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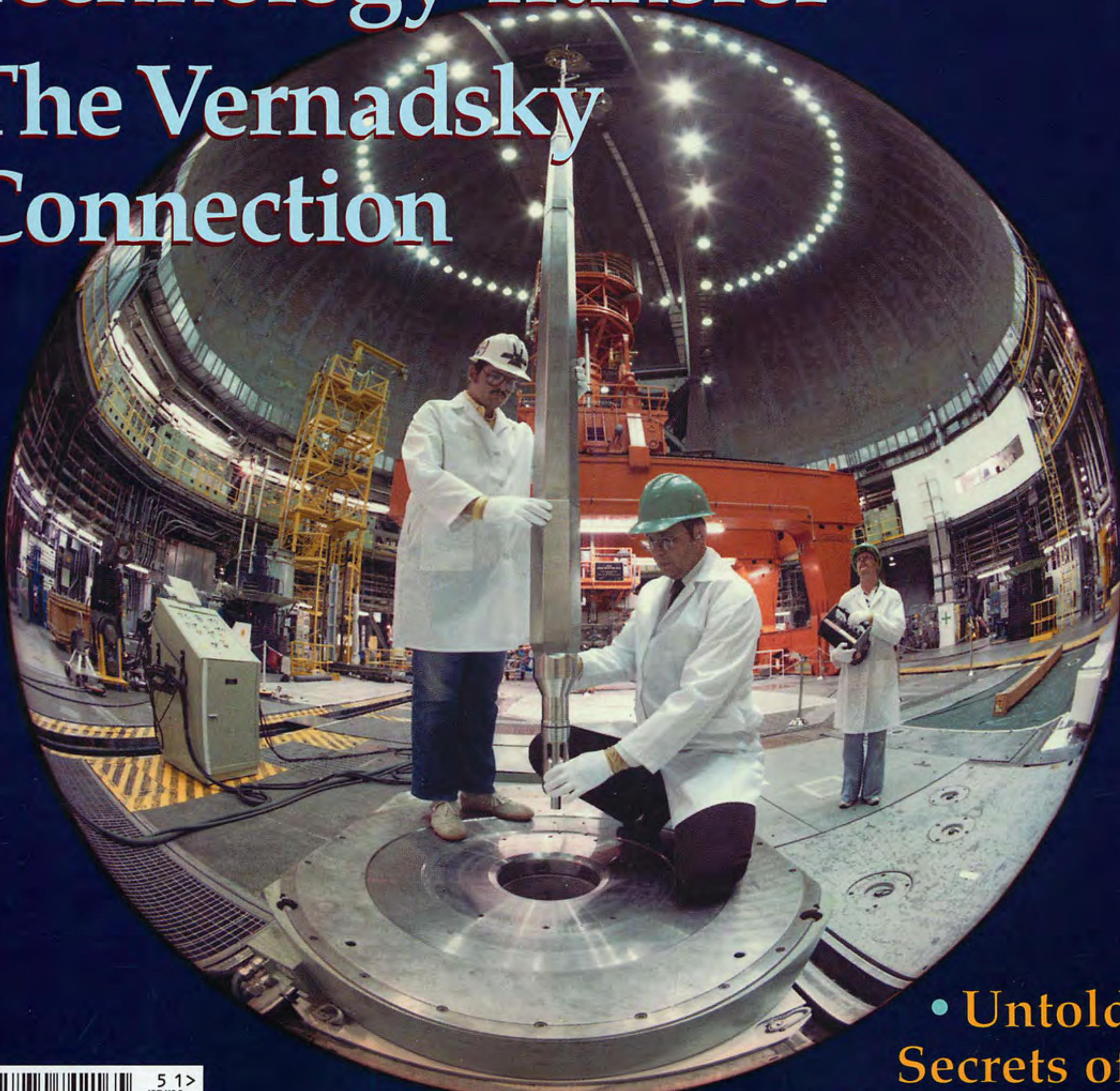

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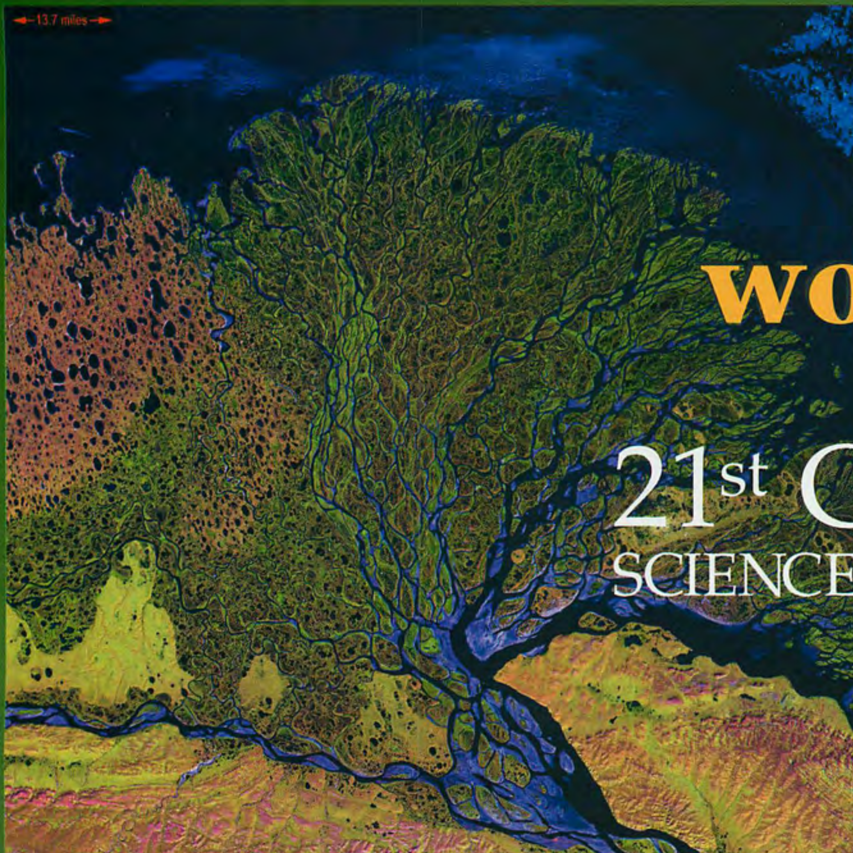

A Landsat-7 false-color satellite image of the Lena River Delta in Russia; the Lena River, 2,800 miles long, is one of the largest in the world. Photo courtesy of USGS/NASA.

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21st CENTURY SCIENCE & TECHNOLOGY

Vol. 18, No. 1 Spring 2005

Features

Science & The LaRouche Youth Movement

On the Cover: FFTF technicians ready a fuel assembly to be lowered into a conditioning cell to prepare it for transfer to a liquid sodium environment (1985). Cover photo courtesy of DOE; cover design by Alan Yue.

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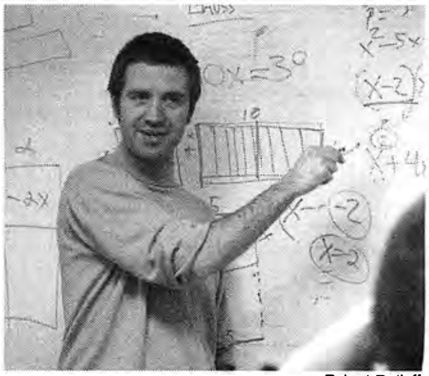

Robert Detloff

Michael Kirsch teaches a class on Gauss's 1799 refutation of Euler, Lagrange, and d'Alembert to LaRouche Youth Movement members in Boston.

21st Century Science & Technology (ISSN 0895-6820) is published 4 times a year by 21st Century Science Associates, 60 Sycolin Road, Suite 203, Leesburg, Va. 20175. Tel. (703) 777-6943.

Address all correspondence to **21st Century**, P.O. Box 16285, Washington, D.C. 20041.

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Subscriptions by mail are $25 for 6 issues or $48 for 12 issues in the USA and Canada. Airmail subscriptions to other countries are $50 for 6 issues. Back issues are $5 each ($8 foreign). Payments must be in U.S. currency.

Printed in the USA ISSN 0895-682
www.21stcenturysciencetech.com

How to Build 6,000 Nuclear Plants

There is only one way to bring the world's 6 billion people up to a decent living standard: by using nuclear fission to provide the energy needed for industrial economies. Nuclear, and in the future fusion, are the only energy sources with the flux density that can do the job. To take one measure of this: One nuclear fission event releases 250 million electron volts of energy, compared to less than 8 electron volts for the best chemical reaction. (See Robert J. Moon's article on the Manhattan Project, p. 45.)

The task is huge, but the issue is one of life or death. Energy production worldwide must be *doubled* in the next 45 years, to bring the existing population in the Third World up to par, and to keep up with the projected 3 to 4 billion in population growth. There are 1.5 billion people in the world who still have no electricity at all—not only no computers and no televisions, but no light bulbs—and billions of others have just a fraction of the electricity required for a productive economy.

How many nuclear plants will it take?

Nuclear engineer James Muckerheide, director of the Center for Nuclear Technology and Society at Worcester Polytechnic Institute, and the State Nuclear Engineer for Massachusetts, has calculated that we need 6,000 new nuclear plants by the year 2050. This requires an aggressive program, starting now to build the factories that can produce the necessary plant components, and mass produce the production facilities that will mass produce reactor vessels. It also requires accelerating the processing and enrichment of uranium.

The production schedule, as Muckerheide outlines it, has to radiate out—along the Eurasian Land-Bridge route, for example—reproducing production facilities at a rate that will keep up with the new cities along the Land-Bridge.[1]

John Ritch, Director-General of the World Nuclear Association, has put the figure at 5,000 new nuclear plants.[2] Both he and Muckerheide envision a mix of plants, large and small, modular, high temperature, fast reactors (breeders), floating reactors—and some new designs still in the idea stage.

The numbers may sound staggering, especially compared to the pitifully small number of plants the U.S. nuclear community intends to put on line in the next decade (exactly one). But the technical and engineering expertise exists, albeit inactive or in embryo. What is missing is the ability to think outside the shrinking social universe of the last 30 years, where both mental abilities and expectations were forced into suspension among the very population that needs to lead the fight to go nuclear today. What has beaten down the former scientific optimism is the idea pushed by environmentalists and anti-environmentalists alike, that austerity rules, that there is a limited pie, that cost-benefititis must infect everything.

For the saner leaders and policy makers in this limbo, the jolt out of this unhappy state will be their increasingly closer view at the edge of the financial precipice, taking in the colossal dimensions of the collapse about to hit.

A New Bretton Woods

As we are already seeing, both Democrats and Republicans are coming to understand what Lyndon LaRouche has been talking about for 30 years: Without a New Bretton Woods financial architecture, and a massive program for building new infrastructure at home and around the world, the world will sink into a New Dark Age, one of perpetual war, disease, and misery more horrible than previous dark ages. Those who remember what it was like in the early postwar years, can see that the United States, with its crumbling bridges and sewer systems, collapsed transportation, and bankrupt industries, will soon be a formerly industrialized nation in a Third World condition.

For those not familiar with the LaRouche economic program, we recommend his new book, *The Earth's Next 50 Years* (Leesburg, VA: LaRouche PAC, 2005, $20.00), which lays out in full historical perspective the dramatic shift in thinking that is necessary to survive the looming crisis and move the noösphere—man's creative development of the biosphere—forward. As a start, see his summary article on "The Peaceful Concept of Technology Transfer" on p. 8, and the accompanying translation of a 1943 paper by V.I. Vernadsky.

Back to Nuclear

Building nuclear plants *is* a known technology. The French can put a 1,000-megawatt plant on line in 3 years, and the Japanese, using a U.S. design, put a 1,000 megawatt boiling water reactor on line in just a little more time. The new, modular, inherently safe reactors, like South Africa's Pebble Bed High Temperature Reactor or General Atomics' GT-MHR can be mass produced and come on line even more quickly in the future.

That the world wants to go nuclear, was made clear at the March 20-21 meeting of the Organization for Economic Cooperation and Development in Paris, "Nuclear Power for the 21st Century." For the first time since the Atoms for Peace years of the 1950s and early 1960s, top level representatives from 74 countries came together to discuss the nuclear option. The vast majority concluded that nuclear was a necessity.

China's plan to build 30 nuclear plants in the next 20 years, and South Africa's plan to mass produce the high-temperature Pebble Bed Modular Reactor for domestic use and export, are the high points of the discussion. The new demand for nuclear was in many cases shrouded in global warming language—all utterly false; nevertheless, there is recognition that if nations want a safe energy supply, nuclear is the way to go.

Where does the United States stand in all this? Disgracefully, despite some pro-nuclear rhetoric, the U.S. nuclear industry and the Department of Energy and its various beneficiaries are chained to a "cost-benefit" economic model that will get them and the nation nowhere, fast. The case of the Fast Flux Test Facility, now on the chopping block allegedly because the DOE found it not "cost effective" (see p. 68), is exemplary of this folly. Essential infrastructure—whether nuclear energy, or national rail systems—should not be measured with an annual cost-benefit yardstick that ignores both the future—and the past.

Should medical isotope production—necessary for treating cancer patients and saving lives—be stopped because it doesn't "pay for itself" immediately? Should the training of graduate engineering students at a nuclear research reactor be stopped, because the payback isn't instantaneous? And how is the testing of new fuel elements and materials for future nuclear and fusion reactors supposed to reap immediate money?

This nation could not have been built with that kind of cost-benefit yardstick, and Franklin Roosevelt could not have retooled America's industries to win a war with that kind of yardstick.

Right now, the United States no longer has the capability to produce even one nuclear reactor vessel—never mind half a dozen—in a timely fashion. With a little effort, we could gear up to do it, providing skilled jobs for the now-unemployed trained production workers, re-training those without technical skills and the unproductively employed, and providing a future for upcoming generations. Instead of downsizing, to keep pace with pessimism, the United States should mobilize its brain power for exporting nuclear technologies and their spinoffs to the vast numbers of people in Eurasia who are eager to industrialize and to make use of their own raw materials.

There is a generation of skilled Americans, who have been fighting for 30 to 60 years to move the nation forward in space and nuclear, using the science driver approach to economic prosperity. We know many of them—and they are eager to see their plans and dreams, many of which exist in blueprints, and some of which have long been approved by Congress, come alive within their lifetimes. The way the LaRouche Youth Movement remoralized the nuclear community in the Hanford area (see News Brief, p. 6) is an example of this. We need the expertise of these Democrats, Republicans, and Independents now to provide leadership for the biggest infrastructure-building plan the world has ever seen: Not just to build a handful of new nuclear plants for the United States, but to help build the 6,000 nuclear plants the world needs by the year 2050.

We also need to totally restructure the regulatory industry, now dominated by the unscientific phalanx of well-paid environmentalist executive idiots, who prate about "the planet" but can't tell you the difference between the biosphere and the noösphere, and who define a human being by the amount of solid waste he produces annually.

Where Does the Money Come From?

How to pay for the necessary infrastructure is where many otherwise-optimistic people stumble into the pessimistic mindset. But, the solution is not so difficult in conception. Society can't advance without adequate energy; the environment can't be maintained without advanced technologies that require energy. Therefore, as with Roosevelt's infrastructure-building programs, the state needs to create the low-interest long-term credits to get the job done. The payoff will be tremendous—like the space program, which returned $14 to the economy for every $1 spent. Men and women will be able to work in real productive jobs; students will have a future to look forward to; and our generation will know that future generations will not have to worry about adequate energy or the basic necessities of life.

As Admiral Rickover, the builder of the Nuclear Navy, was fond of quoting from *Proverbs,* "Where there is no vision, the people perish."

—*Marjorie Mazel Hecht*

Notes

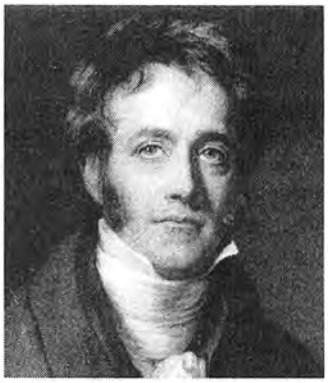
1. Unpublished work in progrss.
2. As reported in *New Kerala* March 14, from Ritch's article in the Indian nuclear journal *Nu-Power.*

VIEWPOINT

A Call for a Musical Pitch of C-512

This letter of English astronomer and physicist John Herschel is taken from the Journal of the Society of Arts, *July 8, 1859, page 581, under the heading "Uniform Musical Pitch."*

Readers are referred to the Winter 1999-2000 issue of 21st Century *for a thorough discussion of the still-urgent necessity of lowering the musical pitch to a value of C-512 (middle C = 256 cycles per second).*



by John Frederick Herschel

The following letter has been addressed to the Chairman of the Musical Pitch Committee:

Sir,—I regret that it was not possible for me to attend the meeting of the Society of Arts on the subject of a fixed musical pitch or diapason; but understanding, from the reported proceedings of the meeting (as, indeed, might have been reasonably expected), that a Committee has been formed to consider the subject more deliberately than could be done in a general meeting, I beg leave to offer my opinion in the form of a letter.

The subject is extremely simple in itself. All are agreed that the present pitch is inconveniently high and *must* be lowered. All are desirous that, when once lowered, it should be kept from rising again, to which there is a continual tendency, arising from a distinct natural cause inherent in the nature of harmony, viz., the excess (amounting to about 11 vibrations in 10,000) of a perfect fifth over seven-twelfths of an octave, which has to be constantly contended against in upward modulations, whenever violins or voices are not kept in check by fixed instruments. But perhaps all are not aware that the evil of fine ancient vocal compositions having thus been rendered impracticable to singers in their original normal key is a very great one, inasmuch as transposition to a lower nominal key involves the sacrifice of the adaptation of the peculiar character of the key (a character intended and felt by the composer), and the substitution of a totally different incidence of the temperament on the series of notes in the scale, and goes, therefore, to mar the intended effect and injure the composition, as much as an ill-chosen tone of varnish would

The Renowned Herschels

John Herschel (1792-1871) was the only son of the world-renowned Anglo-German astronomer William Herschel, often known as the father of stellar astronomy. Wilhelm Herschel had been sent to England in 1757 by his father, a leading musician in Hannover, in order to avoid the imperial draft. William was first employed in the formation of a military band, but devoted his leisure time to mathematics and astronomy, constructing a five-and-one-half foot reflecting telescope in 1774. Gradually withdrawing from musical engagements, he began a survey of the heavens with a seven-foot reflector, and on March 13, 1781, he discovered the planet now known as Uranus. In 1802 he presented the Royal Society with a catalogue of 5,000 new nebulae he had discovered.

William was aided in his telescope-building and observational work by his sister Caroline, who had come over from Hanover in 1772. She was also an active musician and organizer of choruses.

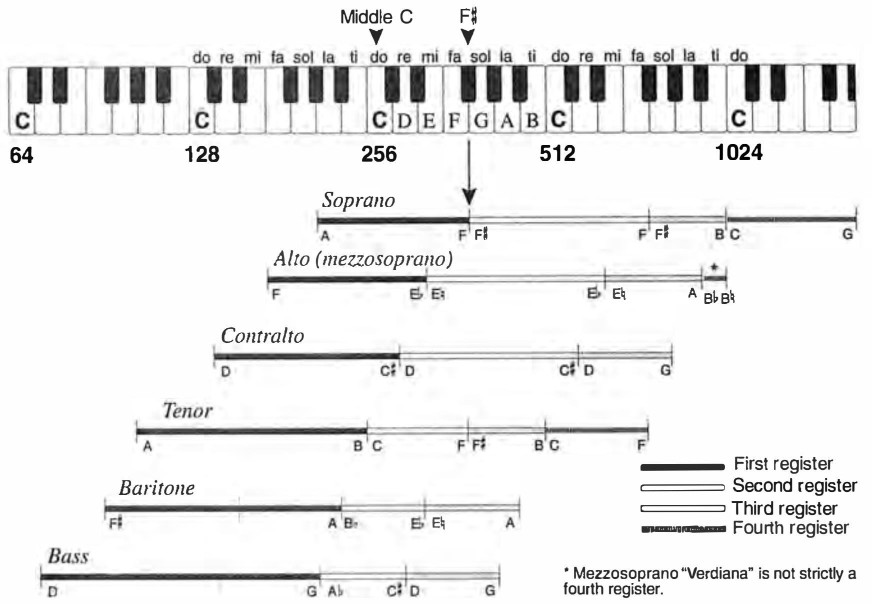
John Herschel continued his father's work in cataloguing stars, presenting a report with James South to the Royal Society in 1824, on the position and apparent distances of 380 double and triple stars, based on more than 10,000 measurements. The report won the astronomical prize of the French Academy, and two years later the gold medal of the Royal Society. His "Treatise on the Theory of Light" appeared in 1827, followed by one on sound in 1830. He was also the author of the "Preliminary Discourse on the Study of Natural Philosophy" (1830) and many other works. In 1847, the results of his vast labor of survey of the southern skies was published.

But the younger Herschel's most lasting contribution may have been his work, while still a student at Cambridge University, to revive the then moribund British science by waging war on the Newton obsession. In 1812, he formed at Cambridge the Analytic Society, along with fellow students Charles Babbage and George Peacock. Their stated aim was to advocate "the principles of pure d-ism as opposed to the dot-age of the university." The pun referred to the refusal of British mathematicians to give up the Newtonian system of fluxions—in which a poor imitation of the differential was denoted by a dot over the unknown value (fluent) under consideration—in favor of the superior and now universally employed Leibnizian calculus. The first act of the society was to translate Lacroix's treatise on the differential and integral calculus from the French.

—Laurence Hecht

damage the effect of a fine Titian.

Since, however, all are agreed that the pitch must be lowered, the only remaining question is, how much? Now, if there were any prospect that this operation which has now to be performed, and which our French neighbors consider themselves to have performed, could be repeated some 20 years hence, I should be disposed to acquiesce, for the mere sake of acquiescence, in the conclusion they have come to, viz., to fix A (for the present) at 870 vibrations per second, which is equivalent to fixing C at 522, looking forward to a future step in the same direction which should bring it to 512; there to remain henceforward invariable. Such a C, being the ninth octave of a fundamental note corresponding to one vibration per second, has a claim to universal reception on the score of intrinsic simplicity, convenience of memory, and reference to a natural unit, so strong that I am amazed at the French not having been the foremost to recognize and adopt it, when it is remembered that their boasted unit of length, the meter, is based on the subdivisions of a natural unit of space, just as the second (a universally used aliquot of the day) is of time; the one on the linear dimensions, the other on the time of rotation of the Earth.



THE SPECIES OF THE HUMAN SINGING VOICE

Middle C at 256 cycles per second is based on the natural registers of the human singing voice, which are built into the human body. A register is a series of notes produced by the same position of the vocal tract. In singing up the scale past a certain point, the mind must learn to shift the vocal mechanism to a new register position, or the voice will "crack."

Children's voices shift to a new register on the second half of the C scale. Later, girls develop into sopranos and mezzosopranos, and boys develop a lower octave and become tenors, baritones, and basses. But the intervals of each voice are still divided into three or four qualities of the distinct voice registers.

Source: Kathy Wolfe, "The Singing Voice Demands a Scientific Middle C," *21st Century*, Winter 1999-2000; adapted from *A Manual on the Rudiments of Tuning and Registration*, Book 1 (Washington, D.C.: Schiller Institute, 1992).

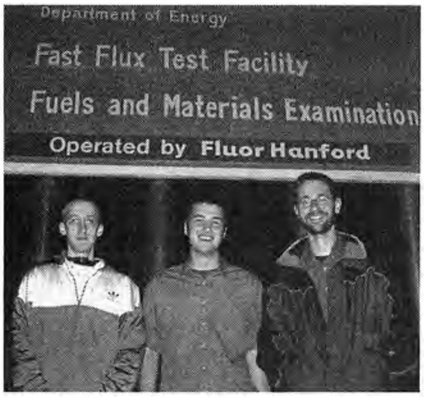
But as there is not the least chance that the present move will be otherwise than final, I confess myself disposed in this matter to be more French than the French themselves; to act once for all; to adopt the C of 512 vibrations, and so to carry out this as part and parcel of a complete natural metrical system, which would recommend itself to all nations on its own merits, while possessing the additional and not inferior merit of meeting more fully than the half-measure proposed, the wishes of the singer, and the requirements of that most perfect and charming (because most naturally affecting the feelings) of all instruments, the female voice: which I consider, in any discussion of the kind, ought to be held paramount to any possible claim on the part of wood, brass, wire, or catgut.

It is clearly the interest of any lover of music that the pitch should be such as can be maintained by a vocalist, not merely in her highest vigor of youth, but up to an age when the voice, though still perfect, and, in fact, improved and mellowed by time and practice, is yet unable, without painful effort, to reach the extreme elevation it could accomplish without difficulty at an earlier period.

If a change be made, I do not believe the instrument makers would find their interests at all more or less affected whether the pitch were lowered to, and permanently fixed at, 522 or 512. In either case, they would stand disembarrassed at once and for ever of the necessity of consulting the varying convenience or caprice of their customers in different places, and it must (assuredly it ought) to be to them a matter of perfect indifference what the requirements of the public in that respect may be. As to what is alleged of the superior brilliancy and "sonority" of instruments pitched a comma or two higher than others, I regard it as mere professional jargon, unworthy of the slightest consideration.

I will add only one further remark. The 512 C is independent of any stan-

Continued on page 77



Oyang Teng

Save the FFTF!: Three of the LaRouche Youth Movement team that toured the Tri-Cities region: From left, Wesley Irwin, Spencer Cross, and David Dobrodt.

LAROUCHE YOUTH INJECT OPTIMISM INTO HANFORD NUCLEAR FIGHT

LaRouche Youth Movement members touring the Tri-Cities region of Washington state (where the Fast Flux Test Facility, FFTF, is on Death Row and facing execution within weeks; see page 68) have remoralized the local pro-nuclear forces with their optimism and enthusiasm, and their vision of worldwide economic development powered largely by nuclear energy.

With the help of the local Benton County Commissioner, and other supporters of the initiative to save the FFTF, the Youth Movement team received local radio, television, and newspaper coverage and held meetings with local leaders and the nuclear community during their late-March tour. These young leaders see this as part of their much-larger mission to remoralize and rally the population-at-large behind Lyndon LaRouche's vision of Earth's next 50 years, with FDR-style development policies for the U.S.A. and a New Bretton Woods monetary system reorganization to industrialize the *world*.

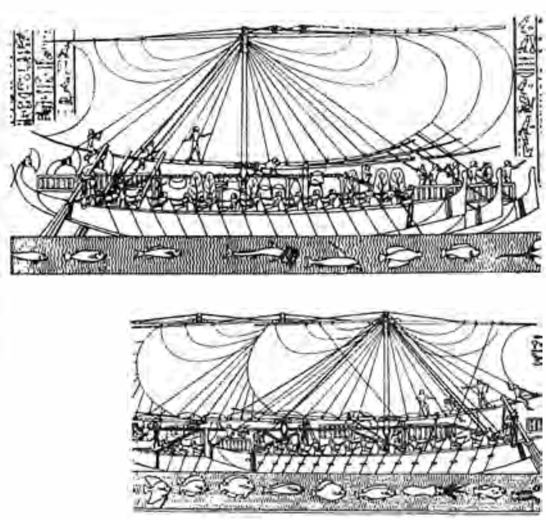
"Why are you here supporting the FFTF?" asked local radio and television interviewers. Because the work the FFTF does in testing nuclear materials and producing medical isotopes is critical for the future of the nation as an industrial leader in the world, the LaRouche Youth answered. At a town meeting the youth held in Richland, one of the Tri-Cities on March 31, they discussed LaRouche's program for physical economy and the fact that both the so-called liberals and the neo-conservatives deny the ability of human beings for making the creative discoveries that change the world for the better.

SCIENTISTS ACCUSE NIH OF IGNORING PUBLIC HEALTH

In an unusual move, more than 750 microbiologists signed a scathing open letter to the National Institutes of Health, published in *Science* magazine March 4, accusing the agency of imposing drastic cuts in essential microbiological research funding in order to beef-up research related to biodefense. According to the letter, "The result has been a massive influx of funding, institutions, and investigators into work on prioritized bioweapons agents: i.e., the agents that cause tularemia, anthrax, plague, glanders, melioidosis, and brucellosis. . . ."

"Over the same period," the letter states, "there has been a massive efflux of funding, institutions, and investigators from work on non biodefense-related microbial physiology, genetics, and pathogenesis."

The scientists emphasize that this diversion of funds represents a significant threat to public health, as the crucial biomedical fields impacted by this are "poised for significant breakthroughs . . . [which] now either may not occur, or may occur only outside the United States, to the detriment of the U.S. national interest."



After A. Marietle, *Deir-el-Bahari* (Leipzig 1877), as reproduced in Lionel Casson, *Ships and Seamanship in the Ancient World.* © 1971 by Princeton University Press. Reprinted with permission.

These illustrations of a relief from the time of Egyptian Queen Hatshepsut, 1500 B.C., show seagoing ships propelled by sails and oars.

ARCHAEOLOGISTS UNCOVER EVIDENCE OF ANCIENT EGYPTIAN SHIPS

An international archaeological team has unearthed the first remains of Egyptian seagoing vessels dating to the 15th Century B.C., or earlier, from caves on the coast of the Red Sea near Wadi Gawasis, as reported in the March 18 issue of the Boston University *Bridge*. From drawings, coins, and tomb artifacts, some archaeologists had earlier surmised the existence of oceangoing voyages as far as Sumatra by the ancient Egyptians.

The archeological team was led by Boston University Professor Kathryn Bard and Italian archaeologist Rodolfo Fattovich. In one of the caves, the team found various ship-related artifacts, including anchors, ropes, woven bags, and two shaped planks thought to be steering oars for a vessel. Pottery shards found near the relics were dated to the 15th Century B.C., and one of the stelae found outside the second cave displayed the cartouche of King Amenemhat III (who reigned circa 1800 B.C.), with narrative text regarding two official expeditions to Punt and Biapunt, which are thought to be near the southern Red Sea coast.

As Bard told the *Bridge,* "It was not known until we found this stela that King Amenemhat III had sent any expeditions to Punt."

IS ATLAS HOLDING THE LOST STAR CATALOGUE OF HIPPARCHUS?

Bradley Schaefer, of Louisiana State University, Baton Rouge, has used the astronomical inscriptions on the globe held upon the shoulders of the Farnese Atlas (Museo Archeologico Nazionale di Napoli) to date the sky view depicted on the globe, and thus identify the probable viewer who recorded that view. The globe records the various great circles—celestial equator, ecliptic, Arctic, and so on—necessary to situate the depicted constellations accurately on the celestial sphere. Because the constellations shift yearly as a result of precession, analysis of their arrangement within the circles allows the pinpointing of both the latitude and time of observation of the observer. Schaefer's results point strongly to that observer being Hipparchus, who lived in Rhodes around 125 B.C., and authored a now-lost star catalogue referred to in Ptolemy's *Almagest.*

The statue of Atlas is Roman, from around 150 A.D., but is believed by art historians to be a copy of an earlier Greek version.

Courtesy of Gerry Picus, Griffith Observatory

The globe balanced on the Farnese Atlas's shoulder may hold the key to the lost star catalogue of Hipparchus.

ELEPHANT SHREW BONES TRAMPLE ORIGIN AXIOMS

Evidence uncovered by a team of University of Florida and Johns Hopkins University paleontologists has cast doubt on the the favored fable of paleontologists for an African origin of mammals. The evidence also casts doubt on the entire methodology of molecular evolution. Leg bones and teeth of these tiny mammals related to the elephant, dated to be 54 million years old, were found in Wyoming by team member Steve Zack. The news was reported by team member and spokesman, Jonathan Bloch to the University of Florida newsletter, *News and Public Affairs,* on March 24. Bloch commented: "Elephant shrews—part of a group that includes elephants, sea cows and aardvarks, are thought to be endemic to Africa—yet we have found evidence of their beginnings in North America."

