three-part project by Vernadsky dealing with the more comprehensive space-time issues provoked by his work in biogeochemistry, the third and final part of that series, "On the Conditions of Physical Space," still remains completely unavailable to non-Russian speakers. It is hoped that the present volume will indeed lead to a resurgence of interest in this remarkable scientist, and to more of his writings in the English language.

While, in this day and age of radar and satellite imaging, many of Vernadsky's "facts" may be somewhat dated (indeed he himself would underline the fact that with the progress of science that *must* be the case), his unique view of man and the universe would be of tremendous benefit to those working in fields about which Vernadsky could have only dreamed—from terraforming Mars to astrobiology.

More important, the fundamental humanist outlook of Vladimir Vernadsky, who viewed the human species and its productive activity as the most important "geological force in the development of the universe," might help revive in society at large, some of the optimism that has been so seriously undermined by the doomsday scenarios of the environmentalist lobby.

Footnotes

1. The text later reports that Vernadsky's article was published in a small Academy journal called *Achievements of Modern Biology.* Vernadsky read the proofs in the Fall of 1944, and lived to see the issue in which it appeared.

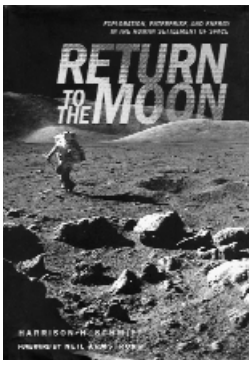
Mining the Moon for Helium-3 To Power Fusion Reactors

by Marsha Freeman

Return to the Moon: Exploration, Enterprise, and Energy in the Human Settlement of Space
by Harrison Schmitt
New York: Copernicus Books, 2006
Hardcover, 335 pp., $25.00

Since President Bush presented his January 2004 initiative for America to return to the Moon, many comments, criticisms, and offers of advice have been written by the science, engineering, and space communities. But few are as qualified to offer proposals on how this program should be carried out as geologist, Apollo 17 astronaut, former Senator, and professor of engineering, Harrison Schmitt.

When most former astronauts write books, they are usually memoirs of their lives and experiences in space. Harrison



Schmitt has worked, virtually since he was the last man to leave his footprints on the Moon in 1972, on the question of how astronauts will return. His new book lays out his plan.

For nearly 20 years, Dr. Schmitt has

worked with Dr. Gerald Kulcinski and other researchers at the Fusion Technology Institute at the University of Wisconsin in Madison, who are investigating the possibility of creating thermonuclear fusion energy using the rare isotope of helium-3.

The reason this particular program is of great interest to Schmitt, is that the nearest and most accessible reservoir of helium-3 is on the Moon.

Helium-3 as a fuel for fusion power has advantages over the heavy hydrogen isotopes deuterium and tritium, which are used in today's fusion experiments around the world. (See the Summer 1990 issue of *21st Century Science & Technology* magazine for a comprehensive discussion of fusion using helium-3.) There is enough helium-3 deposited by the solar wind on and near the surface of the Moon to power the world's economy for millennia.

The importance of the treasure-trove of helium-3 on the Moon as the fuel for fusion has been well recognized by other nations. Japan, Russia, and China stress obtaining the energy resources of the Moon as a goal of their exploration programs.

On Dec. 26, Nikolay Sevastiyanov, president of Russia's space enterprise, RSC Energia, stated: "One way or the other, we will have to go beyond our planet in the search for new, environmentally friendly power soures. A good candidate is the isotope helium-3 for nuclear power. It is available on the Moon" and "can fully meet the entire Earth's power demand for . . . more than 1,000 years."

Given that fusion power is necessary, and helium-3 powered fusion is a most desirable pathway, the task is to consider how this can be accomplished.

Is It 'Competitive'?

For more than three decades, the United States had no program to return to the Moon, nor an adequately funded, broad-ranging effort to develop fusion energy. In response to the lack of Federal support, the University of Wisconsin scientists have proposed to finance their fusion energy research through private funding, by offering spinoffs from their work as commercial products. These include the production of medical isotopes for diagnostic imaging, and land-mine detection.