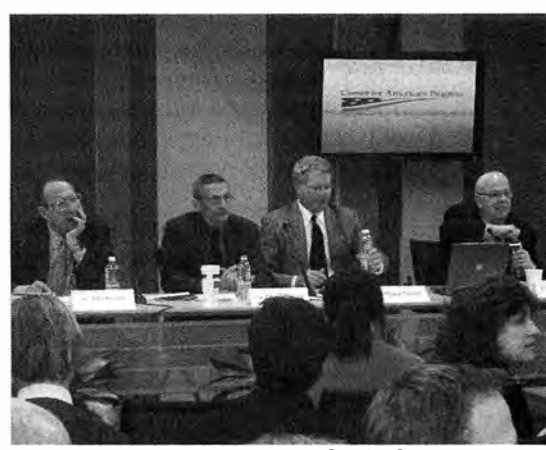
Zhe-Xi Luo, of the Carnegie Museum of Natural History, cites another importance of the work. Molecular evolutionists assume that the history of animal evolution can be determined by studying the molecules of modern animals. "Bloch's team has brought in additional evidence and made a very coherent challenge to the paradigm of molecular studies that you can really infer the breakup of major mammalian groups way back in the Earth's history just by using molecular techniques."

FOR DEMOCRATS, NUCLEAR POWER IS NOW ON THE TABLE

The Center for American Progress, the Democratic think tank headed by former Clinton White House chief of staff, John Podesta, hosted a debate March 3 on the future role of nuclear power in the world.

The significance of this event was more in its occurrence, suggesting a readiness by some leading Democrats to consider the nuclear power option, than in the presentations which comprised it. Podesta brought together three speakers from across the nuclear spectrum: Dr. Burton Richter, nuclear proponent, past director of the Stanford Linear Accelerator Center, and recipient of the Nobel Prize for physics; Dr. John Deutch of MIT, veteran of a top position at the Department of Energy (from where he de-funded and thus killed the fusion program), and long-time advisor to Presidents on nuclear energy matters; and Dr. Thomas Cochran from the environmentalist Natural Resources Defense Council, a nuclear naysayer and member of numerous DOE and nuclear weapons advisory committees.

The debate was severely constrained by adherence to the accepted axioms regarding nuclear non-proliferation and global warming, but that it happened at all was a major step forward.



Christine Craig

Debating the future of nuclear energy at the Center for American Progress: Panelists react to a question from 21st Century. *From left: John Deutch, John Podesta, Thomas Cochran, and Burton Richter.*

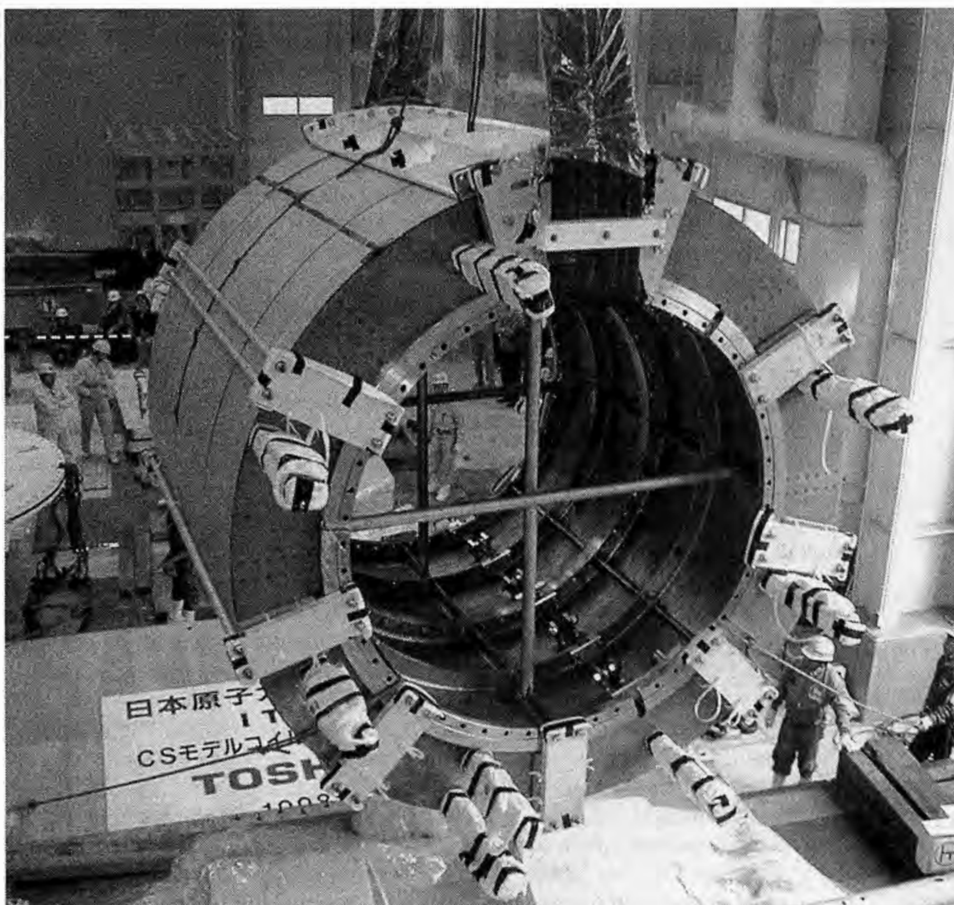
A PRÉCIS

The Peaceful Concept of Technology Transfer

by Lyndon H. LaRouche, Jr.
May 18, 2003

In the aftermath of the recent, U.S.A. war against Iraq, the world has two broadly defined choices for the present course of history: Either there will be an inevitably disastrous continuation of the policies leading to the recent U.S. break from the proceedings of the United Nations Security Council; or the more hopeful prospect, the prospect of measures adopted to reverse the presently accelerating economic collapse of the presently bankrupt, global, floating-exchange-rate, financial-monetary system. That much said, I shall now address certain of the more important difficulties which must tend to arise even in the efforts which I have proposed, to establish a more just, peaceful, and profitable new world economic order within a global community of perfectly sovereign nation-states.

For example, it has been suggested, with a touch of humor, that if India's computer software were combined with China's computer production, those two economies would dominate the world market for that class of combined product. That witticism properly implies, that any suc-



ITER

Construction in Japan of the toroidal magnetic coil for the International Tokamak Experimental Reactor (ITER), a collaborative program to build the next-stage fusion reactor.

In this summary, prepared for circulation at a conference in Bangalore, India, on May 26-27, 2003, LaRouche lays out the cultural preconditions for a new kind of technology transfer that will lead to world prosperity.

cessful program of long-term economic growth in Eurasia as a whole, will be based on an orientation toward replacing the formerly, popularly traditional notions of income from financially competitive export of finished products and engineering installations, by a scientifically more refined concept, of profit as derived *primarily* from technology-sharing as such.[1] That change, while positive, must overcome certain old habits which would tend to ruin its implementation.

However, as I shall indicate here, this shift in conventional economic thinking, toward primary emphasis on technology-sharing as such, poses the need for considering some very important, evolutionary changes in the *cultural* relations between today's globally extended European civilization and the peoples of East, Southeast, and South Asia. When we consider the weight of the sheer size of the population in the potential market represented by the growing populations of South, Southeast, and East Asia, failure to address the implications of this *cultural* challenge, could become a principal impediment to a globally successful economic recovery.

My conclusion here shall be, that understanding the role of separate national cultures in effecting technology transfer, shows us that, happily, the age of the sovereign nation-state has not ended. On the contrary, with the present world crisis, we have barely reached the historical threshold of the sovereign nation-state's most flourishing expression as the foundation of a global system of such nations. Consider the following evidence, and then study the function and consequences of technology-sharing in that setting.

In the meantime, the possibility of a general economic recovery from the presently ongoing self-collapse of the present monetary-financial system, requires a return to the kind of fixed-exchange-rate, regulated monetary system, under which enormous volumes of long-term credit of up to 25 to 50 years maturities, are available at basic simple-interest rates of between 1 and 2 percent. The credit so required for this global economic recovery, can only be generated, chiefly, by the sovereign authority of perfectly sovereign nation-states. The thrust of investments which set the recovery fully into motion, will be supplied, initially, through large-scale investments in expansion of basic economic infrastructure, that in projects which are, in many cases, multi-national undertakings. Without that change from the present, 1971-2003 world monetary-financial system, no general economic recovery were possible at this present juncture.

This reform will feature vast physical expansion of investment in generation and distribution of power, of water resources development and management, of massive water management programs, forestation, and of other natural improvements in the Biosphere, mass transport systems, renovated and new urban and urban-rural complexes, and in health-care and educational systems. This development of infrastructure will stimulate large increases in useful employment, which will therefore be a gigantic and increasing stimulus for the growth of private entrepreneurship, and will move at accelerating rates, into high rates of technology-transfer.

For example, Asian nations such as India and China, will tend to take an initially leading role in generating technologies which will be incorporated in production for export by European economies such as Germany, France, and Italy. The successful reintegration of the railway systems of the Korea Peninsula, would be of crucial importance for emergence of a most significant North Asia (Japan-Korea-Russia-China) component of Asia development. Russia has a vast repository of left-over achievements of Soviet science, which lend themselves to development as part of three-direction technology-transfer potentials: with China, India, and Germany, for example. A general, even kaleidoscopically evolutionary pattern of layered, national, specialized, primary and secondary roles, as exporters of expanding repertoires of technologies, will emerge under the impetus of large-scale economic development in such regions as the internal frontiers of Asia.

The focus of my attention here, is upon the qualitative changes in economic relations among nations of differing cultural characteristics, patterns—changes which must emerge under the impact of this qualitatively increased role

KOIS

The trial run of the Kyongui rail line bridging the South and North Koreas' demilitarized zone in September 2002. "The successful reintegration of the railway systems of the Korea Peninsula," LaRouche says, "would be of crucial importance for emergence of a most significant North Asia (Japan-Korea-Russia-China) component of Asia development."

for technology transfer as a quality of reciprocal export among both formerly "industrialized" and "developing" economies.

In broad terms, the foreseeable physical-economic relationship among the economies of Europe and Asia, should be studied by focussing attention on the increasing significance of the emerging relationship among the four principal divisions of Eurasia as a whole. These divisions are: first, Europe as the typical center of radiation of modern technology; second, the growing populations of East, Southeast, and South Asia; third, Southwest Asia's Middle East; and, finally, the great concentration of mineral and kindred resources located in the vast, undeveloped, now thinly populated regions of Central and North Asia. I shall indicate, at a suitable, later point in this report, why it is the relationship of a Eurasia so defined, to the Americas, Africa, and Australia-New Zealand, which will determine the future state of the world as a whole.

Now, concentrate for the moment, on the generality of the current political-economic and cultural relations within Eurasia as I, a world traveller from Washington, D.C., see it.

From this spectrum of opportunities presently before us, consider the third case. Bringing a durable internal peace to Southwest Asia, creates the opportunity for that region's economic development as a productive, seaborne and land-based[2] crossroads, from the Mediterranean to the Indian Ocean, a crossroads functioning as the key link of Asia to Africa's development, and as a crucial flank for the security of the regions of Asia immediately to the East. Meanwhile, during two generations to come, the emerging, dominant feature of Eurasia's development as a whole, will be the pivotal role of the rational, technologically progressive development of the great geological and related regions of central and North Asia as a growing supplier of materials to the great population centers of East, Southeast, and South Asia.

Already, in a politically sane world, East, Southeast, and South Asia, represent a growing potential for supplying technology among one another, and to and from Europe. More and more, the tendency should be, that, instead of the export of relatively high-technology goods and services from Europe and the U.S.A. into Asia, future trade will be dominated by a two-way flow of technology as such, in both directions. If there is to be a durable economic recovery from the presently accelerating crisis of the present world monetary-financial system, we shall then see that the improved products, and improved production techniques of the future, will become, more and more, the combined effect and fruit of an increasingly complex, and scientifically progressive technology-sharing, flowing simultaneously from both East and West.

This technology-sharing process will require, and will be accelerated by many great and lesser programs of building and maintaining basic economic infrastructure. New land-areas must be developed for habitation. Great projects in mass transportation, water-management, generation and distribution of power, and well-organized urban centers, will be needed to provide for populations, and to make possible increased per-capita productivity. The great transportation routes across Eurasia must bring into being new urban centers, and new agro-industrial regions, and production along trunk-routes of transport. This development will serve as both the goad and the means for management, of the otherwise poorly accessible but great raw materials resources of Central and North Asia.

The Cultural Impact of Economy

For reasons I shall identify here, such changes in the physical-economic relations within Eurasia, demand a corresponding development of the individual within society. Such changes are reflected as a continued increase of the expressed need for an improved insight into the relations between globally extended European cultures and the typical cultures of Asia. The growing importance of this new approach to technology transfer, will require a serious rethinking of much presently accepted doctrine bearing upon the deep interconnections between physical science and national cultures.

For example. The continuing, ancient legacies of human slavery, imperialism, and colonialism, define the uncompleted task of mankind to be service to the principal present and continuing, long-term interest of mankind, to eradicate the traditions under which a relatively smaller number of some human beings have hunted, or herded the much greater number of other human beings as virtual human cattle.

Those presently continuing, predatory traditions are not only wrongful; under present conditions of our planet, they are also deadly for the attempted continuation of a relatively civilized life throughout the planet as a whole. The ability of nations, and humanity as a whole, even to maintain present levels and conditions of populations, requires a continued flow, from discovery of universal physical principles, into resulting bursts of technology, thence into both greater per-capita power of all mankind to exist, and that under conditions ever more consistent with that specific and unique nature of all mankind, which sets the human individual apart from and above cattle.

It is those patterns of gains in net productive powers of labor, per capita, and per square kilometer, which pinpoint the role of technology-transfer as the primary form of commodity for future mankind.

This change to a form of society essential for sustainable growth, requires a broad, scientific-technological elevation of the quality of individual, family and community life, and of education and employment of the generality of individuals. It also requires those realized increases in net productivity, as realized through applied technological progress, which make it possible, economically, for nations to supply the improved education and physical standard of existence this implies. The society needs the betterment of its individuals, and demands the realization of that potential as rises in rates of physical productivity, per capita and per square kilometer, throughout the society as a whole. The gains so generated, so defined, are the only true expression of national profit.

Nonetheless, that said, at first glance, this might appear to signify little more than physical science and technology in today's conventional use of those terms. That physical progress is indispensable for freeing mankind from today's


U.S. Consulate, Chennai

U.S. NASA astronaut Sandra Magnus and J.P. Harrison, widower of Astronaut Dr. Kalpana Chawla, killed in the Columbia accident, pose with schoolchildren at the Jawaharlal Nehru Planetarium in Bangalore, India, in June 2004. The children are holding photos of the Indian-born astronaut. The program was held in conjunction with a 5-day Indo-U.S. Conference on Space Science, Applications, and Commerce.

still prevalent social and personal conditions of physical existence. However, the zeal for progress in science and technology would tend to fail again, as globally extended modern European civilization has failed so often in the past, until we take into account, and examine more closely, what Russia's V.I. Vernadsky identified as that *mental-spiritual process* which is the essential companion and precondition for true and continuing, both physical-economic and social progress.

The notion of relatively increased rates of technological potential of all nations' population, brings us directly into encounter with the crucial contribution to be made by what I shall term "cultural ecumenicism" among the assortments of national cultures within Europe and Asia.

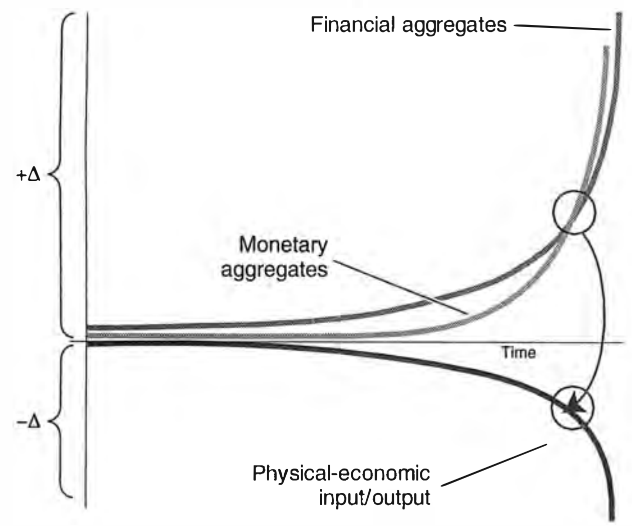
To situate those economic-cultural considerations with respect to widespread opinion today, consider the dominant role of purely fictitious notions of economic value and profit among misguided leading governmental and other institutions today.

Widespread credulity respecting the alleged veracity of contemporary financial accounting practice, is largely responsible for the faddish delusions which have caused, or simply permitted the presently ongoing economic collapse of the post-1971 world monetary-financial system since, notably, the negative economic-cultural effects of the Indo-China war began to be felt inside the U.S.A. about 1966. We have but to compare the accelerating, post-1966 accumulation of nominal financial values, in both the Americas and Europe, with the collapse of net physical output and consumption. It is this presently acute discrepancy between merely nominal and physical wealth, which underlies the presently lurching collapse of many, even most of the world's leading banking and related institutions. The most widespread expression of this mistaken course in the policy-shaping of nations and private investors, alike, has been the fallacy of assuming that net national income, or Gross and Net national product, is to be measured, primarily, as the simple sum of the reported monetary-financial income of individual firms and households.

The simple socialist might respond: "Aha! So, you are proposing that private enterprise is to blame for this!" On the contrary, it is those forms of individual initiative which generate scientific and technological progress, which are essential counterweights against the bureaucratic sluggishness of the combination of habit-weary public institutions and an habituated public opinion's resistance to change. Under the necessary correction, found in a rational division of economic authority between the state and the private entrepreneur, we have the state assuming responsibility for the welfare of all persons and all the territory, and the entrepreneur, or virtuous rebel supplying the spice of introducing useful innovations within the context created and maintained by the economic and related functions of the state. In this context, it is the creative powers of relatively exceptional individual personalities, whether in government, the indispensable rebel in the large corporation, or the private entrepreneurship, which are the typical, principal source of those actualized, principled innovations on which a real net gain in physical-economic output is secured.

It may seem ironical today, but, on this account, the most successful form of economy yet known, has been what today's grumpy right-wing monetarists often label the "socialist" American System of political-economy. This is the American System as defined by such followers of Benjamin Franklin as Alexander Hamilton, Mathew Carey, Henry C. Carey, and also the German-American Friedrich List. It is the American System of Presidents Abraham Lincoln and Franklin Roosevelt.

Unfortunately, for nearly 40 years, since the assassination of U.S. President John F. Kennedy, the American System has not been practiced by the governments or political parties of the U.S.A. A similar downshift has been seen, since the ouster of Germany's Chancellor Ludwig Erhard, in Europe. These disastrous changes, back to the kinds of monetarist policies which



A COLLAPSE FUNCTION AT A CRITICAL POINT OF INSTABILITY

The post-1971 monetary system is characterized by an accelerating and acute discrepancy between physical wealth and nominal financial values. In a typical collapse function, financial aggregates and monetary aggregates increase hyperbolically, while physical-economic output and consumption decline. The collapse reaches a critical point of instability when the hyperinflationary rise in monetary aggregates overcomes the rate of increase in financial aggregates.

Source: Lyndon H. LaRouche, Jr., *Now, Are You Ready to Learn Economics?* (Washington, D.C.: EIR, 2000)

had produced the 1928-1933 depressions in the U.S.A. and Europe, have been increasingly in force since the 1966-1968 Presidential campaign of Richard Nixon. Similarly, the quality of educational systems which had trained the qualities of graduates needed for a sound practice of national economy, has been intentionally undermined, and nearly destroyed, in the Americas as in Europe, since the Paris OECD report of 1963 on education. The radically monetarist varieties of "free trade" doctrines have dominated more and more areas of the world, and been applied with increasingly savage force, since Aug. 15, 1971.

So, in Europe and the Americas, since the initial period of change downward, 1966-1971, we have experienced hyperbolic growth of financial and monetary aggregates, but this at the price of an accompanying, accelerating decline in net physical output per-capita and per square kilometer. Thus, when one speaks of the alleged, but actually nonexistent success of the U.S. internal economy today, one is referring to purely nominal financial gains, even gigantic swindles; whereas, the physical side of the same economy has been going down, down, down, especially since the radical deregulation introduced under Zbigniew Brzezinski and Paul Volcker, during 1977-1981.

The practical conclusion to be drawn from this today, is that money, like Goethe's "sorcerer's apprentice," is an idiot by nature. Hence, the ultimately manifest idiocy of the sundry varieties of monetarists and their recipes for government. Therefore, whenever the American System of political economy was in force in the U.S.A., a wise government carefully regulated the issue and circulation of money, to the anti-inflationary purpose that increase of per-capita valuations of financial and monetary volumes shall not outrun the rate of growth of actual physical values produced and consumed. Government should not suppress the creation of credit, as the reckless "fiscal conservatives" do: in ways which obstruct the fulfillment of necessary consumption and growth. Rather, the sovereign state must use the power to regulate currency, to tax, and to employ other protectionist measures, to curb, or even penalize those business and other practices which generate financial gains at the expense of physical improvement of the economy and the general welfare of the nation as a whole.

Science & Culture

This brings us now to the pivotal element of this report: the cultural preconditions for durably successful technology-transfer policies.

To understand the challenge of technology-transfer-based economic processes, we must briefly disturb what have become, unfortunately, the conditioned habits of thinking about not only economics, but also both science and culture generally, as found among even a majority of today's relevant academics, and as also laymen generally. Lack of comprehension of these matters would tend to prevent a much-needed, improved understanding of the sources of avoidable inter-cultural conflicts. The specific form of danger from lack of such knowledge, is lack of comprehension of that definition of a *universal physical principle,* upon which a functional economic definition of technology-transfer depends.

On that account, as I frequently remind the students of mathematics, for example: the modern mathematical-physics definition of a universal principle was first defined by Carl Gauss's 1799 refutation of Leonhard Euler and Euler's protégé Lagrange, on the subject of the Fundamental Theorem of Algebra.[3] This Gauss work, which gave us the first approximation of Gauss's and Riemann's later, deeper understanding of a strict, experimental-physics meaning of the complex domain, is crucial for introducing university undergraduates, or exceptional secondary pupils to modern science, if they are to gain the proper mathematical-physics notion of what is properly qualified as a universal physical principle.

I have emphasized this from the work of my ongoing program for the political education of the 18-25 university-age group. On this occasion, I present a non-mathematical, epistemological explanation of this crucial point. In the following summary, I shall attempt to make clear, the practical importance, the urgent relevance of stating this case, to this or audiences representing similar ranges of education.

The ancient astronomers known to us through their calendars and related means, saw the nighttime sky as observed objects which may seem to be as if painted on a celestial sphere enclosing us all. That, for them, was the universe as known to the experience of our senses. However, our senses are part of our organism; by their nature, what they convey to our consciousness is not the image of the actual universe around us, but our senses' own reaction to *the effects* of that unseen universe. What our senses show us, is therefore as a shadow of that which casts the shadow. In mathematical language, this sensually unseen reality is what Gauss identifies as the physically efficient, but mathematically complex domain. Or, as Johannes Kepler showed, in detailing his original discovery of gravitation, in his 1609 *The New Astronomy,* it was certain measured anomalies in the planetary orbits which led him to recognize that some unsensed intention, which he defined for us as gravitation, accounted for the actual planetary orbits. In response to Kepler's proposals, we have the unique development of the implications of an infinitesimal calculus, by Gottfried Leibniz, and the treatment of elliptical functions and the complex domain, following the 1799 paper by Gauss.

As Gauss's most famous successor, Bernhard Riemann, stated the case, Gauss's principal work, all of which was pivotted on his original definition of the complex domain, was based on a revolutionary overthrow of the notions of a Euclidean or Cartesian manifold based upon "ivory tower" choices of definitions, axioms, and postulates, in favor of a return to the pre-Euclidean, constructive, physical geometry of such followers of Pythagoras as our ancient predecessors Archytas and Plato. Hence, what Gauss and Riemann presented, was not a non-Euclidean geometry, but an *anti-Euclidean one,* as Gauss's teacher Abraham Kästner had argued earlier.

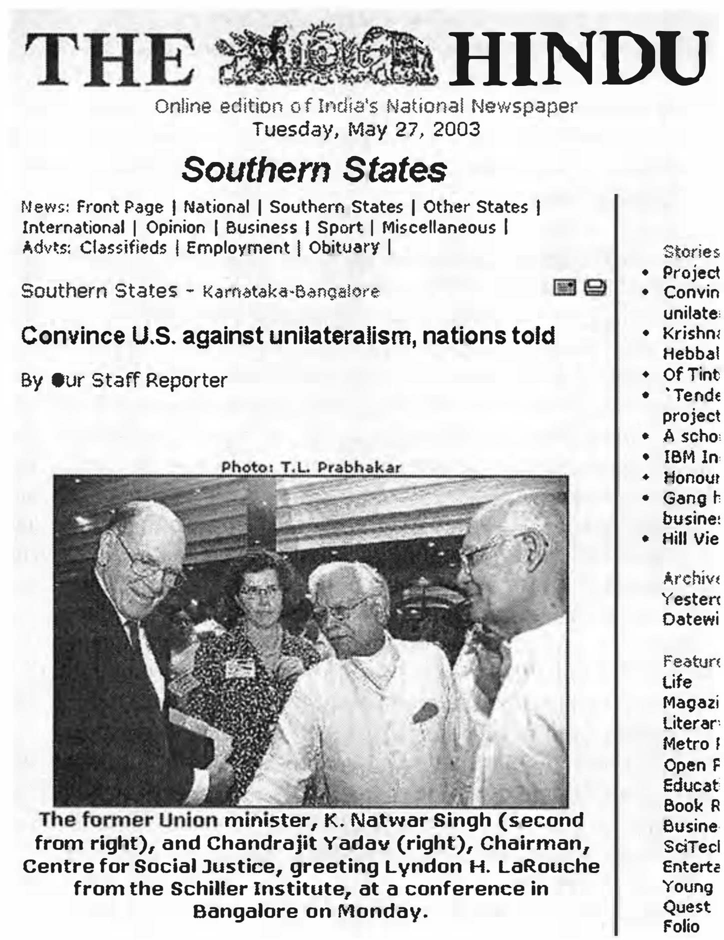
The resulting knowledge of our universe, is that of the conjunction of two geometries. One, was the shadow-world geometry of sense-certainty; the other, the unseen, but efficient physical geometry defined by those controllable, observed effects, and their associated coefficients, which are associated with crucial-experimental proofs of discovered universal physical principles.

These facts are the clue to today's least understood, but, unfortunately, most crucial principles governing real economic processes: *Why is man able to change the apparent laws of the universe, as no other species—excepting the Creator—could?* How did mankind achieve a relative population-density three decimal orders of magnitude greater than any species of great ape? Man, through physical-scientific discovery and experimental control of unseen causes, has already changed the manifest geology of our planet, and is reaching out toward Mars, as no other living species, excepting the Creator, could have done. Here lies the key to understanding and mastering the concept of technology-transfer as such.

Without adopting that point of view, there is no possibility of competent grasp of that current of modern scientific progress traceable through the work of such successors as Leonardo da Vinci, Kepler, Leibniz, Gauss, and Riemann. Without that point of view, their work could be understood only as a form of describing them in a formal-mathematical, classroom-like way, without insight into the underlying physical-experimental, practical nature of the relevant subject-matter. This is otherwise experienced, often, as a form of conflict between physicists and widely accepted, "ivory tower" dogmas of the mathematics classroom.

The crux of the lesson for economics is the following.

Mankind's achievement, in attaining, until now, a global potential population-density three decimal orders of magnitude greater than that possible for great apes, reflects a potential of our species which is lacking in all other forms of life below that of the Creator. This is a potential which is only typically expressed by the ability of the developed mind of the solitary, sovereign individual to detect, explore, and solve


THE HINDU

Online edition of India's National Newspaper
Tuesday, May 27, 2003

Southern States

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Southern States - Karnataka-Bangalore

Convince U.S. against unilateralism, nations told

By Our Staff Reporter

Photo: T.L. Prabhakar

The former Union minister, K. Natwar Singh (second from right), and Chandrajit Yadav (right), Chairman, Centre for Social Justice, greeting Lyndon H. LaRouche from the Schiller Institute, at a conference in Bangalore on Monday.

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Lyndon LaRouche (left) is shown in this press clipping with K. Natwar Singh (center), former Indian Foreign Minister and Secretary-General of the Non-Aligned Movement, now a member of Parliament. Singh and LaRouche keynoted the two-day conference in Bangalore in May 2003, "The World After the Iraq War." At right is Chandrajit Yadav, chairman of the Center for Social Justice.

Schiller Institute

"The individual must experience the great past and current discoveries of universal physical (and Classical artistic) principles in a spiritual way, as a reenactment of the discovery of experimentally validated universal physical principles." Here, young children in China.

those experimental paradoxes of observation which guide that individual either to discover an experimentally valid universal physical principle, or to repeat that discovery made, perhaps, by some original discoverer of such a principle thousands of years earlier. It is the appropriate application of an accumulation of the ability to replicate the discovery of each among such discovered principles by individuals, which has enabled the human species to accomplish all its great leaps of progress.

As the great V.I. Vernadsky emphasized, for example, the power of man to use scientific progress to make cumulative, beneficial changes in the Biosphere of farming, and other types which are not possible for any other form of life, points to a special faculty in man which many have identified as the individual human soul, or as the most essential, spiritual quality of the human being. It is through this faculty, which some of us name a *spiritual power* embedded in each among us, that men and women are enabled to discover the real universe hidden behind the shadows of sense-perception, the universe of the complex domain of Gauss, Riemann, Vernadsky, and their many great, ancient and other predecessors.

This faculty is not only expressed in the forms associated with physical science. It is demonstrably true, that all of those great works of plastic and non-plastic art which could be named "Classical" reflect the same principle responsible for great scientific work. These forms of art, and related productions, have a crucial role in enabling society to share and employ the great universal principles of physical science.

The greatest constitutions and similar works of government also express the workings of those same creative powers unique to all members of our species. The connection of such good works of statecraft to those principles of physical science to which I have referred here, is to be recognized in the distinction of great Classical poetry and drama, that it does not imitate the naive, literal sense-certainty of the beasts, but employs such devices as paradox to convey the same kinds of ideas respecting man's relationship to mankind which good physical science adduces from the individual person's relation to the so-called material realm. Great government shares with great Classical plastic and non-plastic art, the work of discovering and expressing the principles which should govern man's relationship to a mankind exploring and improving the universe. Art, and politics practiced according to the principles expressed by great Classical art, embody a domain of ideas reflecting those same powers of the individual mind which generate our knowledge of discovered universal physical principles.

From the broader implications of what I have stated here so far, the success of the great ventures, such as the development of Eurasia, which I foresee before the nations today, depends upon chiefly two principled considerations. First, the importance of seeking to improve the humanizing of work through sharing the benefits of scientific progress, and to develop the individual member of society, especially the young, accordingly. Second, the indispensable role of the perfectly sovereign nation-state, and the further development of its specific national culture and included cultures. Neither of these two is a mere matter of sentiment, nor of any other mere generalities, otherwise I need not have said what I had stated here up to this point.

Without a shift of economics doctrine and practice back to emphasis upon the leading role of scientific progress, these urgently required changes in relations within and among nations could not be sustained. This bears, most emphatically, on the challenge of new qualities of cooperation among nations of European and Asian vintages.

'Cultural Ecumenicism'

Recently, there has been increasing attention to the matter of improving ecumenical relations among the world's religions. I caution, that it is not the business of a wise government to meddle in the internal affairs of religions as such. However, there is a more appropriate way in which governments may, and, indeed, must, deal with humanity's deepest spiritual concerns. In the best European traditions, we refer to this as a matter of what is termed "natural law."

This body of natural law begins with the notion of spirituality expressed by Vernadsky's physical chemist's experimental definition of the existence of a Noösphere, a form of organization superior to the mere Biosphere. That is to say, that there exists a demonstrated, universal category of physical effects which have exerted increasingly, a dominant role, as a trend, in the physical history of our planet, effects which can be produced only by the creative-mental powers which exist only in one living species, mankind. These powers, which we know as the power of original discovery of experimentally validated universal physical principles, are rightly called *spiritual* powers: powers not found in abiotic or even living processes, except in man. These spiritual powers are recognized as man's likeness to the Creator of the universe which continues to undergo that process of creation.

The appreciation of the evidence that the human individual is made, thus, in a unique likeness to the continuing, efficient authority of a Creator of the universe, is the underlying premise of a notion of universal natural law: the law by which mankind should govern its own behavior, the law of man's mission in our universe. Under this law, that spiritual expression of the individual's mortal existence, becomes the primary, principled point of intersection of natural law with the political obligations of the nations. The elementary obligation of the state is to foster and defend the development and expression of that essentially spiritual being which inhabits the mortal flesh. The love of the state toward mankind, on that specific account, expresses the essence of what should be a universal morality of practice.

On that account, the law of nations should be, as set forth in Europe's great A.D. 1648 Treaty of Westphalia, that the warring parties should seek the pathway of enduring peace by loving one another as children of the Creator, and thus, above all else, never make war in the name of religion, never conduct "crusades" or the like.

On the positive side, natural law requires each state to assume two respectively distinct, but inseparable duties. This set of duties is key to the challenge of technology-transfer policies.

First, the development of the spiritual powers of the individual. On this account, learning by imitation, as a monkey might, is not a proper form of education for human beings. The individual must experience the great past and current discoveries of universal physical (and Classical artistic) principles in a spiritual way, as a reenactment of the discovery of experimentally validated universal physical principles.

Second, society must foster the opportunities for expression of that development of the individual mental powers which is consistent with such an educational policy. The form of work for all people must be continually revolutionized to this effect. The people, whose individual mortal lives are being expended with the passage of time, must be afforded the opportunity to spend that life in ways which fulfill the spiritual hopes of past generations, and build better foundations for the more advanced achievements of new generations.

This twofold mission of society requires the perfectly sovereign nation-state.

Let us agree, for this report, to limit the use of the term "ideas," to that class of physical-scientific and Classical-artistic notions which lie outside the shadow-world domain of mere sense-certainty, in that real universe constituted of those universal principles which can be discovered, and thus known, only through the agency of those spiritual powers specific to our species. That qualification introduced, focus our attention on the process by which today's new generation re-creates the experience of the discovery of such ideas from the past. Let us call that process "culture."

Take language as such as a case in point. Contrary to that self-described, soulless beast-man Thomas Hobbes, the essence of the communication of actual ideas in the English language, for example, lies outside the shadow-world of dictionary-like definitions of words, within the domain where metaphor prevails, the domain of irony. All great ideas are metaphors, as Kepler's conception of universal gravitation is, at the same time, a metaphor, and yet uniquely reflects the true universe, as distinct from the mere shadow-world of sense-certainty. Thus, for the English language, Shakespeare's, Keats's, and Shelley's approaches to composition are the best for transmission of actual ideas, as is shown by the comparable durability of ideas embedded in Classical forms of poetic composition in sundry languages.

What a child born into a certain national culture confronts, is an existing culture already more or less rich in an array of amassed ironies, whose efficient connotations reach far beyond any deductive-dictionary-like sense of intention. It is a mind so situated within those national-cultural modes of communication, which enters family life and education as a child and emerging adult. It is only through aid of those irony-rich features of a national culture, that the individual is able to participate efficiently in the dialogue of ideas by means of which a people might properly rule itself, rather than be ruled by masters, as cattle are.

Therefore, a world government could exist only as a form of inevitable tyranny.

It is the fostering of the education of a people in ideas, and the orientation of national economic practice of day-to-day life toward the frontier of the advancing ideas of the time, which fosters a population capable of assimilating and generating technology-transfer as the common expression of productive practice.

There is much more to be said on this account, much much more, but the essential idea is stated in *precis*. Let further, more fulsome discussion proceed from here.

Lyndon H. LaRouche, Jr., a member of the 21st Century *scientific advisory board, is an economist and world statesman.*

Notes

1. For example, consider the intrinsically anti-scientific follies of what is called "bench-marking," as merely typified by the catastrophic case of the design of Ford's Sport Utility Vehicle (SUV).
2. Production of goods-in-process of development, across the land-routes within which value-adding phases of development are incurring, is usually quicker than corresponding seaborne transport, and is cheaper in net cost per ton-mile.
3. I date the emergence of a comprehensive mathematical physics from the detailed account of the original discovery of a universal physical principle, the discovery of gravity by Johannes Kepler, in his 1609 *The New Astronomy*.

Some Words About The Noösphere[1]

by Vladimir I. Vernadsky

The following article was written in December 1943. An abridged version was published in English in the American Scientist, *January 1945, translated by the author's son, Dr. George Vernadsky of Yale University. The full translation (including portions of George Vernadsky's translation) is provided here by Rachel Douglas of* Executive Intelligence Review, *translated from the Russian edition contained in Vernadsky's book* Biosfera *(Moscow: Mysl Publishing House, 1967).*

Subheads have been added.

Vladimir Ivanovich Vernadsky (1863-1945), who developed the concept of the biosphere and how man's creativity has changed it into the noösphere.

We are approaching the climax in the Second World War. In Europe war was resumed in 1939 after an intermission of twenty-one years; it has lasted five years in Western Europe, and is in its third year in our parts, in Eastern Europe. As for the Far East, the war was resumed there, much earlier, in 1931, and is already in its 12th year. A war of such power, duration, and strength is a phenomenon unparalleled in the history of mankind and of the biosphere at large. Moreover, it was preceded by the First World War which, although of lesser power, has a causal connection with the present war.

In our country that First World War resulted in a new, historically unprecedented, form of statehood, not only in the realm of economics, but likewise in that of the aspirations of nationalities. From the point of view of the naturalist (and, I think, likewise from that of the historian), an historical phenomenon of such power may and should be examined as a part of a single great terrestrial *geological* process, and not merely as a *historical* process.

In my own scientific work, the First World War was reflected in a most decisive way. It radically changed my *geological conception of the world.* It is in the atmosphere of that war that I have approached a conception of nature, at that time forgotten and thus new for myself and for others, a geochemical and biogeochemical conception embracing both nonliving and living nature from the same point of view.[2] I spent the years of the First World War in my uninterrupted scientific creative work, which I have so far continued steadily in the same direction.

Twenty-eight years ago, in 1915, a "Commission for the Study of the Productive Forces" of our country, the so-called KEPS, was formed at the Academy of Sciences. That commission, of which I was elected president, played a noticeable role in the critical period of the First World War. Entirely unexpectedly, in the midst of the war, it became clear to the Academy of Sciences that in Tsarist Russia there were no precise data concerning the now so-called strategic raw materials, and we had to collect and digest dispersed data rapidly to make up for the lacunae in our knowledge.[3] Unfortunately by the time of the beginning of the Second World War, only the most bureaucratic part of that commission, the so-called Council of the Productive Forces, was preserved, and it became necessary to restore its other parts in a hurry.

By approaching the study of geological phenomena from a geochemical and biogeochemical point of view, we may comprehend the whole of the circumambient nature in the same atomic aspect. Unconsciously, such an approach coincides for me with what characterizes the science of the 20th Century and distinguishes it from that of past centuries. *The 20th Century is the century of scientific atomism.*

At that time, in 1917-1918, I happened to be, entirely by chance, in the Ukraine,[4] and was unable to return to Petrograd until 1921. During all those years, wherever I resided, my thoughts were directed toward the geochemical and biogeochemical manifestations in the circumambient nature, the biosphere. While observing them, I simultaneously directed both my reading and my reflection toward this subject in an intensive and systematic way. I expounded the conclusions arrived at gradually, as they were formed, through lectures and reports delivered in whatever city I happened to stay, in Yalta, Poltava, Kiev, Simferopol, Novorossiysk, Rostov, and so on. Besides, in almost every city I stayed, I used to read everything available in regard to the problem in its broadest sense. I left aside, as much as I could, all philosophical aspirations and tried to rest only on firmly established scientific and empiric facts and generalizations, occasionally allowing myself to resort to working scientific hypotheses.

Instead of the concept of "life," I introduced that of "living matter," which now seems to be firmly established in science. "Living matter" is the totality of living organisms. It is but a scientific empirical generalization of empirically indisputable facts known to all, observable easily and with precision. The concept of "life" always steps outside the boundaries of the concept of "living matter"; it enters the realm of philosophy, folklore, religion, and the arts. All that is left outside the notion of "living matter."

In the thick of life today, intense and complex as it is, a person practically forgets that he, and all of mankind, from which he is inseparable, are inseparably connected with the biosphere—with that specific part of the planet, where they live. It is customary to talk about man as an individual who moves freely about our planet, and freely constructs his own history. Hitherto, neither historians, scientists in the humanities, nor, to a certain extent, even biologists, have consciously taken into account the laws of the nature of the biosphere—the envelope of Earth, which is the only place where life can exist. Man is elementally indivisible from the biosphere. And this inseparability is only now beginning to become precisely clear to us. In reality, no living organism exists in a free state on Earth. All of these organisms are inseparably and continuously connected—first and foremost by feeding and breathing—with their material-energetic environment.

The outstanding Petersburg academician Caspar Wolf (1733-1794), who dedicated his whole life to Russia, expressed this brilliantly in his book, published in German in St. Petersburg in 1789, the year of the French Revolution: *On the Peculiar and Efficient Force, Characteristic of Plant and Animal Substance.* Unlike the majority of biologists of his day, he relied upon Newton, rather than Descartes.[5]

Mankind, as living matter, is inseparably connected with the material-energetic processes of a specific geological envelope of the Earth—its *biosphere.* Mankind cannot be physically independent of the biosphere for a single minute.

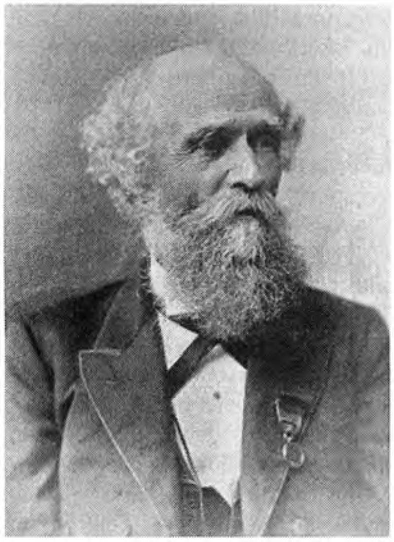
The 'Huygens Principle'

The concept of the "biosphere," i.e., "the domain of life," was introduced in biology by Lamarck (1744-1829) in Paris at the beginning of the 19th Century, and in geology by Edward Suess (1831-1914) in Vienna, at the end of that century.[6] In our century there is an absolutely new understanding of the biosphere. It is emerging as a *planetary* phenomenon that is *cosmic in nature.* In biogeochemistry we have to consider that life (living organisms) really exists not on our planet alone, not only in the Earth's biosphere. It seems to me that this has been established beyond a doubt, so far, for all the so-called terrestrial planets, i.e., for Venus, Earth, and Mars.[7] At the Biogeochemical Laboratory of the Academy of Sciences in Moscow, which has been renamed the Geochemical Problems Laboratory, in collaboration with the Microbiology Institute of the Academy of Sciences (director—Corresponding Academician B.L. Isachenko), we identified *cosmic* life as a matter for current scientific study already in 1940. This work was halted because of the war, and will be resumed at the earliest opportunity.

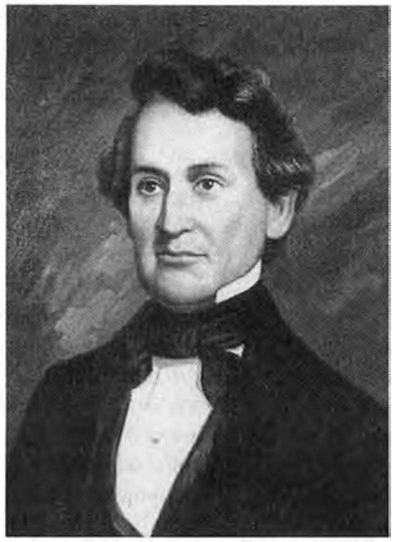
The idea of life as a cosmic phenomenon has been found in the scientific archives, including our own, for a long time. Centuries ago, in the late 17th Century, the Dutch scientist Christiaan Huygens (1629-1695), in his last work, *Cosmotheoros,* which was published posthumously, formulated this scientific question. The book was published in Russian twice in the first quarter of the 18th Century, on the initiative of Peter I.[8] In this book, Huygens established the scientific generalization that "life is a cosmic phenomenon, in some way sharply distinct from nonliving matter." I recently named this generalization "the Huygens principle."[9]

By weight, living matter comprises a minute part of the planet. This has evidently been the case throughout all geological time, i.e., it is geologically eternal.[10] Living matter is concentrated in a thin, more or less continuous layer in the troposphere on dry land—in fields and forests—and permeates the entire ocean. In quantity, it measures no greater than tenths of a percent of the biosphere by weight, on the order of close to 0.25 percent. On dry land, its continuous mass reaches to a depth of probably less than 3 kilometers on average. It does not exist outside the biosphere.

In the course of geological time, living matter morphologically changes, according to the laws of nature. The history of living matter expresses itself as a slow modification of the forms of living organisms, which genetically are uninterruptedly connected among themselves from generation to generation. This idea had been rising in scientific research through the ages, until, in 1859, it received a solid foundation in the great achievements of Charles Darwin (1809-1882) and [Alfred R.] Wallace (1822-1913). It was cast in the doctrine of the evolution of species of plants and animals, including man. The evolutionary process is a characteristic only of living matter. There are no manifestations of it in the nonliving matter of



University of California, Berkeley, The Blue and Gold Yearbook, 1896



U.S. Geological Survey

The American geologist Joseph Le Conte (1823-1901), at left, developed the idea that living matter was evolving in a definite direction, which he called the Psychozoic era. James Dwight Dana (1813-1895), a geologist, mineralogist, and biologist, developed a similar idea, which he called cephalization. Dana was a member of the Wilkes Expedition.

our planet. In the Cryptozoic era, the same minerals and rocks were being formed which are being formed now.[11] The only exceptions are the bio-inert natural bodies connected in one way or another with living matter.[12]

The change in the morphological structure of living matter, observed in the process of evolution, unavoidably leads to a change in its chemical composition. This question now requires experimental verification. In collaboration with the Paleontology Institute of the Academy of Sciences, we included this problem in our planned work in 1944.

While the quantity of living matter is negligible in relation to the nonliving and bio-inert mass of the biosphere, the biogenic rocks constitute a large part of its mass, and go far beyond the boundaries of the biosphere. Subject to the phenomena of metamorphism, they are converted, losing all traces of life, into the granitic envelope, and are no longer part of the biosphere. The granitic envelope of the Earth is the area of former biospheres.[13] In Lamarck's book, *Hydrogeologie* (1802), containing many remarkable ideas, living matter, as I understand it, was revealed as the creator of the main rocks of our planet. Lamarck never accepted Lavoisier's (1743-1794) discovery. But that other great chemist, J.B. Dumas (1800-1884), Lamarck's younger contemporary, who did accept Lavoisier's discovery, and who intensively studied the chemistry of living matter, likewise adhered for a long time to the notion of the quantitative importance of living matter in the structure of the rocks of the biosphere.

Cephalization—the Arrow of Evolution

The younger contemporaries of Darwin, J[ames] D[wight] Dana (1813-1895) and J[oseph] Le Conte (1823-1901), both great American geologists (and Dana, a mineralogist and biologist as well) expounded, even prior to 1859, the empirical generalization that *the evolution of living matter is proceeding in a definite direction*. This phenomenon was called by Dana "cephalization," and by Le Conte the "Psychozoic era." Dana, like Darwin, adopted this idea at the time of his journey around the world, which he started in 1838, two years after Darwin's return to London, and which lasted until 1842.[14]

It should be noted here that the expedition during which Dana reached his conclusions about cephalization, coral reefs, and so on, was historically associated with the researches on the Pacific Ocean, done on ocean voyages by Russian sailors, notably Kruzenshtern (1770-1846). Published in German, they inspired the American lawyer John Reynolds to organize the first such American scientific sea voyage.[15] He began to work towards this in 1827, when an account of Kruzenshtern's expedition came out in German. Only in 1838, 11 years later, did his persistent efforts result in this expedition taking place. This was the Wilkes expedition, which conclusively proved the existence of Antarctica.

Empiric notions of a definite direction of the evolutionary process, without, however, any attempt theoretically to ground them, go deeper into the 18th Century. Buffon (1707-1788) spoke of the "realm of man," because of the geological importance of man. The idea of evolution was alien to him. It was likewise alien to Agassiz (1807-1873), who introduced the idea of the glacial period into science. Agassiz lived in a period of an impetuous blossoming of geology. He admitted that, geologically, the realm of man had come, but, because of his theological tenets, opposed the theory of evolution. Le Conte points out that Dana, formerly having a point of view close to that of Agassiz, in the last years of his life accepted the idea of evolution in its then-usual Darwinian interpretation.[16] The difference between Le Conte's "Psychozoic era" and Dana's "cephalization" thus disappeared. It is to be regretted that, especially in our country, this important empirical generalization still remains outside the horizon of our biologists.

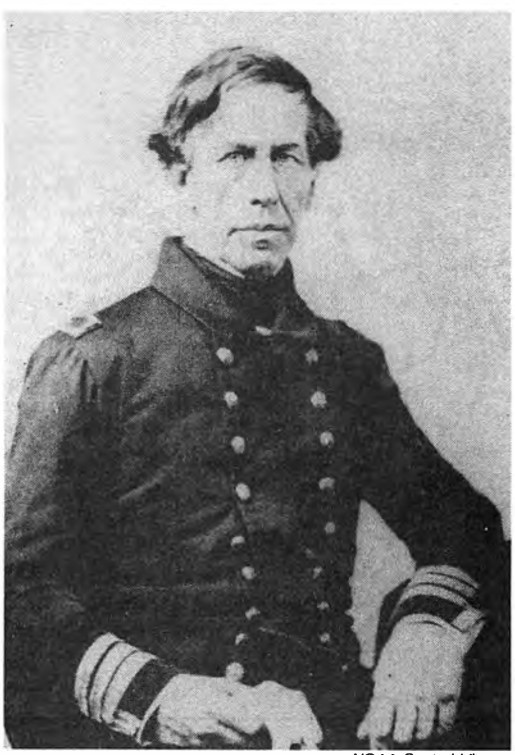
The soundness of Dana's principle, which happens to be outside the horizon of our paleontologists, may easily be verified by anyone willing to do so on the basis of any modern treatise on paleontology. The principle not only embraces the whole animal kingdom, but likewise reveals itself clearly in individual types of animals. Dana pointed out that in the course of geological time, at least 2 billion years and probably much more, there occurs an irregular process of growth and perfection of the central nervous system, beginning with the crustacea (whose study Dana used to establish his principle), the mollusca (cephalopoda), and ending with man. It is this phenomenon he called cephalization. The brain, which has once achieved a certain level in the process of evolution, is not subject to retrogression, but only can progress further.

The Noösphere Comes of Age

Proceeding from the notion of the geological role of man, the geologist A.P. Pavlov (1854-1929) in the last years of his life used to speak of the *anthropogenic era,* in which we now live. While he did not take into the account the possibility of the destruction of spiritual and material values we now witness in the barbaric invasion of the Germans and their allies, slightly more than 10 years after his death, he rightfully emphasized that man, under our very eyes, is becoming a mighty and ever-growing geological force. This geological force was formed quite imperceptibly over a long period of time. A change in man's position on our planet (his material position first of all) coincided with it. In the 20th Century, man, for the first time in the history of the Earth, knew and embraced the whole biosphere, completed the geographic map of the planet Earth, and colonized its whole surface. *Mankind became a single totality in the life of the Earth.* There is no spot on Earth where man can not live if he so desires. Our people's sojourn on the floating ice of the North Pole in 1937-1938 has proved this clearly. At the same time, owing to the mighty techniques and successes of scientific thought, radio and television, man is able to speak instantly to anyone he wishes at any point on our planet. Transportation by air has reached a speed of several hundred kilometers per hour, and has not reached its maximum. All this is the result of "cephalization," the growth of man's brain and the work directed by his brain.

Portrait by Jean Louis Rodolphe, 1866, courtesy of University of Oklahoma Libraries, History of Science Collections

Louis Agassiz (1807-1873), introduced the idea of the glacial period into science.



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Captain Charles Wilkes, headed the U.S. Exploring Expedition, 1838-1842, which discovered the Magnetic South Pole and determined that Antarctica was a continent.

The economist, L. Brentano, illuminated the planetary significance of this phenomenon with the following striking computation: If a square meter were assigned to each man, and if all men were put close to one another, they would not occupy the area of even the small Lake of Constance between the borders of Bavaria and Switzerland. The remainder of the Earth's surface would remain empty of man. Thus the whole of mankind put together represents an insignificant mass of the planet's matter. Its strength is derived not from its matter, but from its brain. If man understands this, and does not use his brain and his work for self-destruction, an immense future is open before him in the geological history of the biosphere.

The geological evolutionary process shows the biological unity and equality of all men, *Homo sapiens* and his ancestors, *Sinanthropus* and others; their progeny in the mixed white, red, yellow, and black races evolves ceaselessly in innumerable generations.[17] This is a *law of nature.* All the races are able to interbreed and produce fertile offspring. In a historical contest, as for instance in a war of such magnitude as the present one, he finally wins who follows that law. One cannot oppose with impunity the principle of the unity of all men as a law of nature. I use here the phrase "law of nature" as this terms is used more and more in the physical and chemical sciences, in the sense of an empirical generalization established with precision.

The historical process is being radically changed under our very eyes. For the first time in the history of mankind the interests of the masses on the one hand, and the free thought of individuals on the other, determine the course of life of mankind and provide standards for mere ideas of justice. Mankind taken as a whole is becoming a mighty geological force. There arises the problem of the *reconstruction of the biosphere in the interests of freely thinking humanity as a single totality.* This new state of the biosphere, which we approach without our noticing, is the *noösphere.*

In my lecture at the Sorbonne in Paris in 1922-1923, I accepted *biogeochemical phenomena* as the basis of the biosphere. The contents of part of these lectures were published in my book, *Studies in Geochemistry,* which appeared first in French, in 1924, and then in a Russian translation, in 1927.[18] The French mathematician Le Roy, a Bergsonian philosopher, accepted the biogeochemical foundation of the biosphere as a starting point, and in his lectures at the Collège de France in Paris, introduced in 1927 the concept of the noösphere as the stage through which the biosphere is now passing geologically.[19] He emphasized that he arrived at such a notion in collaboration with his friend Teilhard de Chardin, a great geologist and paleontologist, now working in China.

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

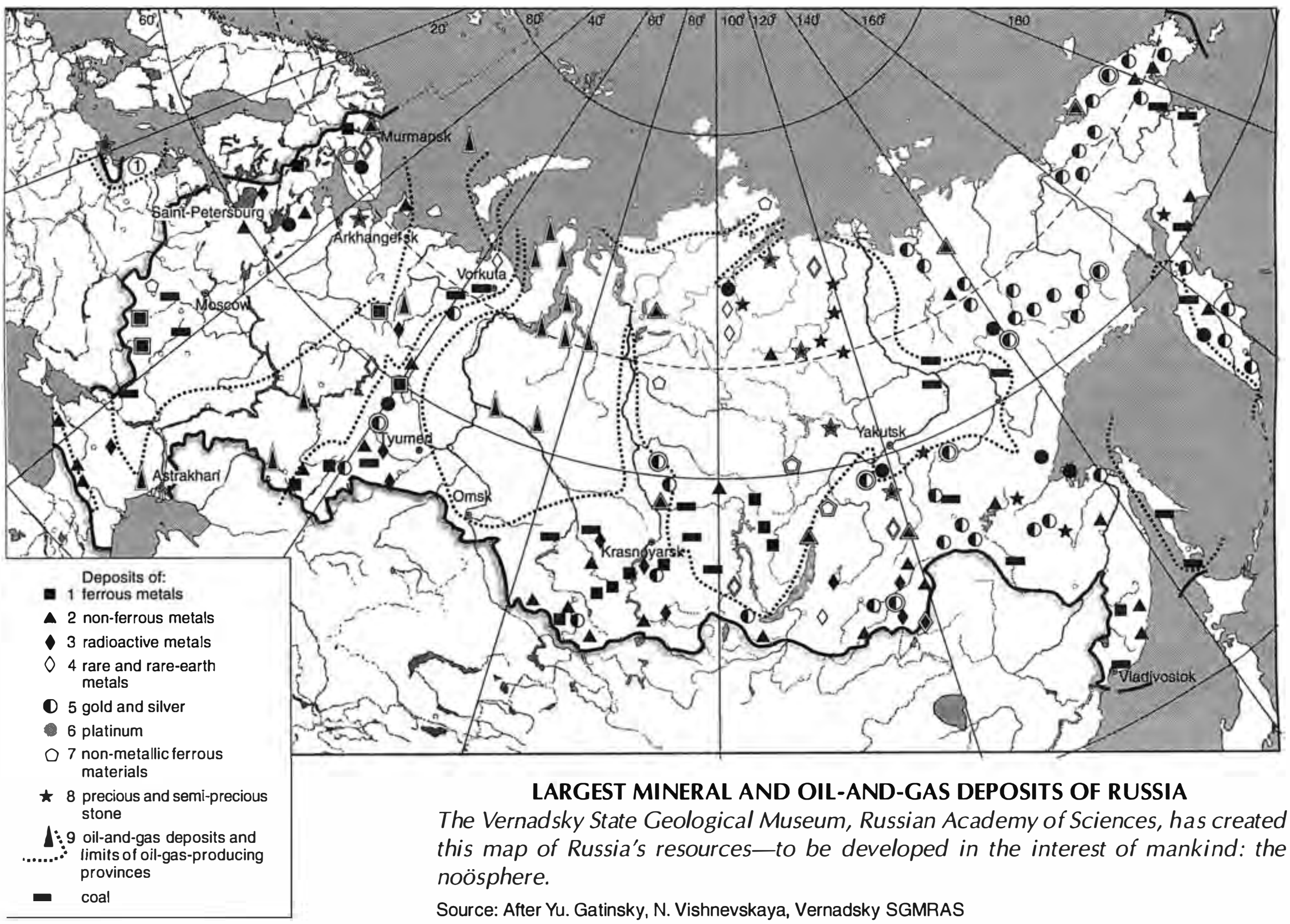
How Can Thought Change Material Processes?

Here a new riddle has arisen before us. *Thought is not a form of energy.* How then can it change material processes? That question has not as yet been solved. As far as I know, it was first posed by an American scientist born in Lvov, the mathematician and biophysicist Alfred Lotka.[20] But he was unable to solve it. As Goethe (1740-1832), not only a great poet but a great scientist as well, once rightly remarked, in science we only can know *how* something occurred, but we cannot know *why* it occurred.

Russian Academy of Sciences

The Russian scientist Aleksei Petrovich Pavlov (1854-1929), emphasized that man was becoming a "mighty and ever-growing geological force."

As for the coming of the noösphere, we see around us at every step the empirical results of that "incomprehensible" process. That mineralogical rarity, native iron, is now being produced by the billions of tons. Native aluminum, which never before existed on our planet, is now produced in any quantity. The same is true with regard to the countless number of artificial chemical combinations (biogenic "cultural" minerals) newly created on our planet. The number of such artificial minerals is constantly increasing. All of the *strategic raw materials* belong here. Chemically, the face of our planet, the biosphere, is being sharply changed by man, consciously, and even more so, unconsciously. The aerial envelope of the land as well as all its natural waters are changed both physically and chemically by man. In the 20th Century, as a result of the growth of human civilization, the seas and the parts of the oceans closest to shore become changed more and more markedly. Man now must take more and more measures to preserve for future generations the wealth of the seas, which so far have belonged to nobody. Besides this, new species and races of



LARGEST MINERAL AND OIL-AND-GAS DEPOSITS OF RUSSIA

The Vernadsky State Geological Museum, Russian Academy of Sciences, has created this map of Russia's resources—to be developed in the interest of mankind: the noösphere.

Source: After Yu. Gatinsky, N. Vishnevskaya, Vernadsky SGMRAS animals and plants are being created by man. Fairy tale dreams appear possible in the future; man is striving to emerge beyond the boundaries of his planet into cosmic space. And he probably will do so.

At present we cannot afford not to realize that, in the great historical tragedy through which we live, we have elementally chosen the right path leading into the noösphere. I say elementally, as the whole history of mankind is proceeding in this direction. The historians and political leaders only begin to approach a comprehension of the phenomena of nature from this point of view. The approach of Winston Churchill (1932) to the problem, from the angle of a historian and political leader, is very interesting.[21]

The noösphere is the last of many stages in the evolution of the biosphere in geological history. The course of this evolution only begins to become clear to us through a study of some of the aspects of the biosphere's geological past. Let me cite a few examples, Five hundred million years ago, in the Cambrian geological era, skeletal formations of animals, rich in calcium, appeared for the first time in the biosphere; those of plants appeared over 2 billion years ago. That calcium function of living matter, now powerfully developed, was one of the most important evolutionary factors in the geological change of the biosphere.[22] A no less important change in the biosphere occurred from 70 to 110 million years ago, at the time of the Cretaceous system, and especially during the Tertiary. It was in that epoch that our green forests, which we cherish so much, were formed for the first time. This is another great evolutionary stadium, analogous to the noösphere. It was probably in these forests that man appeared around 15 or 20 million years ago.

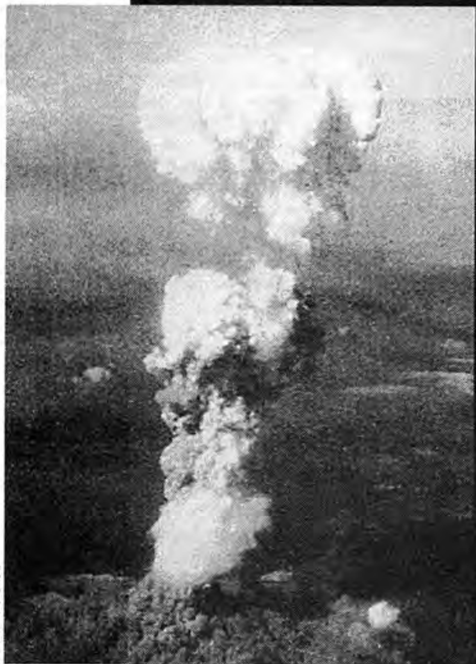
Now we live in the period of a new geological evolutionary change in the biosphere. We are entering the noösphere. This new elemental geological process is taking place at a stormy time, in the epoch of a destructive world war. But the important fact is that our democratic ideals are in tune with the elemental geological processes, with the law of nature, and with the noösphere. Therefore we may face the future with confidence. It is in our hands. We will not let it go.