Similarly, Harrison Schmitt, after decades of watching a rudderless NASA, proposes that private investors be organized to fund space infrastructure—such as heavy lift rockets—and the helium-3 lunar mining and processes facilities.

The problem with such an approach is that high-risk, multidecade research and development programs such as the one proposed, should not, and in fact, cannot, be justified on the basis of the profit they will return to shareholders. Only a Federally funded long-term commitment will work.

Schmitt and the fusion scientists believe that fusion energy must be developed to provide the magnitude of energy that will be required by a growing world, at least by the middle of this century. But by trying to justify why private companies and utilities will order such plants in future decades, Schmitt ends up trying to prove that it will be competitive with coal.

But fusion energy must be developed, regardless of what private companies, utilites, or stockholders support. The same was the case for the development of the railroads, other transport infrastructure, nuclear power, and the Apollo program. The criterion should not be whether fusion power, or, for that matter, space exploration in general, is "competitive." They are urgent national needs.

In his book, Dr. Schmitt makes clear that he has put forward his private funding proposal because he does not believe this nation will make the necessary commitment to return to the Moon—but he has not given up hope.

When George Bush became President in 2001, Schmitt offered his views on the changes that should be made in space policy, and the space agency, for a long-term program to be viable.

On the policy level, decreasing risk, and increasing confidence in space assets, Schmitt advises, depends upon adequate support. Underfunding of the early Space Shuttle design, he states, led to high-risk compromises. "Service in the United States Senate [1977-1983] during this period allowed me to witness this irresponsible Congressional and Administrative behavior first hand," he reports.

For the space agency to be able to carry out a program with the breadth and scope of Apollo, a return to Apollo-style management is required, Schmitt states.

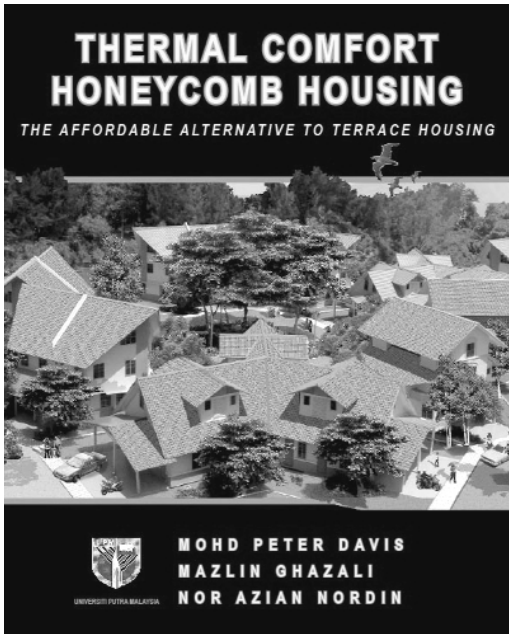
Youth Is the Key.

"The enthusiasm, imagination, and stamina of young men and women formed the heart and soul of Apollo," he says. His first proposal is "that most of NASA be made up of engineers and technicians in their 20s and managers in their 30s." This would return the space agency to the imagination and vitality that it took for the Apollo program to succeed.

Just as Harrison Schmitt's book was being released, near the end of 2005, he was appointed by NASA Administrator Mike Griffin to head the NASA Advisory Council. He is now in a position to use his well-earned scientific and political knowledge, experience, and prestige to help bring the space agency back to where it was, when it carried out the program that took Harrison Schmitt, and 11 other men, to the Moon.

How to Build Comfortable, Cool, and Attractive Housing

by Marjorie Mazel Hecht



Thermal Comfort Honeycomb Housing: The Affordable Alternative to Terrace Housing
by Mohd Peter Davis, Mazlin Ghazali, Nor Azian Nordin
Kuala Lumpur, Malaysia: Universiti Putra Malaysia, 2006
Hardcover, 187 pp., $50.00 (postpaid from Malaysia)*

This book is an inspiring example of how human creativity and determination can solve a problem that will change the lives of many people for the better. As the authors' "honeycomb housing" becomes a reality in Malaysia (where the government and housing developers are awarding honeycomb projects), the idea should catch on, to build comfortable housing around the world—and to tackle other very solvable development challenges.