Notes

1. The word "noösphere" is composed from the Greek terms *noos*, mind, and *sphere*, the last used in the sense of an envelope of the Earth. I treat the problem of the noösphere in more detail in the third part of my book, now being prepared for publication, on *The Chemical Structure of the Biosphere of the Earth As a Planet, and Its Surroundings.*
2. It should be noted that in this connection I came upon the forgotten thoughts of that original Bavarian chemist, C. Schoenbein (1799-1868) and of his friend, the English physicist of genius, M. Faraday (1791-1867). As early as the beginning of the 1840s, Schoenbein attempted to prove that a new division should be created in geology—geochemistry, as he called it. See W. Vernadsky, *Ocherki geokhimii* (Studies in Geochemistry), 4th edition, Moscow-Leningrad, 1934, pp. 14, 290.
3. On the significance of KEPS see A. E. Fersman, *Voina i strategicheskoe syrie* (The War and Strategic Raw Materials), Krasnoufimsk, 1941, p. 48.
4. See my article, "Out of my Recollections: The First Year of the Ukrainian Academy of Sciences," to appear in the Jubilee volume of the *Ukrainian Academy of Sciences* in commemoration of its 25th anniversary.
5. It is to be regretted that the manuscripts left after Wolf's death have been, as yet, neither studied nor published. In 1927, the Commission on the History of Knowledge at the Academy of Sciences decided to do this work, but it could not be accomplished because of the constant changes in the Academy's approach toward the study of the history of science. Now that work at the Academy has been reduced to a minimum, which is harmful to the cause.
6. On the biosphere, see W. Vernadsky, *Ocherki geokhimii*, 4th edition, Moscow-Leningrad, Index; *Biosfera* (The Biosphere), Leningrad, 1926: French edition. Paris, 1929.
7. See my article on "The Geological Envelopes of the Earth as a Planet," *Izvestiia of the Academy of Sciences. Geographical and Geophysical Series*, 1942, p. 251. Cf. H. Spenser Jones, *Life on Other Worlds*, New York, 1940; R. Wildt in *Proc. Amer. Philos. Soc.* 81 (1939), p. 135. A Russian translation of Wildt's study, regrettably not in full (which is not indicated in the paper) appeared in the *Astronomicheskii Zhurnal*, Vol. XVII (1940), No. 5, p. 81ff. By now, a new study by Wildt has appeared, *Geochemistry and the Atmosphere of Planets* (1941), but, to our regret, no copy of it has so far reached us.
8. It would deserve a new edition in modern Russian, with commentaries.
9. See *Ocherki geokhimii*, pp. 9, 288, and my book *Problemy biogeokhimii* (The Problems of Biogeochemistry) III (in press).
10. *Problemy biogeokhimii*, III.
11. In accordance with modern American geologists as, for example, Charles Schuchert (Schuchert and Dunbar, *A Textbook of Geology*, II, New York, 1941, p. 88ff.), I call the Cryptozoic era that period which formerly had been called the Azoic, or the Arcaeozoic, era. In the Cryptozoic era the morphological preservation of the remnants of organisms dwindles almost to nothing, but the existence of life is revealed in the organogenic rocks, the origins of which arouse no doubts.
12. On the bio-inert bodies see W.I. Vernadsky, *Problems of Biogeochemistry*, II, *Trans. Conn. Acad. Arts Sci.*, Vol. 35 (1944), pp. 493-494. Such are, for example, the soil, the ocean, the overwhelming majority of terrestrial waters, the troposphere, and so on.
13. See my basic work referred to in Note 1.
14. See D. Gilman. *The Life of J. D. Dana*, New York, 1899. The chapter on the oceanic expedition in this book was written by Le Conte. Le Conte's book, *Evolution* (1888), has not been accessible to me. His autobiography was published in 1903: W. Armes, Editor, *The Autobiography of Joseph Le Conte*. For his biography and bibliography see H. Fairchild in *Bull. Geol. Soc. Amer.* 26 (1915), p. 53.
15. On Reynolds, see the Index in "Centenary Celebration: Wilkes Exploring Expedition of the U.S. Navy, 1838-1842," *Proc. Amer. Philos. Soc.*, 82, No. 5 (1940). It is to be regretted that our expeditions in the Pacific, so active in the first half of the 19th Century, were later discontinued for a long time (almost until the Revolution), following the death of both Emperor Alexander I (1777-1825) and Count N. P. Rumiantsov (1754-1826)—that remarkable leader of Russian culture who equipped the "Riurik" expedition (1815-1818) out of his private funds.

    In the Soviet period K. M. Deriugin's (1878-1936) expedition should be mentioned; its precious and scientifically important materials have been so far only partly studied and remain unpublished. Such an attitude toward scientific work is inadmissible. The Zoological Museum of the Academy of Sciences must fulfill this scientific and civic duty.
16. D. Gilman, *op.cit.*, p. 255.
17. I and my contemporaries have imperceptibly lived through a drastic change in the comprehension of the circumambient world. In the time of my youth it seemed both to me and to others that man had lived through a historical time only, within the span of a *few thousand years, at best a few tens of thousands of years.* Now we know that man has been consciously living through tens of millions of years. He consciously lived through the glacial period in both Eurasia and North America, through the formation of Eastern Himalaya, and so on. The division of historical and geological time is levelled out for us.
18. The last revised edition of my *Ocherki Geokhimii* (Problems of Geochemistry) appeared in 1934. In 1926, the Russian edition of *Biosfera* (The Biosphere) came out, and in 1929 its French edition. My *Biogeokhimicheskie Ocherki* (Biogeochemical Studies) was published in 1940. The publication of *Problemy biogeokhimii* (Problems of Biogeochemistry) was begun in 1940. (A condensed English translation of Part II appeared, under the editorship of G. E. Hutchinson, in *Trans. Conn. Acad Arts Sci.*, Vol. 35, in 1944.) Part III is in press. *Ocherki geokhimii* was translated into German and Japanese.
19. Le Roy's lectures were at once published in French: *L'exigence idealiste et le fait d'evolution*, Paris, 1927, p. 196.
20. A. Lotka, *Elements of Physical Biology*, Baltimore, 1925, p. 405 ff.
21. W.S. Churchill, *Amid These Storms: Thoughts and Adventures*, New York, 1932, p. 274 ff. I plan to return to this problem elsewhere.
22. I deal with the problem of the biogeochemical functions of organisms in the second part of my book, *The Chemical Structure of the Biosphere.* (see Note 1).

A TRAGEDY IN THREE ACTS



U.S. Air Force

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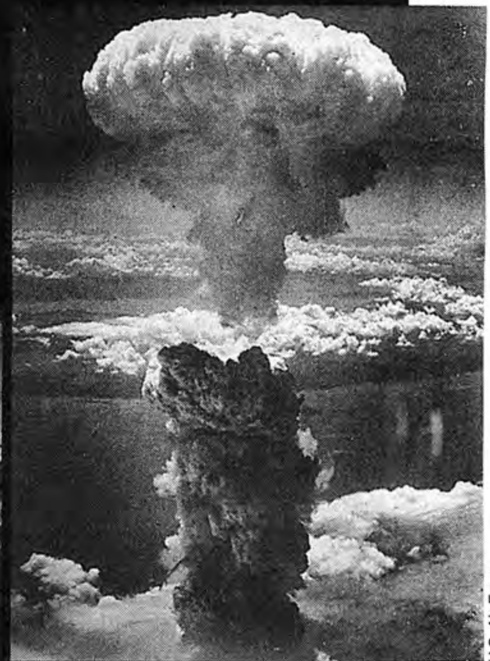

U.S. Air Force

The Beast-Men Behind The Dropping of The Atomic Bomb

Smoke billowing 20,000 feet above Hiroshima (l), after the first atomic bomb blast, Aug. 6, 1945. At Nagasaki, two days later, a second atomic bomb sent a dense column of smoke more than 60,000 feet into the air. More than 300,000 people died in the bombings.

Utopians Lord Bertrand Russell (top l.) and H.G. Wells (top r.) sought to use a weapon of terror, like the atomic bomb, to protect the oligarchical faction's control. President Truman and his Secretary of State James Byrnes (l.) shared this beast-man outlook.

by L. Wolfe

December 2004

Introduction

A little more than 59 years ago, the United States of America, a nation founded on principles that distinguish men from beasts, dropped two atomic bombs on the already defeated nation of Japan, slaughtering more than 300,000 innocent people and plunging the world into the nightmare of "nuclear terror." Over the course of the intervening years, most Americans have been given a fairy-tale story to explain how those bombs came into being and how and why they were dropped on Japan.[1] It is to counter such fairy tales and lies that we present what follows.

International statesman Lyndon LaRouche has said that it is the task of a competent historian to present history in much the same way that a great playwright would do, placing his characters on a stage and having their interplay and actions move

Drawing on original research, historian L. Wolfe shows that the dropping of the bomb on Japan was the result of a conspiracy of political and moral opponents of Franklin D. Roosevelt, aiming to control the post-war world with the ultimate weapon of terror.

the drama forward. Such history becomes alive in the reader's mind, as it unfolds on the stage of his imagination. We shall tell the story of the bomb and its use, in just such a fashion, as if you were looking over the shoulders or through the mind's eyes of those involved.

One must also look for a turning point, a moment on which our drama pivots. In this case, that moment comes on April 12, 1945, the day that President Franklin Roosevelt dies. As we shall see, it was FDR's death that propelled our story towards its tragic end. Had he lived, to see the end of the war, both in Europe and the Pacific, there would have been no dropping of any atomic weapons. Roosevelt was both the political and moral opponent of the utopian Beast-Men who fostered the creation of the bomb to be used as the ultimate weapon of terror. As the most potent American political leader of the last century, FDR was committed to a peace that could never have been achieved through terror, a peace based on bringing humanity out of the darkness of colonialism and subjugation by financial oligarchies.

But on April 12, that great light went dark. And in the office of President, sat the most unqualified of little men, Harry S Truman, a willing and venal puppet of the Beast-Men utopians. And, the path towards Hiroshima was set. Even as some members of the establishment recoiled in horror at what was unfolding, their Hamlet-like vacillation rendered them impotent and contributed to our tragedy; an establishment mired in its false axioms can never "save" us, for they cannot even save themselves.

There was another moment prior to April 12, 1945, where things might have gone differently. If, in July 1944, FDR had chosen his trusted ally Henry Wallace to run for a second term as Vice President, the bomb would not have been dropped. Roosevelt's choice of Truman—a choice forced on him by circumstances—along with his own belief that he would "see things through," helps propel our tragedy forward.[2]

We will limit the scope of what we present here to the making of the decisions to start the U.S. atomic weapons program, to then carry forward with development of the bomb, and, finally, in the post-FDR period, to Truman's decision to drop two bombs on a defenseless, beaten Japan. We shall foreshorten the first two acts of our drama, telling only the essential features, so that we shall leave more room for its final, terrible conclusion.

Let us provide the setting for this tragedy. As our story begins, it is the summer of 1939, the last days of a false peace before the outbreak of the worst war in human history. For some time, a fight has been raging within the financial oligarchy over the Nazi golem that had been their creation. One group, the hard-core synarchist financiers, still see Hitler as a means to destroy the power of Russia in Europe, and then, to conquer that continent, and ultimately, to destroy their main target—the United States. Another faction sees that the unstable Hitler and his Nazis must be destroyed, and reluctantly, accept that the U.S. is needed to accomplish this.[3]

Both groupings are rife with proponents of the utopian views of H.G. Wells and Lord Bertrand Russell about the possibility of development of a terrible super-weapon that might give these oligarchs the ability to terrorize the world to accept a fascist "world government."

Wells, a leading propagandist for the utopian faction of Britain's elite, first made mention of an atomic super-weapon in his futuristic novel, *The World Set Free,* published in 1914. In this work, dedicated to chemist Frederick Soddy's *Interpretation of Radium,* Wells forecast a world war in which 200 major cities suffered "the unquenchable crimson conflagrations of the atomic bomb," a radium weapon which exploded not once, but continuously like a volcano. In his later work, *The Shape of Things to Come,* Wells spoke of a coming period of continual war and calamity, involving nuclear-armed air armadas, savaging populations.

The real origins of the "bomb project" can be traced to the desire of the prevailing Anglo-Dutch financier oligarchy to develop a weapon of such terror as to drive sovereign governments and their populations into submission to a fascist world government. Britain's failure to destroy the American republic in the Civil War, left the United States as the greatest potential

Dedication

This article is dedicated to the immortal spirit of the great American scientist and patriot, Dr. Robert Moon. It was a comment by this universal thinker that inspired me to investigate the true origins of the atomic bombing of Japan. He told me that, in his view, the Manhattan Project, in which he had played a crucial role, stood as one of mankind's greatest scientific achievements; yet, it could lead to the destruction of science itself. Dr. Moon warned that the Project had taught scientists that great breakthroughs and accomplishments could now only be achieved at the patronage of an evil and secretive financial and political establishment; if the hold of such people over science were not broken, they would ultimately destroy human civilization.

Dr. Moon dedicated his life to fighting against such a dismal possibility and for a more hopeful future. It was this commitment that brought him into contact with the LaRouche movement and myself, and for that, I am forever grateful.

—L. Wolfe

threat to their power. Despite financial manipulations, including the 1876 Species Resumption Act, the United States continued to emerge as a continent-wide industrial superpower, which, by the close of World War I, had surpassed the economic power of the British Empire.

A second consideration was the post-World War I emergence of the Soviet Union as another potential superpower with great advanced scientific capabilities, whose policy lay outside the control of this oligarchical faction. The proposed "super-weapon" could also be used to eliminate this problem.

Wells and his cohort, Lord Bertrand Russell, sought to then bring their hideous vision to reality on behalf of an oligarchy in reluctant if necessary combat with the Nazis, but in mortal fear of an FDR-inspired U.S.A. It was on behalf of this evil utopian vision that the investment banker Alexander Sachs moved to use the United States as the vehicle to create the Russell-Wells nuclear terror weapon; and it was to impose a dark night of nuclear terror on the world that the two U.S. bombs were caused to be dropped on a helpless Japan, ready to surrender. The nuclear scientists were mere pawns in this greater game.

It is within such deranged utopian minds that the plot to create a nuclear "Beast-Man" is hatched, to lay the basis for a post-Nazi reign of permanent terror.[4]

Wells's book The Shape of Things to Come *forecasts an age of perpetual war and calamity, as illustrated in this scene from the movie version.*

Act I
The Selling of the Bomb

Scene 1. The Manic Hungarian

A group of men are meeting to discuss the potentials emerging from the exciting news that the splitting of the atom and the release of its energy have been achieved. The men are all immigrants, having come to America to escape the Nazis' persecution and almost certain death; they are all Jews, all nuclear physicists.

Their entry into the U.S. has been arranged through the networks of the Jewish Rescue Committee.[5] They don't know it, but they were brought here just so they might have the discussion they are now having. The group that is meeting, at several locations, mostly in New York City, is known among themselves and other scientists as the "Hungarian Conspiracy," its principal members all fitting the description, "mad Hungarians." Among its leading members are Leo Szilard, then based in the United States at the University of Chicago, who is already becoming acquainted with Lord Bertrand Russell; young Edward Teller of George Washington University in Washington, D.C.; and Eugene Wigner.[6]

The group is being harangued by Szilard, whose current obsession is an overblown evaluation that the Nazis were well on their way to building what he called a "nuclear superweapon"; if they should build this first, he shouted, it would be the end of the world as we know it.[7]

The "Hungarian Conspiracy" decides to approach the most famous scientist and physicist of the day, Albert Einstein, who, like them, is a refugee from Nazi tyranny, now residing in the United States.

Scene 2. The 'Godfather' of the Bomb

Watching over what is happening, but not quite ready yet to intervene, is the financier Alexander Sachs, who is the real "godfather of the bomb." Formerly a managing director of the New York investment bank Lehman Bros., Sachs is also a director of one of Europe's powerful oligarchical investment groupings, or *fondi,* the Société Générale de Belgique, which can trace its origins directly to the House of Orange. It was Sachs who brought the scientists to the United States, secured postings for them at various universities, and provided them with funding. He has been a critical link between the financier interests represented by Société Générale, which we call the synarchists, and certain financial networks in the U.S.A.[8]

Sachs came to the United States from Russia towards the end of the 19th Century. Although of humble background, he took a degree in economics from the elite Harvard University, and was then taken under the wing of Kuhn Loeb head Jacob Schiff, the British royal family's chief financial operative in the United States.[9] Schiff dispatched Sachs into Lehman Bros., whose foreign operations, he, Schiff, had personally established.[10]

Sachs, a Jew, has "joined" the faction, which includes then British Defense Minister Winston Churchill, among others, who are interested in stopping Hitler. They want an American

National Archives

President Franklin Roosevelt (r) and Vice President Henry Wallace, during one of FDR's "Fireside Chats."

"If, in July 1944, FDR had chosen his trusted ally Henry Wallace to run for a second term as Vice President, the bomb would not have been dropped. Roosevelt's choice of Truman—a choice forced on him by circumstances—along with his own belief that he would 'see things through,' helps propel our tragedy forward."

bomb built and used, because, in their utopian views, such a bomb can be used to terrorize and control a post-war, post-Hitler world. Sachs has been chosen as the financiers' "man on the scene" for the bomb project, because of his perceived friendship with the American President, Franklin Roosevelt.[11]

Scene 3. The Great Scientist Is Used

The Hungarians go to see Einstein in June of 1939. Einstein is told by the hysterical Szilard of the potential threat of the Nazi seizure of uranium in the Congo, should Belgium fall to the Germans. He is told that the Nazis are clearly aware of the strategic importance of the uranium supplies, providing as evidence, the Czech action in cutting off shipments to everyone but Germany. Einstein agrees to send a personal letter to the Belgian ambassador, and requests that Szilard write it.[12]

Sachs, however, wants a slightly different message to go directly to President Roosevelt. He asks to see Szilard. Sachs tells the manic scientist that he needs a letter from Einstein that he can bring to Roosevelt. Sachs proposes that the draft of the short letter written for the Belgian ambassador be expanded to include explicit language about the possibility of the bomb and its great destructive power; Sachs virtually dictates these paragraphs, as Szilard takes notes.[13]

On July 30, 1939, Teller drives Szilard to see Einstein on Long Island. He emphasizes that Roosevelt must be made aware of the Nazi bomb threat, and that Einstein must do this. Einstein is at first reluctant to go along, stating that he isn't so sure about the need for the bomb, or even whether it could be built by the Nazis, or anyone. Szilard plays on Einstein's tremendous sense of guilt over his "abandoning" European Jewry to the Nazi beast. Finally, Einstein agrees to a letter—but only if there is no advocacy of the use of this potential weapon.

The final draft, dated Aug. 2, 1939, is typed on Einstein's typewriter, and signed by the scientist. It is an act, that, in the moments after the announcement that the first atomic bomb had been dropped on Hiroshima, Einstein will call the worst thing he has ever done, and something he would regret until the end of his days.[14]

The Einstein letter is *never mailed*—it is hand delivered by Szilard to Sachs in the latter's New York office in mid-August.[15]

Sachs composes a letter of his own, referring to the Einstein letter, but also referring to points he gleaned from the Szilard memorandum and from various discussions with other scientists.

Sachs finally makes an appointment to see the President on Oct. 11. When he arrives, he finds FDR distracted with reports about developments in Europe. I have a matter that is most urgent to our national defense and security to bring up with you, Sachs tells FDR. It is this stress on the question of "national defense and security"—a matter "most urgent"—that has been lacking in the scientists' drafts.

Sachs looks up at FDR and is greeted with a quizzical look from the President. "He doesn't get it," Sachs says to himself. He won't press further now, and tells FDR that he will come back in the morning when the President is less tired.

The next morning, Sachs focusses solely on the Nazi bomb threat. He concludes his presentation with an historical analogy. Sachs tells the President that Robert Fulton had gone to Napoleon, offering him his invention—a steam-pcwered boat. He explained that this would change war for all time. But Napoleon didn't get it. England, said Sachs, was saved by the "great Napoleon" failing to grasp the significance of a new idea and its military potential.[16]


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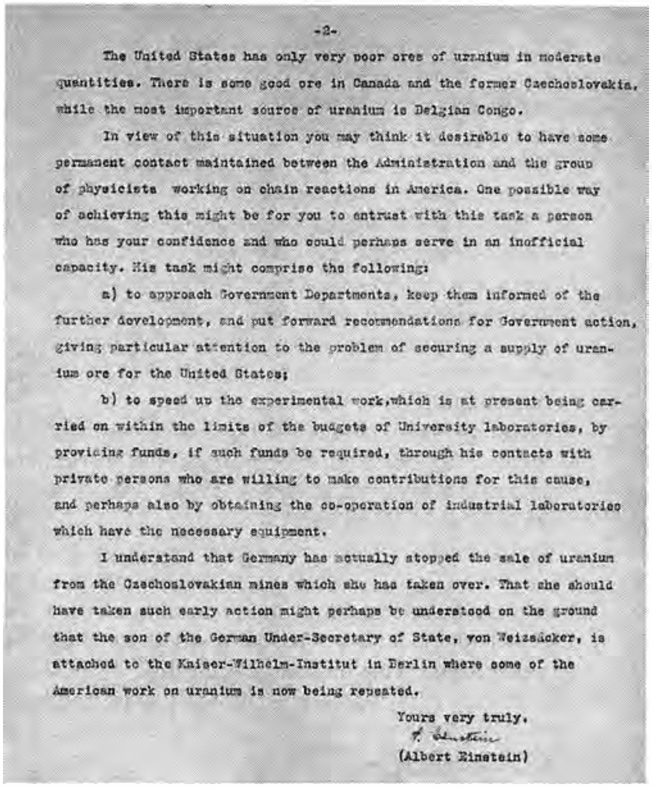
Two of the "Hungarian Conspiracy" members, Edward Teller (l) and Leo Szilard (r), and others, convince Albert Einstein to go along with the bomb project.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The United States has only very poor ores of uranium in moderate quantities. There is some good ore in Canada and the former Czechoslovakia, while the most important source of uranium is Belgian Congo.

In view of this situation you may think it desirable to have some permanent contact maintained between the Administration and the group of physicists working on chain reactions in America. One possible way of achieving this might be for you to entrust with this task a person who has your confidence and who could perhaps serve in an inofficial capacity. His task might comprise the following:

a) to approach Government Departments, keep them informed of the further development, and put forward recommendations for Government action, giving particular attention to the problem of securing a supply of uranium ore for the United States;

b) to speed up the experimental work, which is at present being carried on within the limits of the budgets of University laboratories, by providing funds, if such funds be required, through his contacts with private persons who are willing to make contributions for this cause, and perhaps also by obtaining the co-operation of industrial laboratories which have the necessary equipment.

I understand that Germany has actually stopped the sale of uranium from the Czechoslovakian mines which she has taken over. That she should have taken such early action might perhaps be understood on the ground that the son of the German Under-Secretary of State, von Weizsäcker, is attached to the Kaiser-Wilhelm-Institut in Berlin where some of the American work on uranium is now being repeated.

Yours very truly,

(Albert Einstein)

Einstein called on Pres. Roosevelt to start work on the bomb, in this letter, dated Aug. 2, 1939. The great scientist later called the writing of the letter the worst thing he had ever done, and something he would regret until the end of his days.

Suddenly, FDR turns his gaze directly on Sachs. "Alex, what you are trying to tell me is that we should prevent the Nazis from blowing us all up." Sachs nods. He hands FDR his packet of information—Sachs's letter on top, followed by Szilard's memo, and then finally the Einstein letter, along with articles on nuclear fission from scientific journals.

Roosevelt summons his chief aide, Gen. "Pa" Watson. "Pa, this requires action," the President says, handing Watson the packet he has just been given, without looking at it. Two days later, "Pa" Watson, on FDR's behalf, sends a brief "thank you" note to Einstein. Even more important, FDR tells Watson that he wants Sachs to "stay on top" of the scientists. Sachs's mission has been a total success.

And so, the American atomic bomb project is born.

Act II
The Creation of a Nightmare

Scene 1. The Ball Gets Rolling

As a result of the meeting with Sachs, the President authorizes two actions:

(1) A committee is established to examine uranium resources and supply, and suggest measures to secure that supply from the Nazis; it has members of the ordinance departments of both the Army and Navy, with the director of the National Bureau of Standards, Lyman Briggs, as chairman;

(2) A committee of scientists is set up that will discuss fission research, and its implications. The committee is made up of the "Hungarian Conspiracy" members, with Szilard playing a leading role, along with Wigner and physicists and researchers such as Hans Bethe and Enrico Fermi. Edward Teller comes on board a bit later.

Sachs, although he has no real scientific expertise, is made a special Presidential liaison to both committees.

Today, it is known that estimates of the German program were greatly exaggerated. In simply a technical sense, various sources have estimated that the German program, during this period 1939-1940, was two years or more behind the "official" estimates delivered to the President.[17]

As a member of the "uranium committee," Sachs, according to a *New York Times Magazine* article in 1945, has access to information on the world uranium supply developed from many sources, which he provides to the cartel of private investment bankers, including the shadowy European networks that control the Belgian mining conglomerate, Union Minière, and his own circles on Wall Street among Jacob Schiff's collaborators. As a result of his "insider" information, he is able to guarantee that the bankers' cartel will put a "lock" on the world uranium supply (outside of Russia).

Scene 2. New Players on the Stage

In June 1940, with the fall of France, Roosevelt establishes the National Defense Research Committee, which includes James Conant of Harvard and Karl Compton of MIT. FDR now makes the decision to allocate significant funds for fission research.

In an effort to build a unified government for a U.S. war effort against the Nazi threat, FDR brings into his government several of his "Tory" enemies, including as his Secretary of War, Henry Stimson, who was Herbert Hoover's Secretary of State, and founder of the Council on Foreign Relations; Stimson is immediately briefed on the Nazi bomb project and the U.S. response.

At some point in 1940, FDR tells his Vice Presidential candidate and Secretary of Agriculture Henry Wallace about the atomic bomb; he asks Wallace to stay on top of the discussions and keep him briefed on their progress.

Meanwhile, across the ocean, there is a change in the British government. The new Prime Minister, Winston Churchill, is told by British intelligence of the threat of a "Nazi A-bomb"; he immediately authorizes a secret British program, parallel to that of the Americans.

Churchill has no use for the American President; but he needs FDR to "save the neck" of the British Empire from the Nazi threat. Knowing that the British lack the ability to build the atomic terror weapon, Churchill wants the United States to build and use it to create a new Anglo-American imperium, although Roosevelt does not share these views, Churchill believes that he can manipulate events to bring his scheme to fruition.[18]

Scene 3. Moving Ahead with Caution

In early October 1940, Vannevar Bush, the director of the Office of Scientific Research and Development and a member of Conant's special committee, briefs FDR and Wallace that the British believe that a bomb can be developed from U-235, an isotope that has been separated from natural uranium. Bush says that the consensus within the U.S. effort is that the British are right.

But Roosevelt remains reluctant to authorize the bomb project. For almost two years more, FDR delays any decision, despite prodding and increasingly strident demands from Churchill, Sachs, and others.[19]

According to official records of a June 1942 meeting at FDR's home in Hyde Park, Roosevelt tells the British Prime Minister that he has reached a decision to proceed with a crash program to build the bomb; the United States will assume full responsibility for its development. For the first time, he reportedly discusses its potential use in the war, stating that he will make the sole decision on such questions when it becomes appropriate. The bomb project is given a new code name: TUBE ALLOYS.

FDR now orders the Army to undertake the development of an atomic bomb. In August, a new "top secret" district is created within the Army Corps of Engineers to direct the construction of needed facilities. It is named the "Manhattan Engineering District."

Physicist Niels Bohr (r) meets in October 1941 with Werner Heisenberg (l), who is still working for the Nazis.

"Bohr questions his friend on how he can work for Hitler and the Nazis. Heisenberg replies that he believes that the scientists on the project will never allow Hitler to have a bomb. . . . Bohr is convinced that there will never be a Nazi 'bomb.' "

Scene 4. A Rendezvous in Stockholm

In October 1941, a meeting takes place in Stockholm. The Danish physicist Niels Bohr and his wife meet secretly with their old friend and colleague, Prof. Werner Heisenberg, who briefs Bohr on the Nazi program, in which he plays an important role. Bohr questions his friend on how he can work for Hitler and the Nazis. Heisenberg replies that he believes that the scientists on the project will never allow Hitler to have a bomb. Heisenberg returns to Berlin, where he is questioned by the Gestapo; he tells them that he has met with Bohr to see what the Americans are doing on the bomb. They aren't doing much, he says.[20]

Bohr is convinced that there will never be a Nazi "bomb." His meeting has been noted by FBI Director J. Edgar Hoover, who believes that Bohr might be a spy, perhaps for the Nazis, but more likely for the Russians. He places Bohr on a special "watch list."

Roosevelt remains reluctant to share the bomb research with the British, and this makes Churchill furious. FDR tells Henry Wallace that he fears that Churchill wants to have the bomb for use against the Russians, after the war. While he knows that he cannot ultimately deny the British the information, he decides to dither and delay the sharing, while verbally agreeing to Churchill's demands.

Meanwhile, against the wishes of Stimson and others, and directly contrary to what he has told Churchill about agreeing to keep the bomb project secret, FDR decides to allow Harry Hopkins, his most trusted aide, to discreetly inform the Russians of its existence.[21]

The secrecy around what is now known as the Manhattan Project is enormous. "Exceptional security arrangements" are in effect for a labor force that will swell to 150,000; few know the real purpose of their work. Only at Los Alamos, the main science laboratory for the project, is this code of secrecy broken. There, scientists must be allowed freedom to talk to each other and exchange ideas or no real progress can be made. But even there, the scientists believe that their every move is watched over by Federal agents—and it is.

There is much chatter as well about the "rival" German program. By 1943, many of the scientists share Bohr's view that the Germans will never get the bomb. Since the Japanese have no such project, there is now a question as to whether a bomb needs to be built at all, and whether it should ever be used.

Scene 5. Bohr's Failed Mission

Niels Bohr has never been as hysterical about the German bomb threat as his "Hungarian Conspiracy" counterparts. He has attempted to communicate to FDR in long memoranda his assessments of the German project and the American effort. By the Spring of 1944, Bohr has become alarmed at the push for the bomb and the secrecy that surrounds the project. He is concerned about "building trust" with the Russians, and fears an atomic arms race that will leave the world living under nuclear terror. Bohr, although infected with certain utopian "world government" beliefs, wants to realize the great potential benefits of the peaceful use of nuclear power.[22]

Bohr comes up with a proposal: Before the decision to use the bomb is made, the United States should propose to Britain and Russia the establishment of mechanisms for international control and inspection of atomic energy, to build a world based on "cooperation," not conflict. Russia must be approached as soon as possible to create mutual trust.

The Danish scientist takes it upon himself to lobby support for his plan. Ultimately, through Justice Felix Frankfurter, he gets his message to FDR, who proposes that Bohr go see Churchill to explain his concerns, hoping that this will buy Roosevelt some time to stymie the British push to deploy an atomic weapon.

While in London, Bohr receives an invitation from an old Russian friend, Peter Kapitsa, who is working on the Russian project, under the direction of the great V.I. Vernadsky. He is told that the Russians would make everything available for "his scientific work," which Bohr takes to mean that they want him to work on their bomb project. He declines the offer. Bohr is watched by British intelligence, and the information is passed on to Churchill.[23]

Bohr is greeted coldly by Churchill, who sends him away without really hearing his proposal. The scientist returns to the United States and reports to FDR in mid-June. Roosevelt is friendly, appearing to take Bohr into his confidence. FDR agrees with Bohr's assessment that the Nazi bomb is not a real possibility, provided the invasion of Europe goes as he expects it will. He tells the scientist that he wants the whole world to collaborate on the peaceful development of atomic power. It is through cooperation, he says, that we can make sure that the bomb does not produce the nightmare that Bohr envisions. I see no reason not to approach Marshall Stalin, no matter what Winston believes, FDR says.[24]

Bohr is elated. Roosevelt understands both the danger and the promise of atomic energy. But Bohr has made a serious mistake. For one reason or another, he has not disclosed his message from the Russians in London. The word starts circulating through the Anglo-American intelligence machine that Bohr is leaking information to the Russians.

National Archives

A gaunt-looking FDR (center) with Winston Churchill (l) and Josef Stalin (r) at Yalta, February 1945, just two months before Roosevelt dies.

"FDR never doubts that he will be the man who will make the decisions about the use of the atomic bomb and the immediate post-war arrangements about nuclear power. While often physically strained and increasingly weak, he was in full command of his faculties. Had he seen the potential nearness of his demise, he might have acted differently."

Scene 6. The President's Health

We must now do a bit of a time-reversal. We go back to March 27, 1944, when Roosevelt, at the inducement of several people close to him, who are concerned about his recent health problems and fatigue, goes to the National Medical Center at Bethesda, Md. for a check-up. In the check-up, administered by a young Navy cardiologist, Lt. Commander Howard Bruenn, FDR is his normal, cheerful self, joking with patients and nurses, and putting the young doctor at ease. Bruenn is shocked by what he finds—his patient is suffering from serious and advanced heart disease, with signs of previous cardiac failure. FDR's condition requires immediate treatment.[25]

But FDR is no normal patient: He is the President of the United States. And, although a treatment regimen is prescribed, the patient is not given the normal treatment for advanced heart disease, nor is he ever told the full extent of his illness. It is probable that he guesses some of what is wrong. But FDR believes that he is a soldier fighting a necessary battle for his country and civilization, and he is willing to put his life on the line for his cause.

For the sake of our story, it were important to understand that FDR never doubts that he will be the man who will make the decisions about the use of the atomic bomb and the immediate post-war arrangements about nuclear power. While often physically strained and increasingly weak, he is in full command of his faculties.

(Had he seen the nearness of his demise, he might have acted differently, for example, by ensuring that Vice President Henry Wallace remained on the ticket in 1944, instead of replacing him with Harry Truman.[26] But FDR's hubris and willpower would allow for no such doubts; the very qualities that made him a great leader, in this case, play an important role in the unfolding tragedy we report here.)

Churchill, through British intelligence sources, knows of the Bruenn examination and its conclusions. He is likely told by British doctors that Roosevelt is going to die, most likely within the next 24 months, possibly less.

Churchill realizes that no successor to FDR would dare go against the President's intentions on the atomic bomb. He decides on a gamble: He will bet that FDR will die before the decision to use the bomb is made; before that event, Churchill will obtain a vague agreement on the bomb's possible use against an already increasingly prostrate Japan. Once FDR is gone, Churchill can interpret this piece of paper as authorizing the bomb's use.

Scene 7. The 'Bomb' Memorandum

There are no "official" records of what took place at the September 1944 Hyde Park summit between FDR and Churchill. But from various "unofficial sources," a picture emerges.[27] Churchill has come with certain "information." He tells FDR that he believes that "your friend" Bohr is leaking secrets to the Soviets. He presents Roosevelt with reports on the message from the Russians to Bohr asking him to join "their team." Roosevelt doesn't believe that Bohr is a Soviet agent, but having been confronted with Churchill's allegations, he cannot afford to associate himself with Bohr or his ideas.

Churchill then presents a draft of a memorandum that incorporates the core of his strategy on the bomb.

The following is the text of the memorandum, marked "TOP SECRET," issued Sept. 19, 1944, under the signatures of Roosevelt and Churchill:

> 1. The suggestion that the world should be informed regarding TUBE ALLOYS, with a view toward international agreement regarding its control and use, is not accepted. The matter should continue to be regarded with utmost secrecy, but when the 'bomb' is finally available, it might, perhaps, after mature consideration be used against the Japanese, who should be warned that this bombardment will be repeated until they surrender.
>
> 2. Full collaboration between the United States and the British Government in developing TUBE ALLOYS for military and commercial purposes should continue after the defeat of Japan, unless and until terminated by joint agreement.
>
> 3. Enquiries should be made regarding the activities of Professor Bohr and steps taken to ensure that he is responsible for no leakage of information, particularly to the Russians.

Churchill believes that he has gotten everything he wanted.

Roosevelt also believes that he has what he wants. He substitutes for Churchill's demand for an explicit commitment to use the bomb if military matters might dictate, the conditional agreement, including wording that says that any decision will be taken after "mature considerations."

(Had FDR lived to make such "mature considerations," no bombs would be dropped. But with FDR out of the picture, Churchill will not allow mere nominalisms to stand in his way.)

Scene 8. 'As Long As I Am Around. . .'

The memo is discussed by the special committee established by FDR to handle the bomb project, the so-called TOP Committee. Stimson in particular seems happy with what has happened. He has some vague idea that the bomb might be used only as a threat to force compliance by the Soviets to the international system, to bring them into the "Great Game" under acceptable rules of conduct. On the issue of whether the bomb should *actually* be used against Japan, he is hesitant and uncertain.[28]

In late August, Stimson goes to see the President to convince him of the need to understand how the bomb (code name "S1") could be used to create a "new world order." His notes for the meeting, available from the Stimson archives, read:

> The necessity of bringing the Russian orgn. into the fold of Christian civilization. . . .
> The possible use of S1 to accomplish this. . .
> Steps toward disarmament
> Impossibility of disclosure—(S1)
> Science is making the common yardstick impossible.

Henry Wallace is upset with what he sees in the Hyde Park memo and in Stimson's ideas of a "new order." Wallace, dumped from the ticket in favor of Truman, is still FDR's trusted aide on these matters. He participates in all TOP Committee meetings, and FDR has informed him that he will be made Secretary of Commerce in the next Administration, from where, among other things, he intends Wallace to oversee the peaceful development of atomic power.

Wallace goes to see the President, according to an article he was to write later. He asks whether the memo means a change in his policy—is he going to drop a bomb? Roosevelt says nothing has changed. FDR explains that the memo keeps Churchill off his back. As long as I am around, we will do the right thing, he says.[29]

The President looks tired and gaunt in these last days of the 1944 Presidential campaign, even before his gruelling Yalta trip, that is to come with the New Year.

Scene 9. The Back Channel

Roosevelt has another thing up his sleeve, something that even Wallace doesn't know about. The war in Europe is almost over. That will mean that attention will turn to the war in the Pacific and the defeat of Japan. While the Joint Chiefs are busy formulating a battle plan for the invasion of the Japanese home islands, FDR believes that such an invasion may not be necessary, that Japan can be induced to surrender, without the use of the bomb.

Back in 1941, Roosevelt had attempted to work a back channel directly into the Japanese royal family to reach some kind of agreement to avoid war. It had been sabotaged through the work of networks associated with the synarchist John Foster Dulles, and British networks inside and outside Japan, who desired the Pearl Harbor attack and America's entry into the war. FDR believes that while a militarist-synarchist faction controls the government, the Emperor has been a reluctant warrior. Roosevelt thinks that a new back channel is possible, and that he can work out a peace plan directly with Emperor Hirohito, if necessary. He asks his trusted intelligence operatives, such as Office of Strategic Services (OSS) Director William Donovan, to keep their eyes and ears open for a possible back channel from the Emperor or his networks.[30]

Meanwhile, dissent mounts among scientists working on the bomb project. Alexander Sachs now re-emerges as the voice of this dissent, and goes to see the President in December. Roosevelt tells him that, if a bomb is developed, there *should be* a non-military demonstration, observed by clergymen and international scientists, and perhaps even representatives of the Japanese government. After that, if the use of the bomb were deemed militarily necessary, there should be an explicit and direct warning identifying the time and target of the nuclear attack, to allow for orderly civilian evacuation. The target should be of military value. Sachs does not report this discussion until long after FDR is dead and the bomb is dropped.[31]

Some time in early 1945, the back channel that FDR had expected opens up. Eventually, this develops into discussions in Rome and the Holy See, through the office of the Vatican's Secretary of State and various OSS operatives. As the discussions, code-named "VESSEL," progress, it becomes clear that the Emperor will pursue peace, but needs an assurance that the Imperial family will be left in power in whatever government is formed.[32]

National Archives

At FDR's funeral (from left), James Byrnes, President Truman, and Henry Wallace.

"On April 12, FDR suffers a massive cerebral hemmorrhage. Not long after that, the President is dead. He had told Henry Wallace that he would be there to make the fateful decisions about the bomb; now those decisions will be made by Harry S Truman, whom Roosevelt hasn't even briefed on the bomb project."

Scene 10. The Light Goes Out

For Franklin Roosevelt, time is running out.

In early 1945, Roosevelt tells the Joint Chiefs that he intends to delay any decision on an invasion of Japan until at least the Fall of 1945. In Europe, Gen. Dwight Eisenhower concurs. In the Pacific, Gen. Douglas MacArthur, whom FDR despises as a political thinker and respects as a military genius, thinks the plan for the Japanese invasion is a waste of manpower and money; Japan is no longer a threat to anyone, but itself. Wait them out, until a surrender can be arranged.

Some time in March 1945, OSS chief William Donovan briefs the President at the White House. He emerges from the Oval Office shaken. The President is wasting away. He is gone, he tells an aide, with a sense of foreboding.[35]

Bohr, who has been in Europe much of the time since the Sept. 19, 1944 memo, comes back to the United States in early April. He has heard that Churchill believes that he can force the United States to use the bomb, and that its main target will not be Japan, but the Soviet Union. This is called "terror politics," and Bohr stays up several nights writing a special memorandum for FDR. He argues for openness and for collaboration with the Russians, and against secrecy and distrust, lest the world live in an era of "atomic terror." Bohr seeks out Justice Frankfurter to help him get the memo to Roosevelt. He proposes to meet with the British Ambassador, the synarchist Lord Halifax, who represents himself as an opponent of Churchill, to discuss the matter. The meeting is set for Rock Creek Park in Washington, for the late afternoon of April 12.[36]

On April 11, FDR drafts a speech for coming Jefferson Day events. He is in Warm Springs, Ga., away from Washington for some rest and relaxation. It seems to be having a wonderful effect, reinvigorating him. He is full of hope and optimism. In the draft, after paying tribute to Jefferson as a Secretary of State, President, and scientist, he turns to the world situation:

> The once powerful, malignant Nazi state is crumbling. The Japanese warlords are receiving in their own homeland, the retribution for which they asked when they attacked Pearl Harbor.

But the mere conquest of our enemies is not enough.

> We must go on to do all in our power to conquer, the doubts and fears, the ignorance and greed, which made this horror possible. . . .
>
> Today, we are faced with the preeminent fact that, if civilization is to survive, we must cultivate the science of human relationships—the ability of all peoples, of all kinds to live together and to work together, in the same world, at peace. . . .
>
> The work, my friends, is peace. More than an end of this war—an end to the beginnings of all wars. Yes, an end, forever, to this impractical, unrealistic settlement of differences between governments by the mass killing of peoples. . . .
>
> The only limits to our realization of tomorrow will be our doubts of today. Let us move forward with strong and active faith.

At a little after 1:00 p.m. on April 12, FDR suffers a massive cerebral hemorrhage. Not long after that, the First Soldier in mankind's struggle against the darkness of evil is dead. He had told Henry Wallace that he would be there to make the fateful decisions about the bomb; now those decisions will be made by Harry S Truman, whom Roosevelt hasn't even briefed on the bomb project.

Act III
The Bomb Is Dropped

Scene I. The Little Man Who Is President

Harry S Truman, a mean little man of limited intelligence, is now the President of the United States. The day after FDR dies, Secretary of War Stimson goes to see the new President. Truman has not been a participant in the TOP committee; Wallace has continued to serve there, at FDR's insistence. Stimson now lets Truman in on the bomb project; he tells him that, by the best estimates, a bomb will be ready for use by mid-summer.

Truman is shocked by what he hears. However, he quickly becomes excited by the prospects for the "super-weapon." Was Roosevelt planning to drop the bomb on Japan?, Truman asks. Stimson tells the new President that FDR was prepared to use it on Japan, and hands him a copy of the Sept. 19 memo with Churchill as his "proof." Then, I am prepared to use it, as well, Truman blusters. He never waivers from this initial determination to use the bomb.[35]

That same day, Truman receives a top secret briefing paper prepared by Secretary of State Edward Stettinius that purports to describe U.S. foreign policy.[36] Stettinius had never really shared FDR's views on the prospects for post-war cooperation with the Soviet Union. In two areas in particular, this difference is crucial: (1) The briefing does not mention Roosevelt's clearly stated intention to use American power to end colonial empires; (2) It exaggerates FDR's concerns about problems with the Soviets. Churchill reinforces this briefing in his first communications with the new President.

The briefings reinforce Truman's own Hobbesian views of foreign policy and basic distrust and fear of foreigners. While he soon tells the nation that he intends to "continue [FDR's] policies," Truman intends to put his own stamp on these policies. He will be pragmatic, tough, and forceful, where FDR was a dreamer and idealist.

When Soviet Foreign Minister Molotov stops in Washington for a "courtesy visit" with the new American President, he is greeted with a harangue about how the Russians have broken the Yalta agreements, especially on Poland, and have betrayed the trust of the late President and the hope of the world. Molotov, shocked by the little President's undiplomatic outburst, says, "I have never been spoken to like that in my life." Truman sternly replies, "Carry out your agreements and you won't get talked to like that!"

A stunned Molotov leaves Washington. He had been sent by Stalin to the San Francisco conference to draft and approve the United Nations Charter as a sign of Russia's commitment to the late President's dream. He now cables Stalin that Truman is a "madman."[37]

Scene 2. The Puppetmaster

One man is pleased by the new President's behavior—Jimmy Byrnes, the former Supreme Court Justice and South Carolina Senator, who is to become Truman's Rasputin on foreign policy and his Secretary of State. FDR had used Byrnes's organizational skill in heading the War Mobilization Board, but he knew that the South Carolinian's view of the world was that of an American imperialist, the flip side of Churchill's views. The ambitious Byrnes believed that he, not Truman, should have been sitting in the White House.[38]

Truman knew Byrnes in the Congress, and feels at ease with the bourbon- and scotch-drinking Southerner, a fellow poker player. Byrnes makes Truman dependent on him; if he cannot be President, then the President will be his puppet. He molds Truman's vague Hobbesian worldview into a virulent anti-Communist neo-imperialism, with a utopian flair.

In briefing Truman on the bomb, Stimson had proposed the creation of a new secret "Interim Committee." Perhaps fearing what he sees as the unstable qualities of the new President, and the growing influence of Byrnes, he proposes that this new committee make a recommendation on the testing and use of the bomb. Truman immediately agrees, and Stimson draws up a list of participants. Stimson will be its chairman. However, Truman appoints Jimmy Byrnes as his personal representative to the Committee. Byrnes, not Stimson, becomes the person who briefs the President on its deliberations.[39]

The first meeting of this new so-called Interim Committee in late April 1945, hears reports on the awesome power of the bomb. Byrnes asks whether there is any possible defense against this weapon. He is told there is not, that in the future, only ever-larger and more powerful bombs will be built. Then the only defense against further development is to kill all the scientists? Byrnes asks.

Byrnes asks both the Committee members and the various engineers and others interviewed how long it would take before the Russians might develop an atomic weapon. Based on the information that he is given, he concludes that it would "take seven to ten years, at least. . . ." He believes this estimate to be "optimistic."

On July 1, at a secret session of the Committee, the decision is made to unanimously recommend that the bomb be used against Japan, as soon as it is ready. Byrnes reports that the only caveat should be that a site of some "military value" be selected, that either war production plants, or port facilities, or military bases be in the general area. Wanting to give the Japanese no excuse to surrender and thus avoid the bomb's use, Byrnes argues against advance warning, claiming that if warning were given, the Japanese might bring U.S. prisoners of war to the bomb target.[40]

Byrnes is sworn in as the new Secretary of State on July 3. He now controls all decisions about the potential surrender terms with the Japanese, and can make it impossible for them to surrender without suffering an atomic bombing.[41]

Scene 3. The Puppet Is Manipulated

Byrnes briefs the President on the Committee's recommendation. Truman, realizing that he is now being asked for a decision on the bomb, becomes nervous. Explain to me what the military implications of all this are, he asks. Byrnes starts by telling the President of the Joint Chief's battle plan, which called for an invasion of the Japanese home islands in November, starting with Kyushu, and then followed in the Spring of 1946, by an invasion of main island of Honshu. Five million allied troops, mostly Americans, would be facing 5 million fanatical Japanese willing to die to defend their homeland and the Emperor; there would be probably upwards of 1 million Allied casualties, mostly American, and millions more Japanese dead.

So, you are telling me that using this weapon will save a million American lives and more than that in Japs? Truman asks, as he paces about nervously. Finally, he turns to Byrnes. Well, Jimmy, there's no choice, is there? Tell them I agree with their recommendation.[42]

A Presidential order is issued directing that the bomb be tested, and if successful, that it should be used on a target selected by the Committee.

In the late Spring 1945, Leo Szilard, who at this moment is as obsessed with *not* using the bomb, as he is to later become obsessed with its pre-emptive use against the Soviets, approaches Byrnes to plead his case, which is supported by a large number of top physicists who work on the Manhattan Project. Byrnes rejects their plea for a "demonstration test"; he tells Szilard that the biggest benefit would not be with regard to Japan or in the Pacific War. The bomb would be used, Byrnes says, for another purpose: "to make Russia more manageable in Europe."[41]

National Archives

Secretary of War and dean of the Eastern Establishment, Henry Stimson (with Col. W.H. Kyle) is the "Hamlet" of the story; he fears the utopian Beast-Men, but fails to act.

"Stimson has some vague idea that the bomb might be used only as a threat to force compliance by the Soviets to the international system, bring them into the 'Great Game' under acceptable rules of conduct; on the issue of whether the bomb should actually be used against Japan, he is hesitant and uncertain."

Scene 4. 'Hamlet' Is Gripped by Doubt

As Secretary Stimson sits through the Interim Committee meetings, he becomes increasingly uneasy. He is now 77 years old, part of the "old guard," the founder of the Council on Foreign Relations, and dean of the "Eastern Establishment." He never liked Roosevelt, and suffered him as a necessary annoyance in gaining a victory against the synarchist fascists. Now, he worries about this new breed of utopians and their view of the power of the "bomb." It is one thing to have it as a threat, to be used within the old balance-of-power system. It is another to use it with a blindness about your adversaries—you might trigger a war that will end civilization, and the power of the "establishment" with it.

Stimson is no humanitarian, and has little concern for the lives of "little people," be they Japanese or Americans. It is political pragmatism and fear of utopians like Byrnes that motivate him to press for giving the Japanese a real chance to surrender before they drop the bomb. He drafts a proclamation to be issued by the United States and Britain at the July three-power Potsdam Conference. Aware of the past back-channel negotiations, he comes up with language that threatens Japan with the "utter destruction of its homeland" if it doesn't surrender, but includes an offer to continue "a constitutional monarchy under the present dynasty" if it does.[44]

Stimson now appeals to the little man from Missouri whom fate and poor judgment have made President, going to him with the draft his staff has prepared for the Potsdam declaration on Japan. But the President turns these matters over to his Secretary of State. Byrnes reviews the Stimson draft, accepting its basic wording, but striking its most important passage—the offer to continue the Imperial dynasty.[45]

Scene 5. The Emperor Makes a Move

In Japan, on the eve of Potsdam, the Emperor is becoming anxious. The back channel through the Vatican has yielded no result; with FDR's death, there is no one to talk to. The Emperor, seeing the needless slaughter, decides to make a new overture through the Russians, hoping that they might broker a peace deal.[46]

On July 12, the Emperor goes to see his former Prime Minister, Prince Konoye, who is now in semi-retirement. An opponent of the war with the United States, he had left the government after being blocked in an earlier effort to secure peace prior to Pearl Harbor through direct negotiations between FDR and the Emperor. The Emperor goes alone, in violation of all royal protocol. He asks Konoye for advice. "It is necessary to end this war as soon as possible," the Prince replies. The Emperor orders him to prepare for a trip to Moscow.

A cable is sent from the Japanese Foreign Minister to Ambassador Sato in Moscow on July 13: "His Majesty is extremely anxious to terminate the war as soon as possible, being deeply concerned that any further continuation of hostilities will only aggravate untold miseries of the millions upon millions of innocent men and women in the countries at war. If, however, the United States and Great Britain should insist on unconditional surrender, Japan would be forced to fight to the bitter end." The Ambassador is informed that the Emperor will dispatch Prince Konoye to Moscow to speak with the Soviet government.

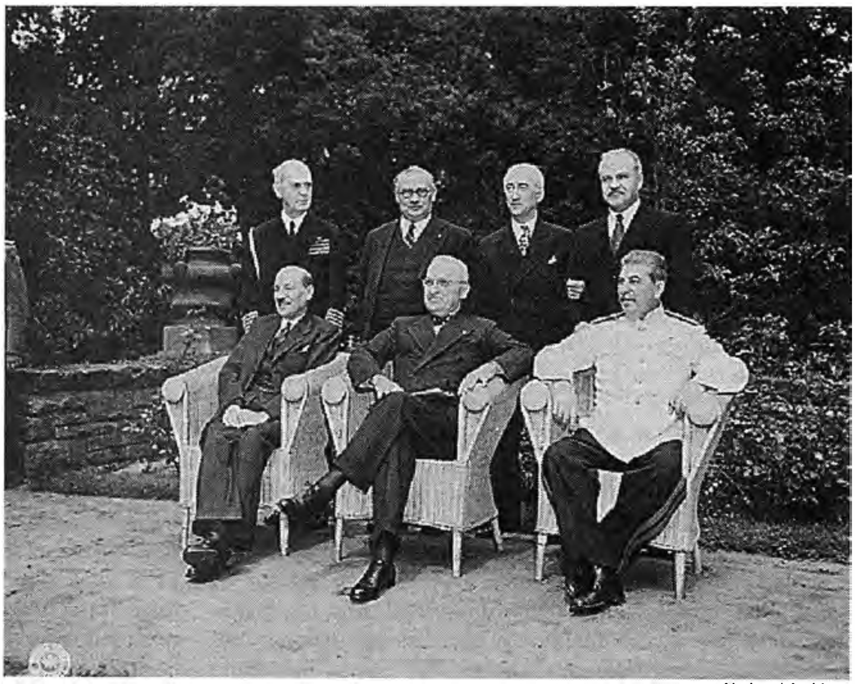
The Emperor unfortunately miscalculates the "good services" of the Soviet government, which is preparing to declare war on Japan—as agreed to in the Yalta accords. In the post-Roosevelt world, Stalin is committed to Russia becoming a "player" in the Asian theater. The continuation of the war, even for a short period of time, is in Russia's interests.

The Japanese message is intercepted and decoded by American intelligence. It is passed on to the President, en route by sea to Potsdam. Byrnes tells Truman to ignore this Japanese "trick." Truman, in the thrall of his Rasputin, dismisses the idea of a negotiated settlement with the Emperor before the bomb is used.[47]

Scene 6. The Bomb Works

On July 16, the world's first atomic bomb is exploded in the sands of the New Mexico desert, as Truman and Churchill meet in Potsdam, Germany. Meanwhile, a cruiser leaves San Francisco en route to Tinian Island; it carries one of the two atomic bombs to be dropped on Japan.

In Potsdam, that same morning, at the dawn of the atomic age, the Joint Chiefs meet with Stimson. According to the logs of the meeting, the discussion centers on the final phases of the war and the bomb. Gen. George Marshall, who later regretted that he had not been more forceful on the matter, expresses his fear that the world will not forgive the United States if Japan is not given a real chance to surrender before the bomb might be used. Admiral King says that there is no need for this weapon; it has no military value, because Japan can be brought to its knees by a blockade. Gen. "Hap" Arnold of the Army Air Forces argues that conventional bombing could end the war. Adm. William Leahy, who had called the bomb project a great and tragic folly, is at a loss to explain why "civilians" seem so determined to use this weapon.



National Archives

At Potsdam, Aug. 1, 1945, five days before the Beast-Men drop the bomb: Seated (from left), British Prime Minister Atlee, Truman, Stalin; standing (from left), Admiral Leahy, British Foreign Minister Bevin, Secretary of State Byrnes, Foreign Minister Molotov.

Stimson listens. He is aware of the Emperor's new peace initiative. He listens, but says nothing as the meeting breaks up.

On his return from a brief tour of Berlin, the President is greeted by a glum-faced Stimson. He has in his hand a cable from his aide George Harrison, who serves as a liaison with the bomb project. It is written in code, and talks about an "operation" that apparently was a "success." At first Truman is confused. It's the bomb, Stimson whispers in his ear. Suddenly Truman becomes highly excited, grinning from ear to ear, he exclaims: "The war is over!"[48]

The next morning, Stimson goes to see Byrnes with the news of the bomb. He pleads with Byrnes for a two-part initiative: Give the Japanese a direct warning about the bomb, as explicit as possible; and, assure them that the United States will allow Japan to keep its Emperor. Byrnes rejects both proposals.

At lunchtime, Stimson walks the cable over to Churchill. The Prime Minister offers his congratulations, but says little else.

As Churchill, Stalin, and Truman meet, and then hold a brief reception, Stimson receives the follow-on cable from his aide Harrison in Washington: Gen. Leslie Groves reports that the bomb had exceeded all expectations. When Truman hears the news, he boasts that the United States now possesses the most powerful weapon in human history.

Truman, already unstable when he assumed office, is now intoxicated with his own power. While he speaks of the United States possessing this new super-weapon, Truman is obsessed with the thought that he, this person that everyone always underestimated, as President is the sole controller of this god-like force; he can make nations bend before his will: I'll show them, I'll show all of them, the increasingly insane President muses.

Scene 7. The War Is Over—The War Must Go On

The next day, July 18, Truman goes to lunch with Churchill. He is alone—Byrnes is not with him, and he clutches the two cables on the bomb in his hand. According to the official notes on the meeting, Truman hands them to the Prime Minister, who greets the "news" with far greater enthusiasm than shown Stimson. This is "world-shaking news," he beams, and the two stand there, gleeful about the savage potential of the weapon.

Truman believes that Stalin needs to be told "something." He suggests that it be done casually, "after one of our meetings, that we have an entirely novel form of bomb, something quite out of the ordinary, which we think will have a decisive effect on the Japanese will to continue the war." Churchill concurs.[49]

Churchill is now certain that Truman will drop the bomb, and is now free to do something to clear his own name of this crime in future history books. He informs Truman that Stalin has discussed with him the Moscow peace feeler, coming directly from the Emperor. "Japan would not accept 'unconditional surrender,' but might be prepared to compromise on other terms," he says. Not accepting this offer and prolonging the war means greater loss of life to Americans, and to a lesser extent the British, and also to the Japanese. Might it not be possible to alter our wording to provide the Japanese with the assurances that they need, that they could surrender with "honor"?

Churchill knows that this will provoke rage from the little President. Pearl Harbor proves that the Japanese do not have nor do they deserve to be treated with honor, Truman shoots back. I am tired of this whining about the terms of surrender; it is "unconditional surrender," period. The "official" history, as recorded in the records of the Potsdam Conference, will now show that the Beast-Man Churchill is not to blame for the decision to drop the bomb—which he has encouraged all along; the Americans have ignored his "wise counsel."[50]

Scene 8. Stimson Goes Along

Henry "Hamlet" Stimson awaits the full report from General Groves. He knows what it will say. He knows what the reaction of the other players in our tragedy—Truman, Byrnes, and Churchill—will be to it.

Another man, a more courageous soul, would have thought of some way to outflank the utopian "atomic bombers." Frightened by such thoughts, this personification of the "establishment" decides to "go with the flow," to rationalize his own defeat, and take sides with the winners. His thoughts turn to how the bomb can be used to change the character and thinking of the Russian government.

Finally, the Groves report comes: The bomb is devastatingly effective as a weapon and massively destructive. At 3:30 p.m., Stimson takes the report to the President, who sits in discussion with Byrnes. The two read it, growing wildly exuberant. They shake hands. In their glee, they shake Stimson's hand. The President thanks him for bringing him this information, for serving these long months in coordinating the bomb project. Stimson doesn't know it, but he has been given the "kiss-off." Byrnes in particular doesn't want any "waverers" around.

Scene 9. A World Transformed

In the Potsdam plenary session of July 21, the official records show Truman, with the bomb "in his back pocket," is aggressive with Stalin to the point of being almost belligerent.

The meeting is paradigmatic of a change taking place in the conduct of global diplomacy and relations generally. The bomb, even before it has been used, has ended FDR's hopes for the post-war world. Roosevelt had believed in developing trust through cooperation, even with a potential or actual adversary. Through trust and cooperation, over time, it becomes possible to change the way that adversary or potential adversary sees things; both sides may begin to see things from a broader and better perspective. Changing the way the Russians see the world and think about it, FDR believed, was the necessary step to creating a community of nations, with different systems of government and ethnic and religious backgrounds, but of shared common goals and principles.

Emperor Hirohito attempted to negotiate a surrender, through the Vatican, and then, with the Russians. But the Beast-Men were set on using the bomb.

"We should like to communuciate to the other party [the United States] through appropriate channels that we have no objection to a peace based on the Atlantic Charter. . . . Also, it is necessary for them to understand that we are trying to end hostilities by asking for very reasonable terms in order to secure and maintain our nation's existence and honor."

—Hirohito's cable to the Japanese Ambassador in Russia

Cooperation has now been replaced by competition, and, where necessary, confrontation. Nobody changes, and foreign policy becomes a series of conflicts to be managed, rather than projects of hope to be realized.

The utopian Byrnes believes, as does the intoxicated Truman, that the bomb holds the mystical power, of a "super-weapon," like Excalibur, King Arthur's sword, and that, once it is used on Japan, it will have such a magical power over the Russians.

Scene 10. 'The Second Coming in Wrath'

On July 22, Stimson walks the Groves report over to Churchill's villa. Churchill is described as being "transported" by the document. "Stimson," he booms out, waving a cigar, "What was gunpowder? Trivial! What was electricity? Meaningless! The atomic bomb is the Second Coming in Wrath!"

The meetings continue, and Stimson sits on the outside, looking in. The Hamlet in him is at work again, as he wavers on the bomb's use. On the morning of July 24, he goes to see Truman, this time bearing a message from Groves that the bomb will be ready to be dropped on a Japanese target at any time after Aug. 3. Truman is delighted; he will get the Chinese leader Chiang Kai-shek to sign on the Potsdam Proclamation, along with the United States, Britain, and the Soviet Union; this will serve as the ultimatum to the Japanese. after which the bomb will be dropped.

Stimson seizes on the mention of the Proclamation to ask again that the deleted phrase about a constitutional monarchy be reinstated. Truman winces, says he will think about it, as he ushers Stimson to the door.

Churchill's Conservative Party has been soundly trounced in the British general elections by Labour's Clement Atlee, who knows little of the bomb, and will have no role in deciding its ultimate use. Churchill departs our stage, depressed at his electoral defeat, but happy in the knowledge that he has kept things on a path leading to the dropping of the great terror weapon—the "Second Coming in Wrath"—on Japan. He will write in his memoirs, that the bomb was totally unnecessary for either ending or shortening the war; yet, he is also to state, that its use "was never really a matter of doubt."

Churchill's manic Beast-Man character is best captured by one of his top aides: Lord Moran, his trusted physician.

Lord Moran, in his diary, reacted to Churchill's report that the bomb was going to be dropped:

> I own [that] I was deeply shocked by the ruthless decision to use the bomb on Japan. . . . There can be no moment in the whole war when things looked to me so black, and desperate, and the future so hopeless. . . . It was not so much the morality of the thing, it was simply that the linchpin that had been underpinning the world had been half wrenched out. . . . I once slept in a house where there had been a murder. I feel like that here [at Churchill's quarters at Potsdam].

Scene 11. The Order Is Given

Meanwhile, in Moscow, the wheels of diplomacy continue to spin. A cable is sent, at the direction of the Emperor, to the Japanese Ambassador. Japan cannot accept unconditional surrender, it says:

> We should like to communicate to the other party [the United States] through appropriate channels [the Russians] that we have no objection to a peace based on the Atlantic Charter. . . . Also, it is necessary for them [the United States] to understand that we are trying to end hostilities by asking for very reasonable terms in order to secure and maintain our nation's existence and honor.

The cable continues:

> Should the United States and Great Britain remain

> insistent on formality, there is no solution other than for us to hold out until complete collapse because of this one point alone.

It is now explicit: Japan is ready to surrender immediately if it is given an "honorable" way out—that is, that the monarchy is kept in place. There is no reason to drop the bomb. The message is intercepted and decoded by American Intelligence and transmitted with highest urgency directly to Byrnes and Truman in Potsdam. Both see the message; Byrnes tells Truman that there is no need to negotiate, at all. Truman has already made up his mind—either Japan accepts the unconditional surrender of the Potsdam Declaration, or it will be atomic bombed.[51]

On July 25, with the knowledge of the Moscow peace feeler, Truman signs the executive command that orders the dropping of the atomic bomb on Japan. Attached to the draft order are one-page descriptions of four possible targets—Hiroshima, Nagasaki, Kokura, and Nigata. The President, with Byrnes at his side, tells Stimson that the "order stands," unless he hears directly from Truman, himself, that the Japanese reply to the release of the warning-communiqué is acceptable.