In the first chapter, author Mohd Peter Davis explains how when he moved to Malaysia from Australia, he found his wife's house in Kuala Lumpur lovely, but too hot. It was a typical terraced rowhouse, but so hot during the day that he couldn't think and so hot at night that he couldn't sleep. Malaysia has 2 million of these grossly overheated houses, both low cost and luxury versions, he says, and the capital, Kuala Lumpur, is now a serious "urban heat island."

The older, traditional wooden kampong houses in the rural areas were cool at night, but unbearably hot "torture chambers" during the day. So, highly motivated by heat stress, Peter Davis decided to design and build a new kind of house that would be comfortably cool without air conditioning. He succeeded, and has been living with his family in their dream house for 14 years.

As he writes, "Our dream bungalow, designed to suit our family needs, has served a wider purpose; it is the first scientific demonstration that energy efficient thermally comfortable houses can be built in Malaysia without using air-conditioning." Davis calculated that his decision not to use air-conditioning will save him the entire cost of building the house in another 9 years. (Note that he is not against air-conditioning, however, and recommends that for bad heat waves or large gatherings, people could have one unit for their living area.)

Thermal Comfort

Davis then took on the project of improving Malaysia's existing urban housing and developing an attractive, comfortable, cool design for new housing that could be easily and inexpensively mass-produced. He and his colleagues scientifically studied, first of all, individual thermal comfort—what a tolerable temperature was for most people in Malaysia's hot, humid, climate—and then measured the temperatures night and day of various kinds of existing housing. For most people, the thermal comfort zone is between 24° and 28°C (75.2°-82.4°F).

They charted the Malaysian climate for every day in a year, and studied how houses heat up, and cool down. Although Kuala Lumpur's humid outdoor temperature didn't get above 35°C (95°F), the indoor temperature reached 49°C under the roof.

Then Davis and co-authors worked on the science of the architecture and the building materials. First, they developed a "cool roof," which reduced indoor temperature by 3.5°C (6.6°F). They found that the common Malaysian practice of using natural ventilation—doors and windows open—during the day made the house hotter, because it brought in the hottest air of the day from outside.

Conversly, opening the doors and windows at night—the opposite of usual Malaysian practice—cooled down the house and stored the coolness, keeping the house cooler the next day. A mechanical ventilation system at night (such as an exhaust fan) helped this process. They found that between 14 to 28 air changes per hour were most effective. Roof wind turbines, they discovered, had no cooling effect.

By combining the cooling features, the improved house was 5.6°C (10°F) cooler than conventional houses. The key was keeping the roof from heat gain from the Sun. They accomplished this, working with industry, by finding a white metal that would stay clean, not leak, and not store as much heat as the usual red concrete tile Malaysian roof. They tested both glass wool and rock wool insulation, which both worked, all in all reducing thermal discomfort in a two-story house by 80 percent and in a one-story house by 70 percent.

To keep the walls from heat gain, they designed wrap-around verandas. This enabled the concrete building materials to store the coolness from night ventilation, instead of the heat from the Sun.

The authors proposed that the government replace the current urban roofs with the new "cool roof," which would cut the thermal discomfort factor by 80 percent. But no one wanted to pay for the renovation. And so, they decided to concentrate on building new housing that was thermally comfortable—at no additional cost to the builder or buyer.