The decision to drop the bomb, Truman would say in a letter to his daughter Margaret, was "no great decision . . . not any decision you had to worry about."

Scene 12. A Terror Weapon

Truman in his memoirs, and Byrnes in his, claim that they never really considered the bomb as anything more than a military weapon. "I regarded the bomb as a military weapon," writes Truman, "and never had any doubt that it should be used." But both men were aware that the bomb was not militarily necessary; they had been told this by members of the Joint Chiefs of Staff. The decision to use the bomb was made exactly as Lyndon LaRouche has described: not for military purposes, but as a weapon of horrific terror, which terror could then be used to shape the post-war world—a weapon for use by "Beast-Men."[52]

On June 1, a report is prepared for the Interim Committee at the request of Byrnes, who seeks a "better understanding" of how best to target the use of the bomb against Japan. The report (which has since been declassified), says that the bomb should not merely be used on a military target, but on a "dual military-civilian target"—a military installation or factory surrounded by workers and families' homes. In that way, the bomb "will have the maximum psychological effect."

As Stimson and Byrnes both know, as Truman knows, there is no need for this "terror effect" on Japan—it is already in the process of surrendering. "However," as historian Charles Mee, Jr. observes,

> if the weapons were not dropped on Japan, the doomsday machine could have no psychological impact on Russia. The bomb was therefore dropped on Japan for the effect it had on Russia—just as Jimmy Byrnes had said. The psychological effect on Stalin was twofold: the Americans had not only used their doomsday machine; they had used it, when as Stalin knew, it was not militarily necessary. It was this last chilling fact that doubtless made the greatest impression on the Russians.

Scene 13. The Ultimatum

At 7:00 p.m. on the evening of July 26, the Potsdam Declaration is issued by the governments of the United States, Great Britain, and China.

> The time has come for Japan to decide whether she will continue to be controlled by self-willed militaristic advisers whose unintelligent calculations have brought the Empire of Japan to the threshold of annihilation, or whether she will follow the path of reason. . . .

It contains the following fateful ultimatum:

> We call upon the Government of Japan to proclaim now the unconditional surrender of all the Japanese armed forces, and to provide proper and adequate assurances of their good faith in such action. The alternative for Japan is prompt and utter destruction.

The next day, July 28, the new British government, Prime Minister Clement Atlee and Foreign Secretary Ernest Bevin, arrive at Potsdam. Together with Truman and Byrnes, they meet that evening with Stalin and Molotov. According to the official records of the conference, Stalin opens the discussions by stating, "I want to inform you that we have received a new proposal from Japan." He then says that although the Americans and British have not properly consulted with him on their "initiative" to Japan—the ultimatum—"we believe that nevertheless we should inform each other of new proposals." Stalin then reads the cable delivered by Ambassador Sato—which both the Americans and British have already seen and have dismissed. Stalin points out that the message comes directly from the Emperor of Japan.

If Stalin were to press his "allies" to accept, or at least work with this overture, then Byrnes's and Truman's efforts to drop the bomb might be thwarted. They breathe a deep sigh of relief as Stalin says that "the document does not contain anything new," and that the Russians will reply in the "same spirit as the last time"—completely negatively. Truman states, "We do not object." Atlee comments, "We agree." Stalin then closes the matter—and, with it, the last real hope to avoid dropping the bomb: "I have nothing more to add."[53]

Meanwhile in Tokyo, the Japanese cabinet debates the Potsdam Declaration. According to John Toland, citing official records, the cabinet's war faction sees it as an ultimatum for an unacceptable "unconditional surrender," an act that humiliates the Japanese nation, its Emperor, and all those who have died fighting for them.[30] But, Prime Minister Togo and Foreign Minister Suzuki see a glimmer of hope in the words about not destroying the nation of Japan, and that "unconditional surrender" refers only to the armed forces, and not to the Emperor. The divided cabinet reaches a compromise: It will publish the proclamation, without comment. They would wait to hear from the Russians.

The Japanese war party plants information in its allied press that the proclamation is considered unacceptable and "laughable." Suzuki holds a press conference in mid-afternoon on July 28 to clarify the government's position. He tells the press that the government sees the proclamation as a rehash of the Cairo Declaration, and not of "great importance." He uses the Japanese word *mokusatsu* to say how the Japanese government intends to treat it. The term was meant, Suzuki said in an interview after the war, as the equivalent of "no comment." Instead, the State Department deliberately misinterprets it to mean "ignore," and the American press prints that the Japanese have turned down the surrender ultimatum.

Scene 14. No Turning Back

Events now move quickly, as our drama rushes towards its now inevitable, tragic conclusion. On Aug. 1, the last day of the Potsdam Conference, an urgent cable makes its way from Tokyo to Ambassador Sato in Moscow:

> Efforts will be made to gather opinions from the various quarters regarding definite terms [of surrender]. (For this, it is our intention to make the Potsdam Three-Power Declaration the basis of the study regarding these terms). . . .

Sato is urged to convince the Russians to accept Prince Konoye as a special envoy from the Emperor. This cable is also intercepted, and is sent directly to Byrnes and Truman. It is ignored, as the others were ignored. Japan, clearly already defeated, is about to be atomic bombed.

Scene 15. 'The Greatest Event In History'

On Aug. 6, at 2:45 a.m. in the Pacific, as Jimmy Byrnes and his puppet, President Truman, sail home on the *USS Augusta,* from their "triumph" at Potsdam, the B-29 bomber *Enola Gay* takes off, headed for the military-civilian target city of Hiroshima, with the atom bomb in its bomb bay. At a little after 9:09 a.m., it arrives at the target. Six minutes later, it drops the world's first atomic weapon on the unsuspecting and mostly civilian population of Hiroshima. One hundred thousand people are killed instantly. Another 100,000 are to die from radiation and related causes.

Cables fly across the Pacific, and then the continent, and to the War Department. Finally, the message confirming the bombing reaches the *USS Augusta.* It is handed to President Truman, who is eating with the crew, by Capt. Frank Graham, an officer in the ship's map room. According to the report in the ship's newspaper, Truman becomes highly excited, flashing his famous monkey-like grin. "This is the greatest thing in history," an insane President proclaims.

Another message follows quickly, this one directly from Stimson. It repeats and confirms the information in the first.

Truman can no longer contain himself, and he jumps up from his seat, and with both messages in hand, this little man strides triumphantly to Jimmy Byrnes. Truman now asks for quiet. The crew, some of them alarmed by the President's behavior, stop all conversation. I have some good news to tell all of you, Truman says. I have just been informed that a powerful new bomb, with an explosive force of more than 20,000 tons of TNT, has been dropped on Japan. Everyone rises and there is loud and sustained applause and cheering.

Truman, with Byrnes trailing, and still with the messages clutched in his hand, storms into the officers' ward room. "Keep your seats gentleman," he says. "We have just dropped a bomb on Japan which has more power than 20,000 tons of TNT. It was an overwhelming success. We won the gamble!" The news is greeted by cheering and applause, as the President smiles and nods, and his puppetmaster Byrnes looks on.

Americans are hearing a pre-recorded broadcast message

A Japanese soldier bears silent witness to the aftereffects of the atomic bomb blast in Hiroshima.

"[We have dropped] an atomic bomb. It is a harnessing of the basic power of the universe. The force from which the Sun draws its power has been loosed against those who brought war to the Far East. . . . If they do not accept our terms now, they may expect a rain of ruin from the air, the like of which has never been seen on this Earth."

—President Truman, in a recorded broadcast to the American people.

from the President, drafted by Byrnes; it sounds like—and is—a message from a "Beast-Man:"

> [We have dropped] an atomic bomb. It is a harnessing of the basic power of the universe. The force from which the Sun draws its power has been loosed against those who brought war to the Far East. . . . If they do not accept our terms now, they may expect a rain of ruin from the air, the like of which has never been seen on this Earth.

The order is now signed for a second atomic bombing using "Fat Man," the last available bomb, the one named for Winston Churchill.

Scene 16. The Rule of the Beast-Men

In Japan, the cabinet remains stalemated. A message finally arrives from Moscow; on Aug. 8, the Soviet Union declares war on Japan.

That same day, the *USS Augusta* docks in Norfolk, and within hours, Truman and Byrnes are back in Washington. "Hamlet" Stimson is ready for another impotent effort; he asks the President to delay the use of the next bomb to give the Japanese a chance to surrender. He suggests that maybe the hand of the Emperor should be strengthened by communicating some kind of language through informal channels about a desire to keep the Imperial family in place. The President is too far gone in his reverie on the bomb to even hear of such ideas.

Meanwhile, in Tokyo, events are coming to a head: Prime Minister Suzuki tells the Japanese cabinet that there is now no alternative but to accept the Potsdam Declaration and hope for the best terms. It is the early morning of Aug. 9. According to Toland, one minute after Suzuki makes his statement, the B-29 *Bock's Car* drops "Fat-Man" on the unsuspecting, mostly civilian population of Nagasaki. The total of dead or dying and deformed is 100,000.

Truman receives news of the second bombing with crazed glee. The war is over, he exclaims. The war could have ended months ago, but Byrnes and his puppet President had prolonged it to drop these bombs.

There are no more bombs left. According to official documents in the Truman Library, Byrnes now authorizes, and Truman approves, a communication to the Japanese about the Emperor: the Imperial family will be retained, subject to the initial command of the Supreme Allied Commander, Gen. Douglas MacArthur.

The deadlock in the Japanese cabinet continues. Debate rages on into the early morning of Aug. 10. Finally, at around 3:00 a.m., the Emperor has had enough. He has been trying to end the war for almost a year, and even now he has received nothing from the atomic warriors in Washington that might help him get the job done. The Emperor announces that he has personally declared an end to the war.

The message is communicated to Washington. Only then, is the message, that the Imperial family will be retained, sent to Tokyo.

On Aug. 14, the President announces to the nation that the Japanese have accepted "unconditional surrender." The Japanese had surrendered on terms that would have been acceptable five months ago or more. Hundreds of thousands of Japanese have died in that time, along with tens of thousands of Americans and Allied forces. All so that the bombs could be dropped.

Writes Potsdam chronicler Mee, "No one likes or wants to confront the fact—but it is clear from the events and conversations during the Potsdam Conference that the use of the atomic bomb against Hiroshima and Nagasaki was wanton murder."

Admiral Leahy is sickened by what has happened. He concludes that "the Americans had adopted the ethical standard common to the barbarians of the Dark Ages." For Leahy and others of compassion and sanity, America's leadership and their Anglo co-conspirators, had become Beast-Men, comparable in their cold calculations to a Hitler. These people were now poised to terrorize the world, perhaps even to launch an atomic crusade against their Soviet "allies" in the near future.

Among the ashes and the dead and dying of Hiroshima and Nagasaki, lay also the hopes and dreams of Franklin Roosevelt for a bright future, based on peace and development and cooperation, replaced by a nightmare of nuclear-doomsday terror. Our tragedy began with little steps, until those steps became a stampede down a pathway towards insanity; it continues in modified form to this day.

As we see events unfold in Washington today, with a new band of utopian atomic warriors manipulating a stupid and insane President, let us dedicate ourselves to not repeat this tragedy. Let us stop it now, by getting rid of our new utopian menace, Dick Cheney and his neo-con cabal, before they kill us all in their folly. It is time to end this continuing tragedy—and for the reign of Beast-Men to come to an end.

L. Wolfe, a long-time associate of Lyndon H. LaRouche, is an editor of The New Federalist *newspaper and has written extensively about Franklin Roosevelt.*

Notes

1. The "schoolbook" explanation for the dropping of two atomic bombs has been that it was necessary to shorten the Pacific War, and that it saved a million American lives in a possible invasion of Japan. This was the "official" explanation of the Truman government, and has been repeated dutifully ever since. Of late, this view has come into question, for example, see Gar Alperovitz, *The Decision to Use the Atomic Bomb* (New York: Vintage, 1996).
2. See Robert Baker, "Henry Wallace Would Never Have Dropped the Bomb," *Executive Intelligence Review,* Vol. 30, No. 43, Nov. 7, 2003.
3. For more on these factions, see Lyndon LaRouche et al., *Children of Satan* (Leesburg, Va.: LaRouche PAC, 2004)
4. See Lyndon LaRouche et al., *ibid;* also Edward Spannaus, "Shock and Awe: Terror Bombing from Wells and Russell to Cheney," *EIR,* Vol. 20, No. 42, Oct. 31, 2003.
5. The Jewish Rescue Committee and Joint Distribution Committee helped get many Jews out of harm's way in Europe. Funding for their operations came from many Wall Street investment banks, and those interests provided lists of those they wanted rescued.
6. Bela Szilard, ed., *Genius in the Shadows: A Biography of Leo Szilard* (New York: Scribners, 1992).
7. As recounted by Edward Teller in a Jan. 14, 1997 speech to an event sponsored by the American Defense Preparedness Association.
8. Sachs is typical of those powerful bankers who exert their power in subtle, if important ways. He was a representative of various oligarchical energy interests (coal, oil, and later uranium). Sources for his biographical material, as well as his role as the bomb's "godfather," include Geoffrey Hellman, "A Reporter at Large: The Contemporaneous Memoranda of Dr. Sachs," *The New Yorker,* Dec. 1, 1945; and Burns, James MacGregor, *Roosevelt: The Soldier of Freedom,* (New York: Harcourt, Brace & Jovanovich, 1970); a 1994 e-mail on the www.freedomdomain.com website discussing Sachs and Société Générale.
9. Schiff managed the personal accounts of King Edward VII. He is the putative author of the Federal Reserve Act of 1913.
10. Lehman Bros. was typical of what FDR liked to call a "Tory" bank, from the point it was established in Montgomery, Ala. in the 1850s, and served British agent and New York banker August Belmont, as a funding conduit for the British-sponsored Confederate insurrection.
11. In reality, Sachs was merely an acquaintance of FDR, to whom FDR was courteous, as much because they both resided in New York, as anything else.
12. Edward Teller, *op. cit.*
13. *Ibid.*
14. Ronald Clark, *Einstein: The Life and Times* (New York: World Publishing, 1971).
15. Letters made available to this author from the Sachs file at the Franklin D. Roosevelt Library, Hyde Park, N.Y.
16. The account of the meeting with FDR comes from various sources, including James MacGregor Burns, *op cit.*
17. James MacGregor Burns, *op. cit;* Edward Teller, *op cit.*
18. Winston Churchill, *The Second World War* (Boston, 1953). His intent, though masked in hyperbolic language, is nonetheless clear.
19. See Warren Kimball, ed., *Churchill & Roosevelt: The Complete Correspondence,* Vols. 1-3 (Princeton, N.J.: Princeton University Press, 1984).
20. See N. Blaedel, *Harmony and Unity: The Life and Times of Niels Bohr* (Madison, Wisc.: Science Tech, 1988). Heisenberg is widely believed to have deliberately sabotaged the German program.
21. Hopkins, as FDR's most trusted aide, is clearly the only person who could have carried out this sensitive mission.
22. N. Blaedel, N., *op. cit.*
23. *Ibid.* Bohr believes that the meeting had in some way been manipulated to occur by British intelligence, who reportedly had assets in both the U.S. and Russian bomb projects.
24. James MacGregor Burns, *op. cit.*
25. In retrospect, the young doctor should not have been surprised—such conditions are common in what is called post-polio syndrome. FDR had suffered from polio since the mid 1920s.
26. Lyndon LaRouche has correctly pointed out that the removal of Wallace, who was loyal to FDR's intent and policies, meant, that with Roosevelt's death, those policies could be quickly ended; the world of a President Wallace would have been quite a different one from that of a President Truman. See Robert Baker, *op. cit.*
27. James MacGregor Burns, *op. cit;* Warren Kimball, *op. cit.*
28. See Henry Stimson, and McGeorge Bundy, *On Active Service in Peace and War* (New York: William Sloane Associates, 1948). While Stimson is self-serving in his reporting, his doubts about the atomic bombing are supported by other contemporary accounts and sources. See also Charles Mee, Jr., *Meeting at Potsdam* (New York: Dell, 1975).
29. Logs, FDR Library, Hyde Park, N.Y.
30. The 1941 peace overtures are discussed in John Toland, *The Rising Sun,* Vols. 1, 2 (New York: Random House, 1970). The back-channel discussion were recounted and documented by former OSS agent Max Corvo in discussions with this news service; the existence of this back channel is also amply documented by Martin Quigley, *Peace Without Hiroshima* (New York: Madison Books, 1991).
31. James MacGregor Burns, *op. cit.* FDR reportedly repeated this formulation to several people, but there is no record that he ever gives explicit instructions to Stimson about his intent.
32. Max Corvo, *op. cit.;* Martin Quigley, *op. cit.*
33. Max Corvo, *op. cit.*
34. Niels Bohr, *op. cit.;* James MacGregor Burns, *op. cit.*
35. Henry L. Stimson and McGeorge Bundy, *op. cit.*
36. Warren Kimball, *op. cit.*
37. Charles Mee, Jr. *op. cit.*
38. According to contemporary news accounts, Byrnes had sufficient delegate strength to block a Wallace renomination and to have himself placed on the ticket at the 1944 Democratic Convention. He had behind him key anti-FDR party bosses, including former FDR ally Jim Farley, as well the so-called "Dixiecrat" bloc of southern delegates. It was speculated at the time that FDR reluctantly pushed Wallace off the ticket, and had the Vice Presidential nomination offered to the nonentity Truman to block the ambitious Byrnes, whom he never wanted to see in the White House. Byrnes felt that he had been double-crossed by FDR. See, James F. Byrnes, *All in One Lifetime* (New York: Harper Bros., 1958).
39. James F. Byrnes, *Speaking Frankly* (Kingsport, Tenn.: Kingsport Press, 1947).
40. Charles Mee, Jr., *op. cit.* Byrnes knew that no such surrender could happen without a signal about keeping the Emperor. He therefore advised the President to make no such explicit or even implicit offer, stating that FDR had been unequivocal on "unconditional surrender," and that any change would actually delay any cessation of hostilities by showing weakness.
41. James F. Byrnes, *op. cit.*
42. *Ibid.*
43. Charles Mee, Jr., *op. cit.* In his own memoirs, Byrnes makes no mention of the real intent to drop the bomb on Japan for its effect on the Russians.
44. Henry Stimson and McGeorge Bundy, *op. cit.*
45. Charles Mee, Jr., *op. cit.*
46. John Toland, *op. cit.* Unless otherwise cited, the source for the accounts of Japanese deliberations is Toland's book.
47. Charles Mee, Jr., *op. cit.*
48. *Ibid.* Unless otherwise cited, the source for descriptions and discussions of Truman's and others' actions at or on the way to and back from Potsdam, is from Charles Mee, Jr.'s book.
49. This is actually done by Truman on July 24, when, after a session of the conference, he walks over to Stalin on the other side of the table, and tells him in vague terms that the United States has tested a new kind of bomb, that it works, and is available for use. Stalin offered his congratulations. See James F. Byrnes, *op. cit.*
50. For those with a strong stomach, see Winston Churchill, *op. cit.*
51. Truman, in remarks to Department of State historians in January 1956, admitted that he had full knowledge of the Japanese communiqués, prior to making the decision to drop the bomb.
52. Lyndon LaRouche et al., *op. cit.*
53. Charles Mee, Jr., *op. cit.*

A FIRST-HAND REPORT

The Manhattan Project As a Crash Science-Driver Program

by Robert J. Moon

A moral decision by American scientists to slow production of plutonium is one of the untold secrets of the Manhattan Project, revealed here for the first time.

Robert J. Moon

The half-assembled Chicago cyclotron magnet. Dr. Moon machined the magnet himself in 1936.

Tom Szymecko

University of Chicago physicist and physical chemist Dr. Robert J. Moon in 1987. The work of this modest man in designing and building the Chicago cyclotron (left) and discovering the neutron interaction with graphite made the Manhattan Project possible.

I think the best thing to do to start the talk would be to discuss what education really is all about. It is not a molding process, to be sure (although you might think it, if you see some of the programs that go on in our schools—particularly elementary schools). But I think this will help you understand how the process goes of all getting together. I'm going to start with the university, and define a university—and we hope to get one started here, by the way, an international university with a set-up here in this area somewhere, probably Virginia, which is right adjacent to this great state of Maryland, and not too far from the office here.[1]

A university, first of all, is a community of scholars. Now what does that mean? Well, it means you've got to communicate. Well, we're communicating here, aren't we? At least we have informal and formal communication. So that's what a university is—it's a community of scholars. And a scholar is a person who is engaged in looking at the frontiers of knowledge, whether it be in the humanities, or the social sciences, or the physical sciences, or biological sciences. Those are the four divisions, and around that you have the applied schools, generally, such as the medical school, the law school, and the school of social service, and music, the appli-

EDITOR'S NOTE: *University of Chicago physicist and physical chemist Dr. Robert J. Moon (1911-1989) was a leader in the Manhattan Project, the secret American program to develop an atomic weapon during World War II.*

Moon made this presentation to a meeting of supporters of Lyndon H. LaRouche in Baltimore on Dec. 13, 1986. At the time, LaRouche had called for a crash mobilization of American scientists to find a cure for AIDS. Moon told the story of the Manhattan Project as an example of what a crash mobilization of science would look like. Former LaRouche associate Warren Hamerman spoke at the same meeting on LaRouche's AIDS program proposal.

Note that the transcript is complete; ellipses indicate only pauses in speech.

cation of music. All these things are hooked together in a unity—that's what a university is. So it has to be an ongoing sort of thing, everyday. And of course, this means that you share ideas, whenever they come up.

I think one of the greatest things about a university is the informal sharing that goes on—where you're just sitting at a table, maybe having lunch or something. We have a good faculty club at the University of Chicago, so we share ideas, and you'd be surprised how sharing ideas with somebody. . . . I have a daughter in art history, but that doesn't mean that I can speak the language of the humanities, nor can they speak my language. So we have a barrier, and that barrier has to be broken. And that barrier is to get down to a language you all understand. This way, you go ahead—this is helpful in generating new ideas. Ideas seem to come out with a —they seem to be God-given in the first place. If you look over the history of science, you'll see that the scientist always finds God in the center of things.

On a Good Exam, the Student Makes 20%

So, what you have, I think we all have intellectual, spiritual, and moral powers that are God-given, too, But then, in each of these powers, the God-given powers, we have different talents. And I think education should be about trying to have a person find out who he is. I would often ask my class that: "Who are you?" And I don't want to know their names—see how far they've gotten along.

And so, if you write an examination—a good examination is one which a student would make, maybe, 20 percent on. But most examinations, you grade them — if you're over 90, you're supposed to be quite a person. But, the examination may be in the wrong direction, because it hasn't helped that person to find out just exactly who he is. And that's so important, in education. And what you've got to do, then, is follow that student, and see if he's remiss in, say, two or three places in the spectrum of the exam—does he blossom out in those fields. And that education, then, makes the person realize just exactly who he is, what talents he has, and how he can expand and go into other fields.

I know Kevin, here, quite well, and, to have kids—Kevin is not seven years old now. But we had kids in the class at the summer camp—and the seven year-olds were doing about as well as the seventeen year-olds. But the point was, they were doing the work. We took the experiments of Ampère, and one of Faraday, and just had them do the experiments; had them build the equipment, instead of buying it. So we tried to put them back in the same—like Warren's doing now—try and put people, in the present day . . . what equipment we had and what to create beyond that in order to understand AIDS, for example. These kids wound their coils, and made their measurements and whatnot, and they discovered. . . . They did the six experiments of Ampère and one on induction, which is Faraday's Law. And that's what all of our distribution of electricity, which is one of the highest forms of energy we know, because it is so easy—it doesn't consume oxygen when we use it in the room, and it produces light, and we can go from high voltage to low voltage or vice versa—we don't have to worry about one of the things that we have in physics with chemical reactions, which has to do with the increase of entropy—and, of course we know that this is not the Universe is running down, but it is being supplied.

Well, anyway, I start at that point because, if we know what education is, then we probably can see how to go on with the crash program. You may have the same experience that I had. I come from . . . see, I'm just a hillbilly to begin with. I come from the Ozarks down in Springfield, Missouri, and we have five colleges in town. But that doesn't necessarily mean that you have everything that's on God's green earth there. You just have an assortment of it.

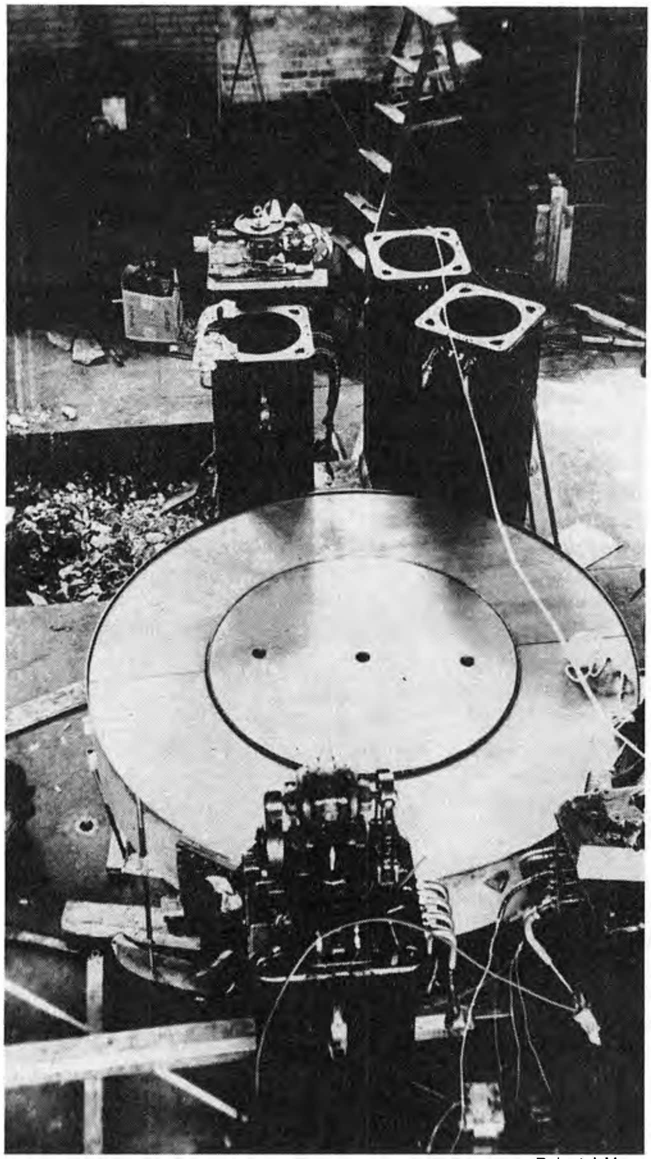
Love and the Manhattan Project

So, you read everything that you can possibly get your hands on, in the things that you're interested in, and then you find that you've got to go elsewhere. So, that was the reason why, at the age of 19, I came to the University of Chicago, because I had been reading papers from some people there—Professor [William Draper] Harkins in Physical Chemistry had written quite a bit on nuclear structure. Well, that's been my field—it's been nuclear structure for some time, now. To give you some idea, when I was born, my mother held me out the window to show me Halley's comet. So, you get some idea. (The comet was here last year, and the group in Leesburg made it perfectly plain to me that it was, by surprising me with four birthday parties that had a crescendo that went up to the [inaudible] finale, which went into the early morning of the next day—with large numbers of people present, besides [laughter]. That's what this group does. I mean it cares for everybody, of course. It takes note of everything, and ideas are shared.

Well, that's the important thing that happened in the Manhattan Project. You might realize that, in the 1930s. . . .

Philip Ulanowsky/EIRNS

Dr. Moon working with youth at summer camp in 1986. "These kids wound their coils, and made their measurements and whatnot. . . . They did the six experiments of Ampère and one on induction, which is Faraday's Law."



Robert J. Moon

The core of the Chicago cyclotron under assembly in 1936. Moon's cyclotron was the source of neutrons for the first American verification of uranium fission, and subsequently an indispensable tool for designing the world's first nuclear pile at Chicago.

You go to the university. . . I have an experiment I want to do on fusion energy. I have the experimental idea. I want to build this particular piece of equipment. That's what you have to do; you have to be creative. See, that's one of the things, in God's image, which you have. We create. We don't create the universe, but we create things. We create simple things like this, for example. Or this painting that Pasteur did of his father at 17? [Hamerman: He was 13.] Thirteen—well, that's creativity, you see. The creativity within, it came out. And that's what we want to do, is get this creativity to come out.

And, what's the other thing, that happens, that God gives us all? And that's the love—to love one another. In other words, we just don't do it for ourselves; we do it for the whole of humanity. And that's the basis on which all the people I've ever run into in this group . . . they're all concerned with the world—lifting humanity up, humanity as a whole. Otherwise, you would just draw a boundary around yourselves, or around your group, or around your city, and say, "This is going to be AIDS-free, and forget about the rest of the world." Then you'd probably go under too, with the rest of the world.

But anyway, when you find that the Physics Department [under Arthur Compton—ed.] at a great university says there's nothing to be gained in nuclear energy—that the energy is in the nucleus, but you'll never get it out. Well, a couple of years later—after he'd gotten there—the neutron was discovered, and then Fermi changed his [Compton's] mind. He started working with neutrons. And see, a neutron is really a newcomer, although Harkins had predicted it in 1917.

Building the Cyclotron

So, right in the middle of the Depression, we knew that in order to have a lot of neutrons, you had to build a high-energy machine. Because, a gram of radium—a neutron source—we'd take a gram of radium and put beryllium around it, and that produces neutrons. The alpha particles hit the beryllium and produce neutrons. And these neutrons come out. And if I have a block of paraffin, a large block of paraffin. [draws on board] I have a neutron source here, the radium-beryllium here, and then a block of paraffin here. I don't see anything coming up here—no ionization. But on the other side, I see protons coming out. And they're coming out with high velocity. They ionize the air, and you can measure that ionization.

Well, that was discovered in 1930. Now, it took two years for the mind to turn around, to realize what had happened. Any of you played billiards? All right, what happens when one ball of a given mass hits another ball of a given mass that's at rest? What happens?

[Voice: It takes off.]

All right, there you are. Well, that's what happens to the neutron. It has roughly the mass of the proton in the paraffin—see paraffin has a lot of hydrogen in it. It hits it and out it goes. So it took two years for—now if you were a good billiards player I suppose you could do it—would have seen that right away. But it took two years for the scientists to understand what had happened. So, that right away said, you've got to have more neutrons. So we—I had to give up making some of the equipment I was making. So, we decided to make the best cyclotron in the world, which we succeeded in doing—right in the middle of the Great Depression. And to keep up today one has to have—before they can turn around the corner they probably have to have all kinds of devices with them that are expensive, in order to get any place.

But, at any rate, we had pure iron. Baltimore is really responsible for a lot of that. There is one company here—see if any of you know it. Do you know the company that makes the pure steel here? [Various guesses from the audience].

No, we wrote to all these companies to get the pure steel. Did you ever hear of Armco? Isn't it located here? Well, they could get—instead of what they call low metaloid steel—you could get that, or you could . . .

Armco finally said, "Yes, we could get you pure iron." And, as a result of getting pure iron, we could make a magnet. The magnet weighed—the iron in the magnet weighed 50 tons, and the coils weighed 15 tons—15 tons of copper, roughly, and 50 tons of pure iron. And we set up a mull and measured it—we took samples of their steel and made our mull, and we went on further to design the cyclotron.

So we had the cyclotron. That was very interesting, because we knew that we could go up to, probably, 500 million volts. Actually, it was designed to go to about 20. But we knew that we could do it, if we could enlarge it. And, well, maybe I shouldn't go into all these details, but anyway it's part of the whole picture of going there. This creativity has to come in, and the creativity involves many people. You put things together—for example, the rectifier tube for the high-voltage power supply. WBBM in Chicago, the radio station, gave us their partially used ones, and we had to wind our own transformers, our [inaudible] transformers, to build our final stage, which put out a hundred kilowatts of rf [radio frequency] at about 10 megacycles, about. And of course we had a control power amplifier, so its frequency was fixed. We had control on our . . . well, I'm just showing you how things exist, and you can put them together and make something useful.