It should be noted that in the past, Malaysia has been a housing success story, constructing "reasonable quality urban housing," Davis says, to keep pace with the population increase and the migration from the rural areas. The

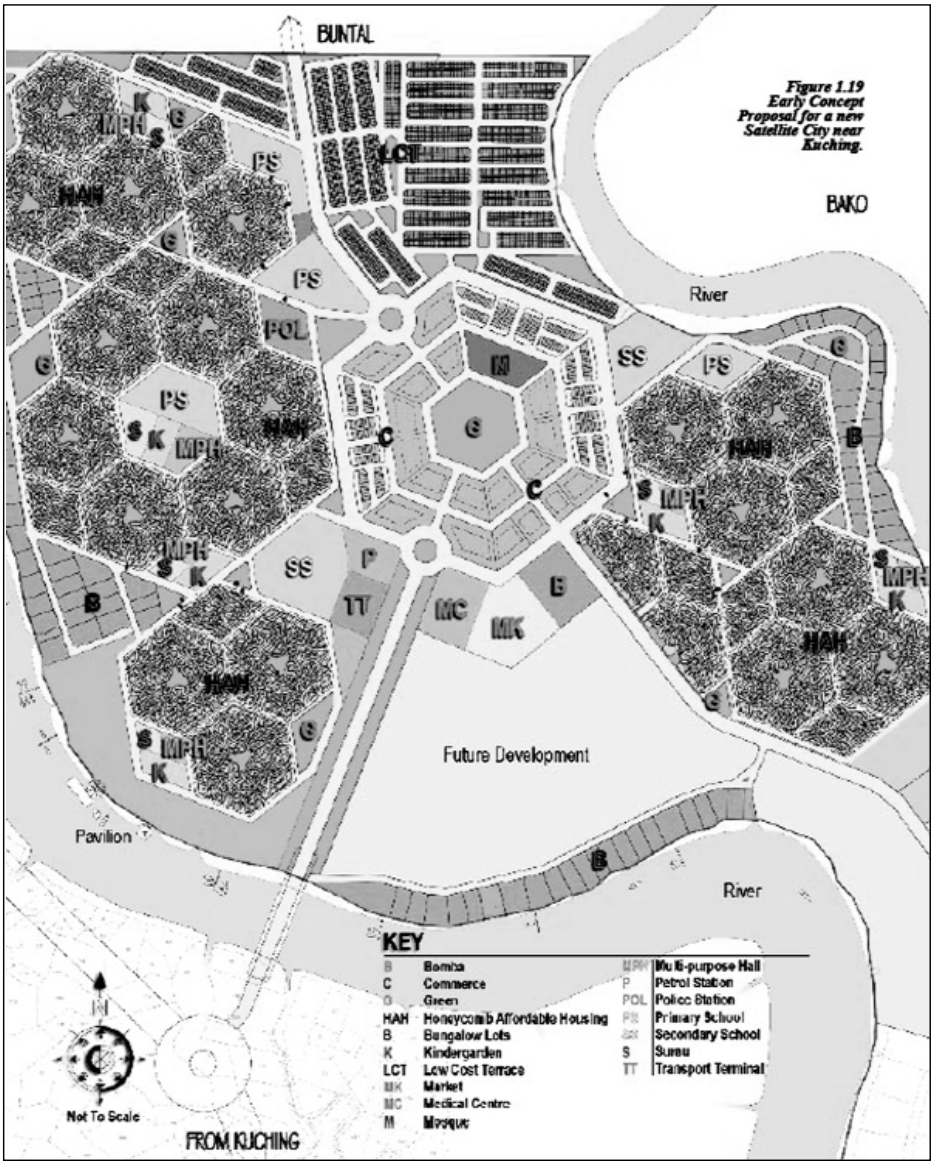
problem is today that the price of buying a row house is too high for most working families, who live instead in high-rise "pigeon-hole" apartment buildings.

The Honeycomb Design

Architect Mazlin Ghazali's honeycomb design addresses the cost question, and also two other complaints by residents of current low-cost housing: thermal discomfort and too-small kitchens. He also considered the lack of community spaces and the unfriendliness of conventional urban designs.

The Ghazali design revamps the traditional urban row house design by placing housing units around a central space in hexagonal formations. This gives the group of houses an inner courtyard. Instead of "monotonous terrace houses with small front yards," Ghazali says, there are "semi-detached houses with generous gardens . . . at no extra cost to the buyers."