We had induction voltage regulators. They say there are some engineers here. Do you know the old induction voltage regulator, any of you, any electrical engineer? Well, it's a rotatable core transformer. It has a tertiary winding on it, which we opened up, and used this as a variable ratio step-up transformer, so we could vary the voltage on our Dee circuit—accelerating electrodes, that means.

Moon Finds the Graphite Moderator

Anyway, we put it all together and we had a good one. We were getting 150 microamps of deuterons, which is quite a large amount of neutrons—because a deuteron is a proton hooked to a neutron. So when this deuteron goes into matter, the proton is stripped off, and so we can study the life of the neutron. And this is where we had what I called the signal pile. It was just this pile that we designed. The neutron would bounce around hitting the carbon atoms, and finally come to rest, and we'd study its lifetime. The reason we studied its lifetime was to get pure carbon. It's a good way to find pure carbon, because, most things stop neutrons, but carbon is one that doesn't.

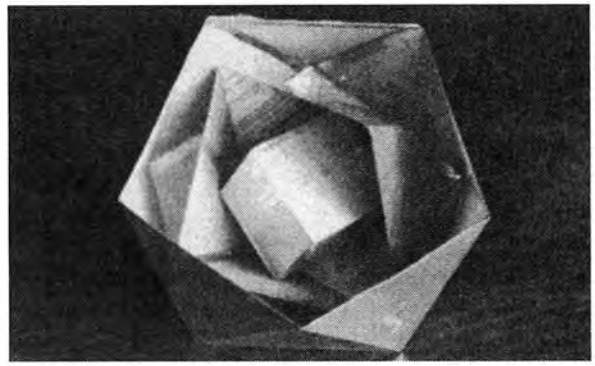


Figure 1
CUTAWAY OF THE MOON MODEL REPRESENTATION OF PALLADIUM
In Moon's nuclear model, protons are positioned at the vertices of four of the Platonic solids (cube, octahedron, icosahedron, and dodecahedron) nested within one another as shown. If closed, you would see only the outer dodecahedron. The total vertices equal 46, the atomic number of palladium.

And so, by finding a source of graphite, this leads to the [Manhattan] Project, now. And the thing that happened was, the physicists had gone off in one direction—Fermi, actually, was awarded the Nobel Prize for something he hadn't done [laughter]. But he'd done a lot of other things. Don't blame Fermi; I'm blaming the Nobel Prize committee. They just picked the wrong [inaudible]. But he'd written quite a bit on the transuranic elements—when you bombard uranium with a neutron. Well, what he was actually seeing, was not that at all. And he was awarded a Nobel Prize for all his work on the transuranic elements.

Stephen Deutch

Arthur Compton (1892-1962)
"You find that the Physics Department at a great university says there's nothing to be gained in nuclear energy—that the energy is in the nucleus, but you'll never get it out."
Later, University of Chicago Physics Department Chairman Compton changed his view. Compton is pictured here in his laboratory at the University of Chicago in 1935.

Turns out that most of the work on the transuranic elements was fission. And this came about because the person—not in physics—there were a couple of people. They were in Germany; they were in chemistry. And they had looked at the chemical properties of what happens when uranium was bombarded with neutrons. And what did they find? They found elements in the middle of the periodic table.

So if you had a big. . . . Well, I don't have the other mate that goes with this [takes up a model of his nuclear structure, Figure 1]. But you can imagine two of these together. (We've gotten into a lot of fun with nuclear structure, creating nuclear structure. I won't go into that, because that'll take too long.) But this represents palladium. This would represent iron [removes the icosahedron from the dodecahedron], and that's where the packing fraction—do you all

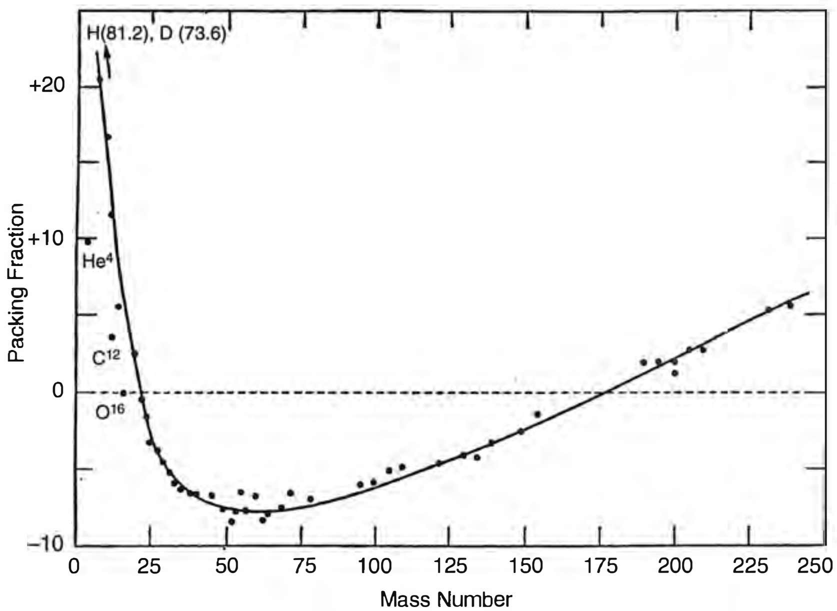


Figure 2
ASTON'S MASS PACKING FRACTION CURVE
The packing fraction shows the relative defect of mass in a nucleus. The mass numbers along the x-axis are the whole numbers closest to the measured atomic weight of the isotope. The most abundant isotope of iron (mass number = 56) represents a minimum on the curve.

Source: Samuel Glasstone, *Sourcebook on Atomic Energy*, 1958

know the packing fraction? Well, let me show you. The packing fraction here (Figure 2) is. . . . You start out here with hydrogen [first point at graph at left side] and you go up here to uranium at the end. And then we have the mass. What's the mass of the hydrogen nucleus. Some of you are chemists. What's the mass of the hydrogen?

[Voice: Simple hydrogen? It's one.]

No it's not one. Have you got your tables? [laughter]

[Voice: Well, I say approximately one. I think it's 1.01846, for some reason.]

Well, no, you're almost there. It's one double-O eight (1.008).

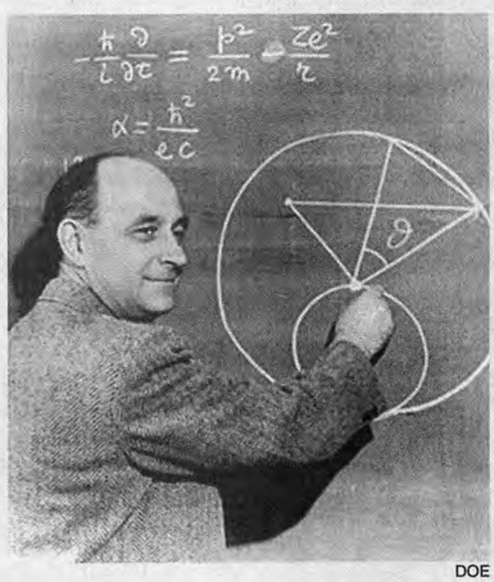
Do you know what that is? Do you know what this mass represents?

Well, if you take this amount of gas—22.4 liters, at standard pressure and temperature, room temperature—standard temperature and pressure (STP). That will have roughly 6.06 times 10^{23} particles in it. So you're dealing with a lot of particles. But if you weigh it, it weighs this many grams. If you weigh that amount of hydrogen, it will weigh that many grams.

But then when you get up to weighing helium, you find that the mass is less than four times this. Because helium is . . . if I draw a proton this way (I'll put a plus sign in it) and this is a neutron (just an open circle—I'll put an N in there). These are our building blocks. And of course, hydrogen is just one proton. And helium will be essentially this kind of arrangement—that's helium [diagram unavailable].

And so you say, well this should be four times this. But it isn't. It's less than that. So a certain amount of mass—there's an excess mass here—that's gone. And that's called the mass packing. In other words, if you look it up in the periodic table, it will look like this [shows graph, Figure 2]. So if you take uranium and break it up, you can go to something in the middle of the periodic table, and you get energy out. That's called fission. This is fission up here [at right side of graph in Figure 2] which you probably all know, and fusion down here [at left side], where we're fusing together four hydrogens to make helium. So, this is the mass packing curve. So, from here [hydrogen] down to here [iron at mass number 56], we could get energy out. And, if these elements are synthesized, then we have to figure out ways that this goes up to here [to right of iron on the table]. It takes energy to do it. And it works out very well.

So this is what we knew. Rutherford had an analysis. They all called it the bible, then, in nuclear physics. And Chadwick was the one who finally discovered the neutron, in 1932, by putting all this information together—maybe he played billiards, I don't know [laughter]. Anyway, we all realized. . . . And the cyclotron had been built ahead of time, so we could get neutrons, so we could work with them. And the thing that had happened, was that Hahn and



Enrico Fermi (1901-1954)
"Fermi, actually, was awarded the Nobel Prize for something he hadn't done. But he'd done a lot of other things. Don't blame Fermi; I'm blaming the Nobel Prize committee."

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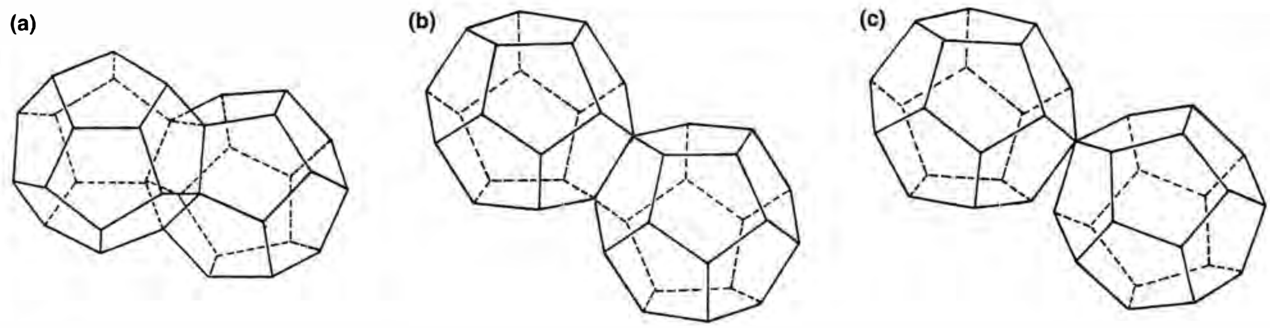


Figure 3
MOON MODEL REPRESENTATION FOR URANIUM FISSION
(a) To go beyond palladium (atomic number 46), which is represented by the completed dodecahedron, an identical dodecahedron joins the first one at a face. When the second dodecahedron is completed, it is seen that six positions on the common dodecahedral face are already occupied. This represents the nucleus of radon (atomic number 86).
(b) To go beyond radon, the twin dodecahedra open up, using a common edge as if it were a hinge.
(c) To create 91-protactanium, the hinge is broken at one end. To create 92-uranium (not shown), the position where the two protons join must be slightly displaced, so that one goes inside the other, creating the instability which permits fission.

Strassmann in Germany, doing the chemistry of it (I'd alluded to that a moment ago), found that these products that were produced by this reaction were not transuranic elements, but were elements in the middle of the periodic table, in this region [points to middle region of packing fraction table, Figure 2]—the thing broke apart.

Moon's Model of Fission

Well, this new model shows it very nicely, because it's just two of these held together. This, when it's completed, would be palladium (Figure 1). And palladium seems to be a building block of the nucleus.

But two of them held together. . . . in order to have an exclusion principle. . . . Say we have only one proton on each vertex. Then a proton—in order to form uranium, you have another one like this (Figure 3). Except, in order to have only one proton (by the exclusion principle) at this vertex here, it has to go inside this one, and this one goes inside the second one [Figure 3(c)].

So, a new process is set about now. You see, this isn't held together very well. So you have the possibility of fission. These two dodecahedrons can fall apart, because they're held together very weakly. And that's the fission of uranium that takes place.

So now, the point that comes about then is, recognizing all this, and recognizing how much energy was available in the fission process, as this separation here. You know we're talking about 250 million electron volts. That's the fission, approximately. An electron volt . . . voltage is potential. So if I raise this above the table here, it has potential energy with respect to the table. And if I let it drop, by the time it hits the table, the potential energy becomes kinetic energy. So, here's the potential, here's the charge. So this, electrically a charge of a certain voltage with respect to this table, which we say is at zero voltage. There's 250 million volts here, and we have an electron up here, and it's attracted by the positive charge down here. It would have 250 million electron volts energy.

Now, that doesn't sound so big, does it? But the best chemical reaction is less than 8 electron volts. So you see we're dealing with something that's way above the chemical realm. So, if you could make a nuclear reaction, then . . . It seemed to be coming at just the right time, because we were running out of oxygen, because—you know why we're running out of oxygen?

[Voice: Photosynthesis. The plant life has to consume it and then give off oxygen.]

Right. So that limits the flow, doesn't it, because that's a solar energy process, isn't it? A photo-chemical process—it depends on the sunlight. So we're limited. Well, if you're in business, you probably realize that. With oxygen, there's a real shortage. See, we're reaching equilibrium, that's the point. We are using up oxygen faster than it's being produced. And we all like cars.

[Voice: we're cutting down trees.]

Yeah, we're cutting down trees; we're cutting down the rain forest now in Brazil, which helps to make the atmospheric potential of about 300 volts per meter. And I mean, that seems to be one of the things that makes cloud formation very possible. Now, I suppose all of you have flown in airplanes? You notice how flat they are at the bottom. They have a certain potential. And there are several layers, depending on the potential of the clouds, and of course that also makes the charge dissipating from one cloud level to another. There is a potential difference between the two at different heights.

But, anyway, with this amount of energy available, the question was then: Since Hahn and Strassman had showed that, if you were producing the elements in the middle of the periodic table, that this energy could possibly be achieved for beneficial use of mankind, if we were able to produce neutrons. The neutrons come out at very high velocity, generally.

Well, if you drive a car, and you come to an intersection, there is one possibility—you can go through it very slowly. Do you think you will be hit? It's [the risk] increased isn't it?

[Voice: You've got to get in the intersection and get the heck out [laughter]. That's where 90 percent of the accidents occur. Right in the intersection.]

Yes. Well, now, the neutron that comes out with such a high energy goes through pretty fast. So it comes up to uranium and goes right through it. It goes right through the nucleus. So, see, with uranium-235, for example, you have to be going very slowly. So you have to slow it down; you need a moderator. Then, when it gets into the nucleus, it causes the nucleus to get all excited. And the nucleus—as you see, if you have a nucleus like this, if it gets too excited, it's going to fall apart. We knew this was happening, and so we had to have a moderator, and, the three moderators were beryllium, which now we've made in metal, but at that time, there was no beryllium. I've got a beautiful piece of beryllium, ought to bring it down—it's so light and strong—it's beautiful. And then, the other thing is, what are you going to do—see, you haven't got heavy water; you haven't got beryllium. Then you look for the next, and there is only one other, and that's carbon—that's graphite. And if you are in an area where they are making steel—you know how to make graphite?

[Voice: They compress it.]

They compress it. The graphite's rather thick, you know. You compress it, and then you heat it up by passing a high current through it. And you have a great big pile of this, what are called "centering." You've seen graphite blocks, and they're pretty strong, aren't they? Well, we found, we had to use the cyclotron for this. We found that the graphite that was in the center of these huge stacks—4 by 4 inches by 4 feet long—used for making crucible steel. Those were very pure that were in the center. All the impurities had diffused outward as a result of the heat. So we always had very pure carbon.

But we always had people around . . . and it's good to have them around. And they say—maybe I shouldn't mention the name, but maybe I should: Hans Bethe. He always liked to tell you the cyclotron won't go to more than 10 million volts energy, if that. And we knew at the time we could go to 500 million, if we would be able to build it that size. So he was very much concerned that—he said the reactor wouldn't work. If you'd stack it right—you can make these calculations of how much graphite you'd need to slow it down to where it would be captured. So you have the number that you will lose, and the number that will stay in.

Now, if you have a generation of a family, there's not much to do. There are two people involved, here. But now we are talking about a single neutron, produced by a double process. But, nevertheless, we talk about the generations of neutrons, because we knew how long a generation would last in the reactor. So if you have two coming out at fission, which is roughly what there are, around two—except for plutonium, we found, is three. And if you lose one, then you are just on the verge of it not going, see. So it's the same way—generations of the family. If you only produce one child—two people may produce one child—the family dies out. It's the same with the nuclear reaction. They die out in the reactor. So, we had to produce slightly more than one, and then the reactor would go. But it had also another thing—there is also a delay period in the emission of neutrons. That is, it's delayed a little after the fission has taken place. These delayed neutrons mean the pile, the reactor, is controllable.

The Physics Department Had Given Up

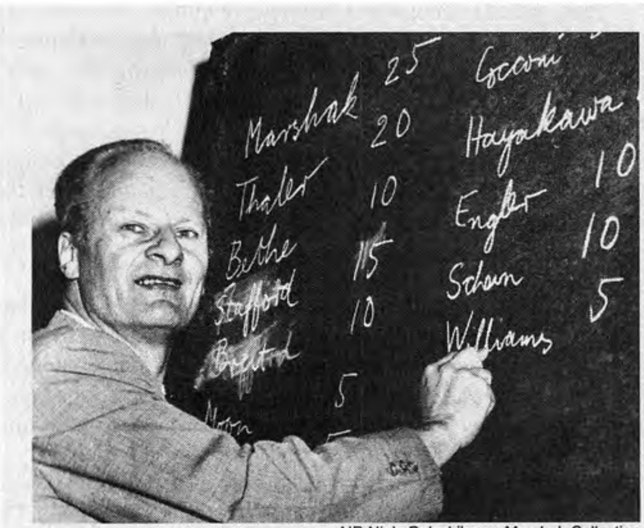
So we all get together, you see. First guys got together with other chaps from the Physical Chemistry Department. Von Grosse, Aristide von Grosse, had gone over to Germany, and had seen this, talked to these chemists, and they said, "Look, this is not making transuranic elements. It's splitting apart."

So then we had faculty meetings. The faculty all got together in Physical Chemistry. We talked every day about it. The Physics Department had given up. So we had to talk among ourselves. So right there you had the beginning of the thing. Then the physicists began coming in, and so then, as the conversation grew, at the Faculty Club, in the departments, we realized that we should do all these experiments.

We did, and in six months we proved that what Otto Hahn and Leo Strassman had found in Germany was true. And then the scientific community says, "We don't publish it." The government didn't impose that. We did it. We asked the question: "Was the world ready for this, spiritually and morally?" was the question. That was what we asked. And all through the project, we always had that spiritual and moral question up there. And that was a very cohesive thing in the whole group.

So we stopped publishing. And finally, the reactor that was not supposed to react—we were supposed to have the air pumped out, and we had a cubical balloon made by Firestone, and they assured us it wouldn't fly—they thought it was a dirigible that we were making [laughter].

So we were stacking, we were building this graphite pile, which was quite big—we were building this enclosure which we would pump out the air; you see, it had to



AIP Niels Bohr Library, Marshak Collection

Hans Bethe (1906-2005)
"He always liked to tell you the cyclotron won't go to more than 10 million volts energy, if that. And we knew at the time we could go to 500 million, if we would be able to build it that size."

Bethe is pictured during the Manhattan project. Moon's name appears at lower left.

Stuart Lewis/EIRNS

Dr. Erich Bagge (l) was Werner Heisenberg's chief aide in the German World War II program to develop a fission weapon. In this 1985 meeting with Robert Moon (r), Moon told Bagge how he solved the problem of the graphite moderator, which had stumped the efforts of Germany and other nations, including Great Britain, to develop their own atomic bomb.

be vacuum tight. We'd pump out the air, and maybe get it to go. The probabilities of Hans Bethe's would be that it wouldn't go [laughter]. So the thing was—stacking graphite, and then putting uranium around it so as to have a lattice, a regular lattice, so that there was a possibility of some neutrons being slowed down to capture—was the distance to separate those lattice points. So you put in some uranium, graphite. We built a cubical structure, because that was the best you could do, with electrode graphite. And that was all right. We could make it so it was ellipsoidal in shape. We had to, so we could have graphite supporting it on the outside, so as to make it cubical.

Well, anyway, before it was completed, now this is what happened. Before it was completed, 75 percent completed, actually, the reactor started—to go! We were prepared for it. We knew boron would absorb neutrons. So that stopped the reactor from going. In fact, one of the men had an accident. The rope stuck, and he chopped the rope in two with an axe, like you chop off heads, I guess, with a guillotine at parties.

But, anyway, we were able to control that reaction. We ran it up to 2 watts, two or three times. Of course, we were right in the middle of a big city. We were on the West Stands, which was concrete all around it. That was a good shield—it was on a squash court [laughter]. So we ran it up to 200 watts for a microsecond or two, and then we took it apart and took it out to the forest preserve, which was the Argonne Woods—which was where the first encounter of the American Doughboys in France in World War I took place. And that was called the Argonne Forest Preserve for that reason. And so, that's where we got Argonne coming into—the Argonne National Labs.

[Voice: That's where it started?]

Yeah, it started in a forest preserve. We built five reactors there. At the same time—that's another thing—that in this crash program, now, you see, the first time we got this reactor going in the West End—we called it the CP-1, that's Chicago Physics-One.

Roosevelt's Response

That was . . . well, this was the way the crash program begins. You all see—everyone is seeing what has happened against all adversity that it wouldn't happen. *It happened!* And so you go down to . . . In this case, Leo Szilard wrote a letter for Einstein to sign, and a group of us signed, and then took this down to President Roosevelt. And his main comment was: "For heaven's sake, don't get it to Congress. They'll talk it to death." [laughter] So, he said, "I'll tell you what I'll do, I'll give you some money out of my (what do you call it—funds that executives have—what ever you want to call it"). They're the ones who gave us the money for building the first pile, as it was a possibility. And so, once we had it done, then you know what happened. [Voice: It's called a contingency fund]. Yeah, that's the name of it. It's money that you don't have to account for very much.

So, right away, then it became all set up, and it became a two billion dollar project. See, the money came in, because you had the—you had proved it was possible. Then, the next thing to do was to make a lot of the fissionable material. And you had two ways of doing it. One was to—oh, we actually had more than that. Ernest Orlando Lawrence, who . . . I suppose most of you have been to California at some time in your life. Well, Californians, they think big, don't they? So, he'd actually come up with something that was very big. That was the Y-10.

You have to remember, you start everything in parallel. You don't just say, "I'll do this, and if this works then I'll do that . . . if that works then I'll go this way, and so on." Chicago was to head up the plutonium work. When the neutrons hit the uranium-238, the U-238 plus a neutron, then it goes to—the next number is neptunium-239—239, that's the mass of it. And then this goes to plutonium-239 by giving off an electron here. This has different chemical properties, that mix. See, this [uranium-238] is not fissionable at room temperature. The uranium-238 is 99.3 percent of natural uranium, while the uranium-235 is only 7/10 percent of the natural uranium, and it is fissionable. The uranium-235 will fissh with slow neutrons.

And so you have these two, and later, since the war, we had uranium-233, which you make in thorium. And thorium is very abundant in the monazite sand of India. They used to go down there in boats and gather it up. The German sailors would gather up the monazite sand, and what they were really doing was, they were mining thorium. Thorium became very useful in making the mantles for lamps, gaslights, and the like. But anyway, these are the only three fissionable isotopes we had.

Now this is used in the Candu reactor today, where [inaudible] is produced. They load it with thorium (and this produces 235), and you just leave it in there, push it through slowly. And then 235 is what Lawrence made. He used it—in order to separate the 235 from the 238, you have to use a magnetic method. All right, he went ahead with that: Took the silver out of the mint; wound magnets with it, because it was a better conductor than copper,

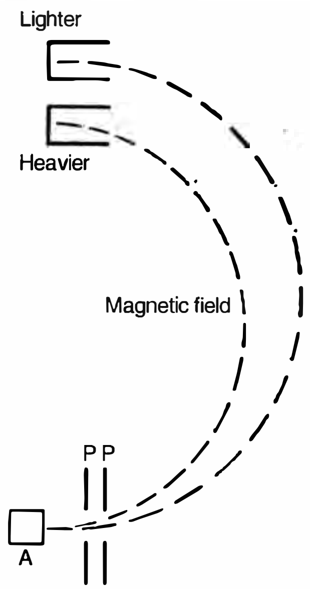


Figure 4
SCHEMATIC OF MAGNETIC SEPARATION METHOD
In the separation of isotopes by the magnetic method, ions of the lighter isotope move on the arc of a circle of slightly larger radius than those of the heavier isotope, when subjected to a magnetic field.

and we were short on copper. We didn't want to put the silver windings on Army equipment [laughter]. So, that was what happened. Since he was thinking in this way, that didn't bother him.

So he set up in Y-10 at Oak Ridge. He set up a whole bunch of electromagnets there that were wound with silver, and was separating, magnetically, in a magnetic field, the 235—uranium-235. Take, this is the U-235 (Figure 4). Now it's not an exact circle. But you have a magnetic field going into the board here. That [inaudible] will go in a circle all over this board here; it will take a certain circular radius to eject the . . . and this is an ion, a positive ion. And the U-238 will take a larger radius. So you've got your 235 coming out here, and your 238 coming out here. These run all during the War, and by the end of the War we had, guess how much U-235? [Audience guesses.] No, they had something like two and-a-half pounds. You should see that set-up down there sometime. The mint hasn't reclaimed the silver yet. They figure it's safe in the winding [laughter]. Better than Fort Knox. And, so it's still there.

But anyway, that's what we had. That was just about enough for a bomb. That's what went off over Hiroshima, you know.

The Plutonium Project

But, anyway, the thing that was happening over at X-10, which was the plutonium—you see, once we had the reactor at Chicago, and we built reactors out in the Argonne, and then we had the reactors down at Oak Ridge, being built. The site was already there. Compton had gone down there and got it going, Arthur Compton, and then we were building Hanford, Washington, and building Los Alamos.

So you see how it's going. Here's Chicago; this is, say, Chicago. I'm just talking now about the plutonium work. And then we had the Argonne Lab, out here. Of course, now we have, we still have Argonne, and we have Batavia, which is the trillion-volt accelerator. And then, down here we had Oak Ridge, where we have several things going on, both diffusion, which is another way to separate these isotopes. Harkins had done that with mercury—Mulliken and Sam Allison both worked on the separation of isotopes by diffusion of mercury vapor through these clay pipes. And you could separate isotopes by means of diffusion—that was one of the—diffusion was going on down there. But that did not come into being until just about five years after the War. We use that now for enriching material.

So we had this started. We didn't know how long any of it would take. We had the magnetic separation. Then we had the plutonium work, which—that was X-10; and this was Y-10; and down here was the diffusion process; and we also had the centrifugal means. That was pretty hard to centrifuge, uranium. It does a good job of mixing, too. And then, we didn't have the lasers at that time, so we couldn't excite different states and make—that is, uranium-235 could be excited in one state and uranium-238 would not be, and you could use the excited atom (it had different properties). So you could separate it that way.

But the plutonium work—because it's chemically so different, you could then separate it chemically. And Glen Seaborg did that right in the attic of Jones's chemical laboratory at the University of Chicago. But one thing, and I think many of us miss these things, because we don't save anything, we don't . . . American scientists have contributed a lot towards the building of science. But we don't have any museums which preserve these things. Well, it turned out, for example, with Case and Michelson, when the plutonium work came to the University—the Physics Building, the Ryerson Lab, which [inaudible] and chemical lab and George Herbert Jones—these were all on the Project.

You Need a 'Conscription of Ideas'

And then we had the Museum of Science and Industry. We took over a large part of that, and we called it the Metallurgical Department—General Groves did. And of course, one of the things that he wanted to do—and this is very important in getting through. General Groves wanted to compartmentalize us. You know, I'd be working on one phase; somebody else would be working on another phase, but, we weren't to talk with each other. And we said, "No! That's not the way you do science. You don't do science that way at all. You've got to share ideas." So, we had three information meetings a week. The top scientists would get together and share ideas. And we listened to everybody, regardless of race, regardless of sex, regardless of religion, and what have you. I mean nothing is divided; we shared ideas, equally.

If a young person has an idea, the professors don't look down on him and say, "Who are you?" They say, "Come out with it." Instead, it was the ideal to come out with their ideas. And that's very important in any project in which you wish to achieve an end—like on AIDS, that Warren has been talking about. You've got to get people together and sharing ideas, independent of who they are, what their rank is. Because, you'd be surprised what good ideas come if you are in the right setting. And that means to be right, you really have to be. . . . We were always talking about the moral implications and spiritual implications on the Manhattan Project.

And this is the thing that would go on in connection with AIDS, I'm sure. You have to be right with the Good Lord. *And you have to love.* This little squirt down here, if he has an idea, you don't turn a cold shoulder on him. You let him come out with it. Because you never know where these ideas are going to come from. Each and every one of you have ideas. I don't know whether you've had them. They come like bright lights, at the most unexpected times—so don't go back to sleep [laughter].

But that's very important as far as the crash program is concerned. You've got to have, what you might call, a conscription of ideas. You have to be able to conscript ideas from people. And that's what you do.

I had gone off the nuclear energy work for about eight months, because they were sinking ships at sea. So I wrote a program real quickly, on what people ought to know in order to repair radars at sea, instead of having to come back to port, and being like a sitting duck, to be sunk by a submarine; or an airplane. So I—it's very interesting, because we took these students through senior college/graduate level work in about seven weeks—a whole year. They really worked. In fact, one class was all girls; they did as well as the boys. But that was one of the things that was quite . . . and of course we had the—they all had the same qualifications coming in. They had to pass; we wrote an exam.

So, from that I went back on the Project then, again. But you see, in time of emergency there may be many aspects come up, as Warren's pointed out many aspects on AIDS. So, bringing together those, the different aspects—he spoke about the biophysics, that deal with light. Now we have lasers which have come into the picture, or sensitivity of the instruments; he mentioned that—the sensitivity of what Dr. [Fritz] Popp is using in his photocells, which are much more sensitive than were in the '30s. The mitogenic radiation came out in the '30s, but now it's known for sure, because of the improvement in the sensitivity of detecting light, single light quanta. And see, you have only about 6 percent efficiency in the old cathodes. Now they've increased that.

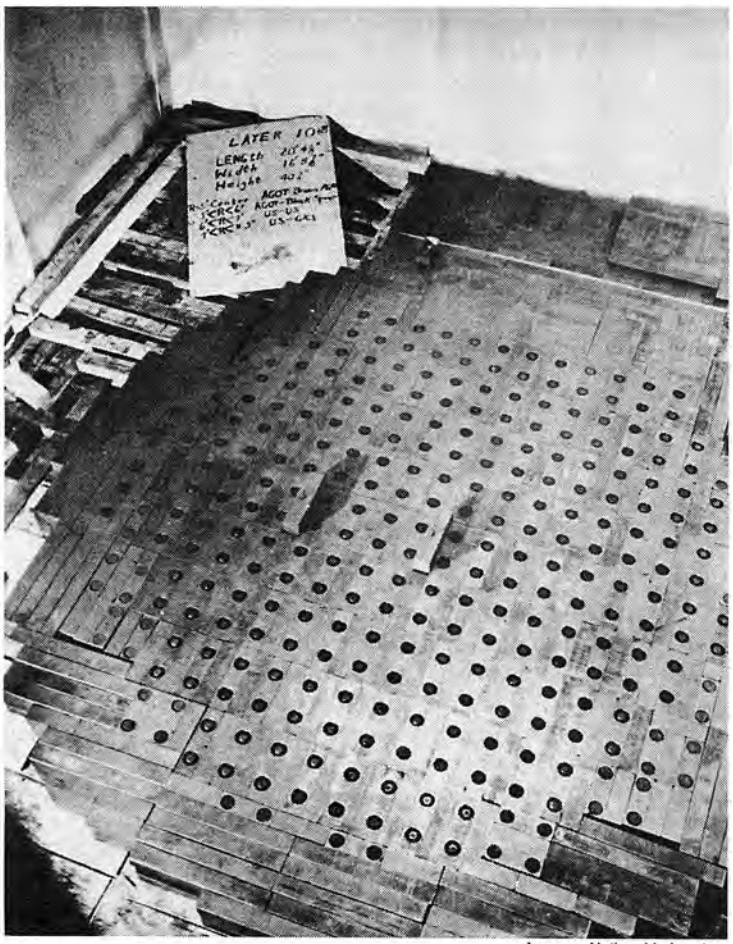
Stopping Plutonium Production

And so, as I say, there is only two-and-a-half pounds produced here. The plutonium we were producing at the time was two-and-a-half pounds. We were producing enough plutonium for a plutonium bomb in three days. We could drop the bomb on Japan every three days.