The Ghazali tessellating design is not only attractive, but is more efficient than the usual row house design, accommodating more housing units per acre, using duplexes, triplexes, and quadruplexes. He has designed whole neighborhoods in a hexagonal grid, and all types of housing, including honeycomb four- and five-story apartment buildings. The design allows for mature trees to have the room to grow in the inner courtyards, unimpeded by sewer and utility lines.



An early concept proposal for a satellite city envisioned to house 100,000 residents in 2,000 acres.

A basic consideration was how to provide safe play areas for children, and community recreational spaces in an urban setting, and how to make quality homes available for every Malaysian family. Toward this end, for the last four years, the authors have been talking about thermal honeycomb housing with consumers, developers, and the government. In one market survey, their scale model of "My First Home" had 80 percent approval among respondents. When you look at the housing layouts, and the sketches of the honeycomb community, it is easy to see why they would be preferred to the usual row house.

The authors note that the world needs "about 500 million new houses, mainly in developing countries." They see their design as a counterpole to the greens who advocate going back to nature and the Stone Age. Instead, they write, we have to go "back to the optimism of the great Biosphere scientist Vladimir Vernardsky and his concept of the Noösphere. . . ."

We need 1,000 new cities in the developing world, the authors state, and Malaysia is positioned to play a leading role as a city builder. Where will these cities be located? The authors cite the Eurasian Land-Bridge, as pioneered by Lyndon and Helga LaRouche, as the location for these new cities.

The book concludes: "We can only agree with Vernadsky: 'The future is in our hands. We will not let it go.' "

The first honeycomb cities, to be funded by the Malaysian government, are on the drawing board (see figure).

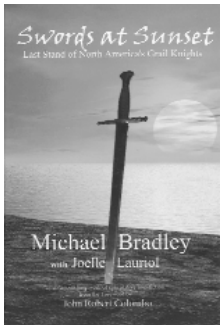
If Malaysia can do it, why not New Orleans?

Notes

* The book can be obtained directly from the authors in Malaysia. Send a bank draft for U.S.$50.00 (which includes postage), payable to Peter Davis, and mail to him at Institute of Advanced Technology, Universiti Putra Malaysia, UPM 43400 Serdang, Selangor, MALAYSIA. For more information, contact Peter Davis at e-mail: mohd_peter@hotmail.com.

Templar Knights in North America?

by Charles Hughes



Swords at Sunset: Last Stand of North America's Grail Knights
by Michael Bradley with Joelle Lauriol
Ancaster, Ontario: Manor House Publishing, 2006
Paperback, 240 pp., $24.95

Swords at Sunset was written in an attempt to prove that America was discovered in 1398 by the Scotch prince Henry Sinclair of Rosslyn, Scotland. According to author Bradley, a settlement was set up in what later became Nova Scotia, Canada, with colonists consisting of refugee Templar Knights who were fleeing persecution by the French and English kings.

That America was discovered by an expedition led by Prince Henry 100 years before Columbus is not exactly a new idea; it has been debated for the last 400 years, since the publication of a book and maps by the Venetian Niccolo Zeno ("The Zeno Narrative"). However, to push the controversy further, Bradley claims that the expedition and subsequent colonies were largely Scotch Templar Knights. Bradley is obsessed with the legends concerning the Templar Order and the Holy Grail, whatever that may be.

As readers may have noticed, a flood of books, films, and television programs has appeared since the publication of the book *Holy Blood, Holy Grail,* in 1981. These books, along with other fungus productions, conspire to bring about a cultural change in America and Europe by pushing feudalism and a new Dark Age.

The themes here are the Holy Grail, revisionist Christianity, pagan cults, and speculation about oligarchical family trees. That the Crusades of the European Middle Ages were a curse upon humanity, a promoter of genocide and the destruction of civilization, no one actually familiar with history can deny! Military orders such as the Knights Templar and the Knights of Malta were leaders and organizers at the behest of the oligarchy of this sorry mess. The so-called Republic of Venice was the controller of the feudal system.

Aside from Bradley's feudal and pagan outlook, he has done some serious antiquarian investigations over the last 20 years, looking at strange ruins and artifacts in the United States and Canada. In other words, he may have made some genuine and important historical discoveries of pre-Columbian history.

Bradley received a letter in December 1981, requesting that he come and investigate a strange ruin on the letter-writer's property in Nova Scotia, which resembled the remains of a castle or fort of stone-rubble-type construction, a common style in medieval Europe. The location of the ruin was a town northwest of Halifax, Nova Scotia, called The Cross.

Bradley went to see the ruin, taking photos of the walls and looking around the area for objects. He urged the Nova Scotia government's Ministry of Recreation, Culture, and Fitness to conduct an investigation, reporting that the ruins could very well be medieval European, built by religious refugees fleeing persecution. And, yes, they could be relics of the Sinclair expedition of 1398, as well.

Bradley's secondary axiom was that the historical Templars were Christian heretics, many of whom were given refuge in Scotland by King Robert the Bruce, after their suppression in 1307 by the French King Philip le Bel and the Pope.

A few years later, Bradley was informed of another possible Scotch ruin located on the Vermont-Quebec border, near Lake Mephremogog. People living around the lake had dug up artifacts in the course of house construction. One find was an iron spearhead, but the major anomaly there was a gigantic stone dam, some cut blocks of which weighed a ton or more. Stakes of spruce wood used to lay out the structure were discovered under the dam and, subjected to radio carbon dating, were found to be at least 500 years old, a date prior to French settlement of the area. Nearby, a stone carving of a gargoyle was also discovered in a style possibly Scotch or Norse. This discovery was filmed for a television documentary.

The Zeno Connection

The old book mentioned above was supposedly written at the time of the alleged Sinclair discovery in 1398, by a Venetian sailor who was employed as the leader of the Sinclair fleet of ships.[1] The book was discovered 160 years later in Italian, and soon English editions came out. It gave an account of a voyage from Scotland to the Atlantic coast of Canada of several ships and seamen, and more than a hundred fighting men. Landfalls were cited on Iceland, Greenland, a place called Friesland (still not identified), and an island or peninsula called in the narrative Esstiltoland, which is thought to be modern Nova Scotia.

This Zeno narrative, with its maps, has been disputed for the last 400 years, so, beware, as this book was written by one of the leading oligarchical families of Venice. Nevertheless, Henry Sinclair had good reasons to attempt an Atlantic crossing when he did, because Henry possessed a significant fleet of ocean-going ships, which also served the rulers of Norway; he was a vassal of Norway, having the title Earl of Norway.

In this period, Scotland looked toward the north, and not toward England. Norway at this time pulled, or had controlling influence over, Denmark, Sweden, Iceland, and Greenland. The Zeno family and their country, Venice, wished to take part in the extensive and profitable trade in fish, timber, furs, and seal oil. Venice was cut off from its eastern trade, because it was blockaded by the Turks, who suspected that Venice was running the Crusades against Turkey.

Perhaps Venice wanted to be part of a North Atlantic empire which would outflank the Hanseatic league, which had a

monopoly on the North Sea trade. Fishing grounds were all controlled by rivals, and of course fish were very important in the Middle Ages, when the Church forbade the consumption of meat during Lent and other numerous fast days.

Henry Sinclair could also have had accurate information on North America from his contact with Norway, including maps. One such map, included in the Zeno Narrative, was studied by map expert Arlington Mallery, and featured as a chapter in his book *The Rediscovery of Lost America* (Dutton, 1979). On the Zeno map of the North Atlantic, Greenland is shown correctly positioned as to longitude and latitude, and is shown without ice, consisting of three islands, a fact confirmed in modern times by seismic studies.

Mallery said that this must be a genuine map, predating the Middle Ages, of possibly Arab or Phoenician origin. He claims that a map can be the oldest written record, and may precede knowledge of writing. So the Zeno map looks like it may be real, though anomalous, even if the text may not be reliable.

The Narrative relates that Prince Sinclair took a flotilla of ships and a large crew of at least 100 fighting men, whom Bradley assumes were Templar Knights. Sinclair may have been tired of supporting these people who, since they had been condemned by the Pope and the Inquisition, were best sent West to set up a colony.

Prince Henry returned to Scotland in 1399, and was killed in a battle that year. The majority of the colonists remained in Nova Scotia, the initial settlement being at The Cross near Halifax, or perhaps at a place called Green Oaks. The area that most fits the description of the Zeno Narrative is the modern town of Stellerton, Nova Scotia, which has an exposed oil spring and gold-bearing beach sands, both items mentioned in the Narrative. This spring is a good indication that the Narrative refers to Nova Scotia, because there are only two such oil springs in North America (the other is in Los Angeles).

Bradley says that the colony, or several colonies, kept moving west to avoid other Europeans after the 1500s. Were these Scottish Templar Knights finally wiped out by the expanding onslaught of the Iroquois? Bradley thinks so, and thinks that the final battles were fought in the Rochester, New York, area, and in the area around St. Catherine's Ontario, no later than 1570. The major battle took place, according to Bradley, right where the Latter Day Saints (Mormons) place the battle of Cumorah, near Palmyra, New York. Could the family of Joseph Smith, the Mormon founder, have been survivors of this battle, and picked up an account of it from his ancestors?

Notes

1. The "Zeno Narrative" can be found in the *New England Antiquities Research Association Journal*, Vol. 32, No. 2, Fall 1998.

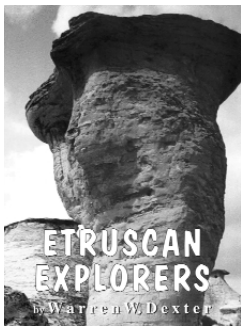
North American Evidence of Pre-Columbus Voyages

Etruscan Explorers
by Warren W. Dexter
Self-published
Hardcover, 63 pp., $28.50 order@bookmasters.com 1 (800) 247-6553

Warren Dexter's passion has been to create a photographic record of ancient sites in America and other countries, to preserve these artifacts for future generations, at least in pictures. Now 95, Mr. Dexter has made a selection of his thousands of photos available to the general public in this small book, *Etruscan Explorers.*

As the dustjacket to his book quotes him, "I'm not a verbiage writer but a graphic specialist." The frontispiece reinforces this, proclaiming: "This book is a graphic story board of the records left behind by Ancient Explorers. This is *not* in an academic or literary format, but the pictures tell the story." And so they do.

Most spectacular is the subject of the cover photo and several inside photos, the Milk River sculptured heads located in Alberta, Canada, about 10 miles up the river from the U.S. border. Sadly, the Canadian government did not see fit to preserve this ancient site, and pieces of



it have fallen into the Milk River, so Dexter's photos, taken in 1982, take on an increased importance. Vandals also demolished one of the sculptured heads with bullet holes, using the sculpture as a target.

These tall pillars are located on a cliff about 65 feet above the river. The base of one pillar has Ogam writing inscribed in a circular pattern. Using a montage of Dexter's photographs, Dr. Barry Fell deciphered the vowel-less Ogam which tells of using the flight of migrating birds to prophesy the future. It describes the same divination procedure attributed to the ancient Etruscans.

That same pillar has a sculpted Caucasian head, and next to it is another, smaller pillar with a sculpted Negro head, similar in style to the Olmec sculpted figures in Central America. (This is what you see clearly in the 1982 photos, although now both pillars are damaged.)

Dexter shows in his photos the only two places that the raised letter Ogam, spelling out the name of the god Baal, is found: in ancient (9th Century B.C.) Etruscan hut urns, used for cremated ashes, and on a Milk River dolmen monument, not far from the pillars decribed above. Hence the name of his book.

Among the other unique photographs are some of ancient Zulu artifacts. One of these is an ancient gold trading stone which has six different alphabets, including Ogam.

The author has written and contributed to other books about ancient America, including sites in his home state of Vermont. But there are thousands of unpublished photos in Warren Dexter's archive. It is hoped that enough people will be intrigued by this volume to support the publication of more of Mr. Dexter's photographs.

—Marjorie Mazel Hecht