Well, we didn't want to do that. We had quite a discussion about that, where we actually discussed the spiritual and moral implications of the nuclear age. And that's important; and that's exactly one of the factors that has to be in the AIDS work, too. You always keep that in mind. You've got to keep the *whole* population of the world in mind, not just isolating yourself and saying, "We're not going to have it. Let the rest of the world do what it wants to." We have to *share* these ideas, and find what's at the basis of causing AIDS.

We have to find out how to cure AIDS. I have a suspicion, that since it's systemic, I think we have to use a systemic method to get rid of it. I see one possibility—I don't know whether it'll work, but it's a possibility. For example, we have nuclear magnetic resonance. That is, when the nucleus is in a compound—let's say a nucleus is in a compound, say, and it has a certain resonance. Now, what do I mean by resonance of the nucleus? Now, this is the nucleus [holds up Moon model]—not the extra-nuclear electrons, but the nucleus, a very tiny part of the inner core, the massy part. And if it's in a magnetic field, and you notice it has a spin, that means that this is rotating. And so the axis of rotation—you put it in a magnetic field, it tends to go up; it tends to line up. And then, if you put microwaves in, and you vary the frequency of them, you find that you get to the point where it just wants to spin around like this [shows audience], and that's the nuclear magnetic resonance. That nucleus will spin around, with the microwaves. So you get an absorption of the microwaves at that frequency.

But off here is another atom. If you continue varying the frequency, it has affected the nuclear spin, so that the two will make another thin line. And, so you have a spectrum. (In our *Handbook of Chemistry and Physics* we have a lot of the nuclear magnetic resonance spectra, that are used for calibrations, particularly.) And from that you are able to tell about other molecules—it helps you get molecular structure much better. So maybe in this very complicated DNA or RNA—it's just a possibility—that those frequencies that are unique with the AIDS virus, would be useful in destroying the molecule, by causing the [inaudible] sequence of amino acids (which



Argonne National Laboratory

The Chicago atomic pile produced a nuclear chain reaction on Dec. 2, 1942. A circular pattern of bricks of graphite, the moderator, were stacked up in layers. Alternate layers had holes drilled into them to contain uranium pellets.

it probably is, I don't know) in the virus. A virus is not a living thing; it's a dead thing. But the sequence, it doesn't fit our,. . . But anyway, if you can cause that to fall apart, then that would tend to systemically get rid of the AIDS, and let you start over again. And give the person, maybe. . . . You don't know—you might have had a drought for 15 years in Africa, in East Africa. Ethiopia was very badly hit—emaciated people. And that's one of the, probably it's one of the things that helps to—it's a co-factor with AIDS. And then you have the Kaposi's Sarcoma, which is around the Mediterranean—that seems to be a co-factor. So they are the things that encourage the AIDS to grow.

And, in isolating these various facts . . . you notice everybody is going to Africa—aren't they?—to find different strains, and whatnot. And the ironical part about it all is, we don't have to have a drought anywhere in the world today. But you have Africa, which is . . . they don't like—on the other side you have the Soviets, who would like to get down there. And if the Africans choose anything from the U.S., or from the Free World, they wonder how they will upset the balance with respect to the Soviets. So this is another problem. That's a political problem.

But you really have to identify these problems. And the group here has done this type of thing. They understand what's going on, politically. And that's very important. Just like, well you take the [inaudible] did work in Chicago to the Congress, and then to the President. You have to pick out somebody in government who's reliable. And you have some governments, like in Peru, have been created, that aren't quite reliable now, that aren't the voice of the people. But we do have to have people that know what they are doing, too—they have to be educated. I don't mean educated in a criminal way, but educated in the right way [laughter]. The knowledge of this universe that God has created for us.

[Portion missed because of tape change.]

. . .we just get to the club, and [inaudible] "What're you talking about?"

"Oh, we learned how to make an atomic bomb!"

And he says, "How did you do it?"

And he says, "You just take two halves of—you have half the plutonium over here, and half the critical mass over here, and you just bring it together . . . with a big explosion. [laughter] And the house is gone."

And he ends up telling me about—"Oh well, I needed a new house anyway" [laughter].

So you see that, we were concerned that, after the War was past—once you get a group together, you don't disband it. After the War we knew that we could run back to our labs—that things would get in the same old rut again—so we wanted to determine it, so we called in people, leaders of thought, leaders of education, leaders of business, leaders of banking, leaders of religion, leaders of labor. And it ran up to three days—we'd sit together at the University. Half the day we would share ideas informally, and the other half they were formal. And so this way we got the idea that we were really in the atomic age, and that something had to be done about living in the atomic age, otherwise we'd destroy ourselves. Or be fearful to go anywhere. And this process is going on. We see the same process happening here with AIDS. And I think this kind of thing—will, by keeping everyone informed of what's going on, it prevents us from getting to a path—a place of no return. We can get there. But no matter what we do, we can't get back.

The Fight for Fusion

We recognized, too, we have a place of no return with constructing a fusion reactor. Now, with fusion, we're starting up here, putting hydrogen together to make helium. But if we don't do it in time, *do you know we will never be able to do it? Are you aware of that?* Some of you are aware of it. But it's the same way with AIDS. If we don't get rid of AIDS in time, there's no point in discussing it. So, we know we have to get fusion, and there's not too many years left to get it. But we're almost there. With all those groups working on fusion energy—get together once a year at Princeton. That's where they have a big Tokamak machine, and it looks as though we'll have it.

Of course we can get fusion; we don't have to have high temperatures or high velocities to get it. We could get it at low velocity, you know. You can get it—do you know what a muon is, any of you? Well, it's an electron with a negative charge. It has 200 times the mass of an ordinary electron. Well, you take deuterium, liquid deuterium, and tritium, down near zero [degrees Kelvin], and you shoot a muon in. Do you know fusion will take place? You get 172 fusions with one muon! That's a pretty good catalyst, isn't it? And it's—apparently, if you have the two—deuterium and tritium—they won't go together. The muon comes in, it's negative, and it's moving slowly enough, and it's massive enough, that it destroys their electric field momentarily, and they start moving towards each other. And that is something—it's called "cold" fusion, because it's down near absolute zero. The other is high-temperature fusion.

So that's roughly the thing that I wanted to emphasize here, but we were travelling—it takes a great deal of travelling. I had half my group at Oak Ridge. I had Los Alamos. We had quite a community. Some went out to Hanford. And there was all this movement that had to take place; and we were not permitted to fly in those days. So we had to—well, it was lucky, because we—you run into all kinds of things like this. Now we had to have equipment down at Oak Ridge. We built it in Chicago—not that you couldn't do it at Oak Ridge, but at least we had the talent there to do it at the time. So I'd take my group, and we'd rent a compartment, with two or three others, or four, sometimes. We'd rent a compartment and [fill it] with all this equipment. Then we would sit up with it—take the train from Chicago to Knoxville. If we trusted the Army, they'd take the stuff there. But if we sent it by Army, you'd find, it took two weeks to get there, whereas we could get it there overnight [laughter]. But, these are the problems you run into.

And you are going to run into them with AIDS. Warren isn't sitting at home and waiting for something that comes in on the wires. He's out travelling around, gathering up information. And that's what has to be done—that type of thing. And then we have to start the laboratory work. We're going to have to try these ideas that'll come up. We have to have the sharing of ideas. They have to go on—this has to be an ongoing sort of thing, every day. And this is the way you put the thing together. That's the way you save humanity, I guess. Seems to me that's the only way.

Well, that's about it, I guess [applause].

[We have time for a few questions. Any one have questions? Yes, Mark?]

Mark Nafziger: Is this the same, when you use this graphite core, for this reactor, is it the same thing that was used in Chernobyl?

Moon: You see you don't really need a graphite core, unless you want to make plutonium. Plutonium is fissionable. That means you want to [inaudible]. Do you know how many graphite reactors there are in this country, at the moment? [Voice: One.] That's right. One. Only one. [Voice: In West Virginia. . . .] No, that's it. The one at Hanford, Washington. That's produced all the plutonium we need. The Russians built this reactor . . . see we don't combine civilian production of electrical energy, and civilian production of the isotopes that are used in medicine, metallurgy, and whatnot. What do we do? We separate them. Hanford is where we make the plutonium. The reactor that was designed at Oak Ridge [inaudible] at Argonne—Wally Zinn designed it, and he used a boiling water reactor—he used water as a moderator. Now, the reactor's in the contained vessel. Then, when it gets hot, the water is forced out into another vessel, and the reactor stops, see. That's the moderator. It can't go without the moderator. So, that's the built-in safety. You have either a pressurized boiling water reactor, or just a boiling water reactor, where it's not pressurized. And most of our reactors, all of our reactors are of that nature, in this country.

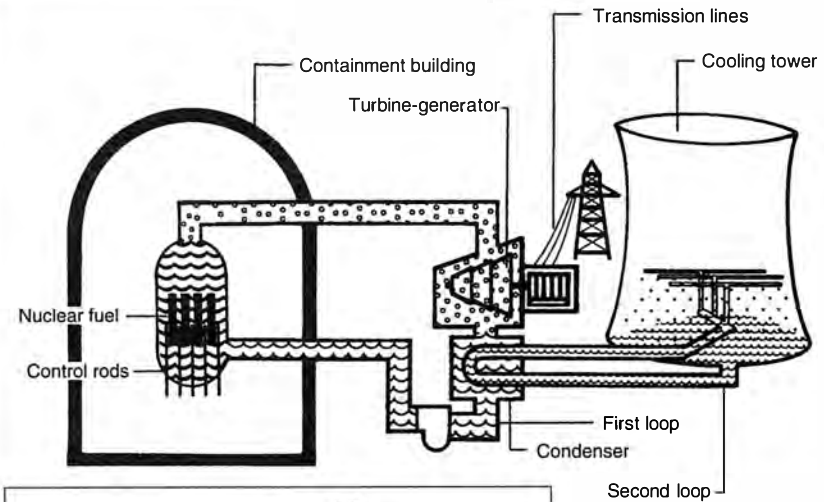
Of course, we have heavy water reactors, which we built for special purposes. That's one of the things we had. The CP-5 reactor was a heavy-water-moderated reactor—the first one they ever built in the world. But that put us way ahead, because we got streams of neutrons out of there, and we could get them any energy. So we were way ahead of anybody else. We could know the neutron cross-sections at any energy, from this CP-5 reactor. And that's the same way with AIDS. You're going to have to do the same thing.

Hamerman: I have a question. In the Manhattan Project, were scientists of the Allies—British, others—involved in labs in their own countries, in the Project, or were they brought over here, or is this just the American scientists involved in the Project?

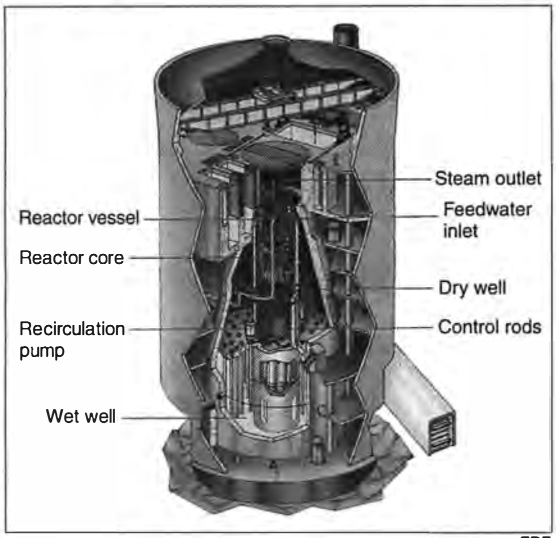
Moon: Well, we had several of the foreign scientists, but they had to be approved by Intelligence. There was one chap, who wasn't approved. I can tell you his name, because he's very proud of being what he is. He came from Italy, but he was a member of the Communist Party, there. So he went to England—couldn't get any information there, what the British were doing—but they were behind, anyway. Then he went to the Chalk River in Canada. And, of course, they were behind us. But he found he couldn't get enough information there. So then he came down to Chicago, in the War. And the first time he came down, he stayed for a week, and invited us all out to parties. And the security told us, "Well, go to the party. Just tell us the kind of questions he asks, but don't give him any information" [laughter].

So you can imagine what the party was like. But that's just the way it was. [laughter] That didn't discourage him, so he decided he had to have six months to do it. So he came down with his leg in a sling. Now, he said he got it skiing. But whether he did or not, he stayed six months in Chicago; and was having these parties and all kinds of means whereby he was trying to get information as to what we were doing. *He never got it.* But the other people who were reliable. . . [Hamerman: What's his name?] Bruno Pontecorvo. He was now, well after the War, as soon as the war—Hiroshima came about—he scooted right back to Italy, picked up his family . . . [Hamerman: Went to the Soviet Union]. And he's there today.

[Voice: In Italy?] No, he's not in Italy, he's in the Soviet Union—Russia. But that's another part—that's one place where the so-called intelligence can be helpful—what do you call it, security, or intelligence? Well, you have to have some bright people.



Department of Energy



EDF

Boiling water reactors (BWR) do not have steam generators. Instead, water in the BWR boils inside the pressure vessel, and the steam is used directly to turn the turbine. About 30 of the U.S. nuclear plants are BWRs. The pressurized water reactors have a third loop that goes from reactor to a steam-generator.

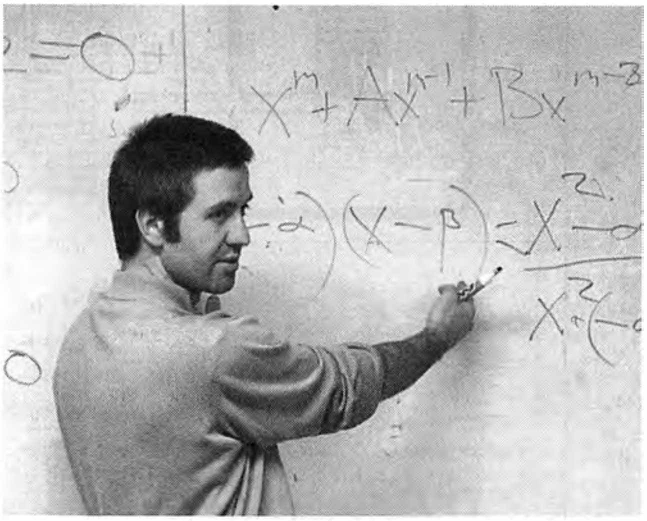
At left is a cutaway view of a boiling water reactor.

Notes

1. LaRouche had proposed the construction of an international university under the auspices of the Schiller Institute. Moon had undertaken design specifications for a physical science laboratory for the university.

How Gauss Defeated Euler's Sophistry

by Michael Kirsch



Robert Detloff

The author at work in a class to the LaRouche Youth Movement in Boston.

Prologue: Bringing the Axioms to the Surface

The paradigm shackling the minds of people today, such as free-trade economics, has similar roots to the mental disease which shackled 18th Century mathematics. Gauss identified and attacked that sophistry in his 1799 paper on the Fundamental Theorem of Algebra. My purpose in writing this report is to take you through the personal discovery I made by working on this paper, so that we, as Gauss did, can not only defeat the sophists of today (those "economic hit men" who threaten to send humanity into a new dark age), but also aid humanity in preventing this pestilence from arising again.

1.0 Who Needs 'i' Anyway?

Find *X*. Why? Was there ever a reason?

$(x-1)(x-2) = x^2-3x+2$. Got it? How fast can you do it? We were taught well to FOIL (First, Outside, Inside, Last): $x^2-6x+8 = (x-2)(x-4)$. I was one of the students who memorized the rules. I loved the puzzles. I went along with all of it, from second grade, winning the speed flash card races, through senior year algebra.

By my final year of high school I became a "senior slacker," and I remember quite distinctly the reaction I had getting into algebra. Trig was okay, constructing triangles, angles, and so on, but getting into algebra began to seem useless! When I did ask questions about algebra, I'd end up more confused, so I just memorized the rules to pass the tests.

Anyway, what did I care? Is school the place where we find enlightenment? Who could be so foolish? School was compulsory only. Halfway through senior year, the math got pretty complicated and equations got harder and harder—more and more rules! I got really frustrated. What was I, a computer? I thought, "Who cares about this crap? It's completely irrelevant to the happiness of anyone!" There was a poster in the back of the room listing 100 professions in the economy, with the level of math required for each. I didn't need to worry. "For what I'm going to do, I won't need math!"

Halfway through the year, the teacher started introducing the number "i" and talking about what the imaginary "i" does. After asking what the heck that was all about, I dropped the class a couple of days later. That was the breaking point. Besides, I had fulfilled the "math requirement" to get my diploma.

After dropping out of school at Loyola University after a semester, to seek enlightenment out East and in Hawaii, I finally returned to school after two years of travel. Then I got my hands on some LaRouche pamphlets; three weeks later, I dropped my classes and acted on principle.

I joined LaRouche because of the political situation and because of the moral necessity to act for justice. But soon I was being shown math symbols and a lot of emphasis was being put on $\sqrt{-1}$! I had sworn off science! I had sworn off mathematics! Now I was again face to face with $\sqrt{-1}$.

1.1 Joining the Project

Gauss wrote this paper in 1799 as a doctoral dissertation to receive his degree. The stated subject is: "New Proof of the Theorem That Every Algebraic Rational Integral Function in One Variable Can Be Resolved into Real Factors of the First or the Second Degree."[1]

Can any function *X* be broken down into real roots?

I hadn't done any algebraic manipulations for four years. Peter, a recovering reductionist and LaRouche Youth Movement member, started showing me the 1799 paper. I didn't get anything out of it. The whole paper seemed like a haze of symbols!

Peter was patient and showed me how to derive sine and cosine functions. "You mean geometry is what generates mathematics?" Peter replied in a typical fashion. "Yes! But that's not what you were taught; you were brainwashed to memorize cult symbols!"

After reading his works, and being in the movement a couple of months, I trusted LaRouche's advice for education, but I was simply incapable of figuring out why the 1799 paper was so important. I was intrigued, but the language meant nothing to me. I had blocked out the math. It took me a long time just to relearn how to factor. No joke, looking at the paper was like walking through fog. I didn't grasp even a couple of sentences in the refutations. Euler's proof seemed like Greek, and Gauss's proof was just as bad. I got the joke about the triangle; that was about it.

For months, we tried to figure it out. A lot was attempted to try and flank the paper itself. We gained an insight into the history of algebra by looking at the work of Al Quarismi, we looked at sine and cosine functions, we built some of the surface constructions, and we multiplied complex numbers. Peter and I would always start looking at Euler's proof, but we would get stuck trying to figure out what Euler was doing. We'd compare equations in algebraic form with Gauss's geometric form.[2]

(If you want a deeper insight into many of the avenues we took, look into Peter's article, "How to Win Gauss and Influence History," *21st Century,* Winter 2003-2004.)

The first thought that came into my mind was that LaRouche was having us look at the 1799 paper to un-brainwash us from our math experiences. Everyone had been forced to memorize these symbols, never learning that they were only shadows, and that without understanding the principles generating them, they mean nothing. Gauss shows that algebra comes from geometry. From that view I ask, "Do you want to know where these symbols came from? Did you know $A^2+B^2 = C^2$ is about areas?"

That simple example alone is a fundamental breakthrough for all "symbol"-minded victims out there, and perhaps enough to realize that all of your education has been a fraud. (It is also the realization that all shadow-world dwellers are boring and humorless!)

In spite of all this, I thought, if LaRouche says that this is the key to a competent education, it must be deeper than an exercise in geometry. What was it that we weren't getting? When I would read through the whole paper with groups of people, we'd spend a limited amount of time on the refutations, treating them as a formality, and then spend the majority of the time on Gauss's proof.[3]

But if we just build his constructions and formally act like we get the importance of his complex domain and his jokes about the shadow dwellers (Euler, Lagrange, and so on), we are missing the substance of the proof entirely. It was as if we were analyzing a Shakespeare play without asking what Shakespeare was thinking when he wrote it, and just mechanically acting out the parts and analyzing the characters.

What unstated hypotheses must Gauss have had that he made the refutations such a prominent part of his composition? A couple of us decided to figure the paper out. I got together some youth who had not read much of the paper before, and for the first time we *read the refutation of Euler first.* The usual agenda, people falling asleep after 45 minutes of Euler's own proof, was broken; Gauss's own words provided the inspiration. We got Gauss's third objection!

The whole paper started to come to life. The elation I felt was perhaps the deepest satisfaction I'd ever had—*two years* of fighting with the language I had so desperately tried to forget, and now relearning it from the higher standpoint of LaRouche's epistemology.

How does the mind function? Looking at the refutations in this new light, Euler's mind becomes exposed: His method of sophistry is laid naked, shivering under the cold stare of Gauss's reason. Not only is Euler's proof inconsistent with mathematical rigor, he is, in fact, not trying. It's a cheat. A steal. A fraud.

2.0 Euler's Sophistry

To understand why Euler is a sophist, let's go back and start at the beginning:

Gauss sets the scene, like a play: Imagine sitting in the audience. The curtain opens. It's a lovely day in feudal European history. It's a court filled with nobles dressed in 18th Century garments. The King walks in, a feast is had, the order of the court is clear.

Suddenly, a messenger walks on stage and reads aloud a message from a colony across the ocean declaring its independence from the Crown. Obviously what you thought was clear, becomes paradoxical, and the development of the play begins. This is how Gauss starts out his paper. A logical set of axioms. An algebraic equation X, of variable x, can be written as the product of factors, such as $(x–3)(x+9)$, and so on. Every equation of degree m has m roots, and every equation can be broken into factors. Seems fine.

"On this account, epistemology, it was the relevant specific virtue of that 1799 Gauss piece, which had prompted me to situate it as the cornerstone of the initial educational program of the youth movement. The immediate issue of the dispute over that piece, from the close of the 18th Century to the present day, has been, as Gauss's enemies themselves emphasized at that time, Gauss's insistence on viewing problems of modern mathematical physics from the standpoint of a Classical pre-Euclidean, geometric treatment of those same errors which Gauss exposed as the products of the 'ivory tower' mysticism of Euler and Lagrange."

—*Lyndon H. LaRouche, Jr. from "Visualizing the Complex Domain,"* 21st Century, *Fall 2003*

Juliana Jones

Lyndon H. LaRouche, Jr. with youth organizers. He has challenged the youth movement to master the complex domain.

$X = x^m + Ax^{m-1} + Bx^{m-2} + \ldots + M = 0$

$X = (x-a)(x-b)(x-c)$, etc.

$x^2+2x+1 = 0$, $X = (x+1)(x+1)$.

Two factors, two roots.

There you have it. The curtain opens, the drama begins, and what seems logical, consistent, pleasant, and true, is intervened upon by an anomaly. The perfection breaks down.

Gauss says: "Analysts seem to have adopted far too quickly and without previous solid proof a theorem upon which almost all of the teaching of equations is built: *That any such function* X *can always be resolved into* m *simple factors* or, which agrees with that entirely, *that every equation of degree* m *has indeed* m *roots.*"

Already in equations of the second degree, a strange number arises: $\sqrt{-1}$.[4] In order to follow through with the algebraic manipulations, "the algebraists were forced to invent an imaginary quantity whose square is –1." In the domain of the algebraists, real numbers exist only as counting objects on a line. If that's your domain, then the anomaly demands to be reprimanded and dismissed to the dungeon, so that the kingdom is once again orderly.

For how could you have $\sqrt{-1}$? It's neither less than 0, greater than 0, nor 0; it's "impossible!" Gauss's composition begins in this way. He states the assumptions of algebra and the anomaly challenging those assumptions. But the real fun begins when Gauss exposes the approach taken to the anomaly, stalking his prey, the hapless Beast, Leonard Euler ("E.")

2.1 Gauss Points Out E's Assumptions

1. *There are roots.*

2. *All equations can be reduced to "pure equations."* To "solve" an equation one reduces it to "pure equations." For example: Take an equation like:

$x^3-13x-12$

and resolve its factors:

$(x+3)(x-4)(x+1)$.

A pure equation takes the form

x^2-4; or x^2+8.

There are no middle terms. It is easy to determine exactly what x is with little manipulation. For instance:

$x^2-4 = 0$

can be resolved as

$x^2 = 4$, or $x = \sqrt{4}$.

3. *The sum of the roots are equal to the opposite of the first coefficient (second term).* Take an equation, $x^2+2x+1 = 0$. Its factors are $(x+1)(x+1)$; x must equal –1 to "solve" the equation, that is, making the equation equal zero. There are two x's, therefore the sum of the roots is equal to –2; –2 is the opposite of the second coefficient, 2. This rule is always true. This rule, that the sum of the roots is always equal to the opposite of the first coefficient, is used as the basis for Euler's proof.

4. *The sum of the roots equals zero.* Euler then creates an elaborate system of two polynomials so that their product yields a new, bigger equation in which the second term cancels out. He uses the third rule, that the sum of the roots is always equal to the opposite of the first coefficient (second term), to show that the sum of the roots will equal zero.

For example:

$(x+1)(x-1) = x^2+1x-1x-1 = x^2-1$.

See, the second term with x (first coefficient) cancels out! $x = -1$, that's the first root; $x = +1$, that's the second root. $1-1 = 0$; therefore, the sum of the roots will equal zero.

5. *The roots will be real when the last term is negative.* Euler compares the coefficients of his big equation and comes up with a new equation. He then takes the fact that the sum of the roots in this new equation is equal to zero to prove that they will individually have to be real if the last term of is negative.

6. *Roots can be obtained through rational operations for equations of any degree.* Although Euler shows how, in certain cases, he can find roots for equations of degree four or less, he projects this occurrence as true for quintic equations and higher.

Gauss saw through this sophistry and made the following devastating exposé in his third objection:

> E. tacitly assumes that the equation $X = 0$ has $2m$ roots and that their sum is = 0 because X has no second term. . . .*The assumption that the sum of all the roots of any equation is equal to the first coefficient, with opposite sign, does not seem applicable to other equations, but only to those that have roots* [emphasis added]. But as by this proof it must be shown that the equation $X = 0$ indeed has roots, it does not at all seem permissible to assume their existence.

As Gauss states, Euler's whole proof begins with a false assumption! He assumes that there are roots, and therefore feels himself obliged to use this rule of algebra (rule 3) to prove his theorem. He uses the rules of algebra to prove the validity of it! But how can you use the rule of something that you haven't proved works? What a sham! He assumes as an axiom the existence of roots and creates a system that is logically consistent with his assumption. In a sense, he assumes what he wants to prove!

Now wait a second, wasn't the proof supposed to be that we can resolve functions to real roots? Gauss states, that types like Euler say: *"That here it is not to be proved that the equation* X *= 0 can be satisfied (. . ."it has roots") but merely that the equation may be fulfilled by values of* x *of the form* $a+b\sqrt{-1}$. The former statement they assume indeed like an axiom."

To make the point clear, I also include a similar objection by Gauss to d'Alembert's proof: "D'Alembert expresses no doubt about the existence of values of x to which given values of X correspond, but *assumes their existence and investigates only the form of these values"* [emphasis added].

What x equals in the end is of no importance, as long as we can find what x is equal to, even if x equals an "imaginary" number, or something else deemed "impossible." The "form" of what x looks like doesn't matter, as long as the "form" makes the equations work! As long as the "math" works out, who's going to care?

As Gauss observes: "But it can certainly not be understood with that clarity which must always be insisted upon in mathematics how quantities of such a nature, of which you cannot have any idea, may be added or multiplied. They are merely a shadow of a shadow."

As long as the equation is "solved," it's enough for Euler. Does he care if he knows how to use this form in physical space? Does he care about using absurd forms like negative areas for which there is no basis? No! He wants to impose his will upon you. Since Gauss knew that the symbols were shadows of geometry, then a number that is "impossible," and has no meaning on the algebraic number line, but is used anyway to satisfy equations, is a "shadow of a shadow."

The absurdity really comes out when Gauss shows that even Euler's false, manufactured idea of a proof, cannot be shown to work within its own system! *Even if you use* these shadows, you still can't find the roots: "But it was by no means allowed to infer from this that by admitting quantities of the form $a+b\sqrt{-1}$ equations of fifth or higher degree can be satisfied. . . ." In other words, even if you allow this "imaginary number," your problem of breaking the equations down into pure equations is still not solved in all cases (rules 2,6). Gauss says in Section 9 of his paper that it should be easy to show how it is in fact impossible for equations of the 5th degree. Indeed Abel later proved it so.

After sufficiently refuting Euler, Gauss adds in Section 9 of the paper:

> Against this reasoning one can object that after so much labor of such great mathematicians there is very little hope left ever to arrive at a general solution of algebraic equations. It seems more and more probable that such a solution is entirely impossible and contradictory. This must not at all be considered paradoxical, *as that which is commonly called the solution of an equation is indeed nothing other than its reduction to pure equations.* For *the solution of pure equations is* here not taught but *presupposed;* and if you express the roots of an equation $x^m = H$ by $\sqrt[m]{H}$, you have in no way solved it. . . .[emphasis added]

Euler's real idea of a proof of equations is just isolating the x's. But just because you can see what x equals, doesn't mean you've solved anything! Euler will never be able to prove the fundamental theorem of equations if his idea of a proof is reducing it to pure equations, because it is not a principle; it is an assumption. Gauss says that a proof resting on this assumption has no weight, because it is false. Gauss demands rigor, and as can be seen, allows no false axioms to hide from his examination. As you can see, Euler has a fantasy world; to support the fantasy he uses the "logic" of his fantasy world, which rests on the authority of the "popular opinion" of the times (sound like any Presidents you know?).[5]

SCIENCE and the LaRouche Youth Movement

One can hear Euler screech, "How could this great system of equations work out until now? What happened to my system?" Well, it wasn't real! Reality forces its way into your fantasy world. What are you going to choose, your fantasy, or relinquishing your fantasy for a greater view of reality? That's the issue.[6]

2.2 Hunting the Beast[7]

Watch out! E.'s world is not one for human habitation. Once you swim into the first assumption, you get caught in a net, and become trapped into the deep waters, writhing about, struggling for air. As an unsuspecting fish biting the facsimile of food is later clubbed to death once out of the water, so the cognition oozes out of your own head when it accepts lies for truth and gets raped in Euler's cage of sophistry. This may seem a bit scary, but the results of an unscientific outlook based on Euler-like fantasy assumptions are more murderous when they manifest themselves in the language of economics. It is necessary to comprehend a sophist, or else the trick will be on you and all of us! We must dissect this method of sophistry, lest we get caught unawares in the net. The sophist tricks us into his game quickly, and unless you are familiar with his rules and definitions, you'll be seeking out the reasons for these rules, and therefore become his slave. If you try to work outside a

Man Is Not a Beast

"However, a human being, insofar as he does not act empirically but rationally, does not rely solely on experience, or a posteriori inductions from particular cases, but proceeds a priori on the basis of reasons. And this is the difference between a geometer, or one trained in analysis, and an ordinary user of arithmetic, teaching children, who learn arithmetical rules by rote, but do not know the reason for them, and consequently cannot decide questions that depart from what they are used to: such is the difference between the empirical and the rational, between the inferences of beasts and the reasoning of human beings. . . .

"Thus, brutes (as far as we can observe) do not acquire knowledge of the universality of propositions, because they do not understand the ground of necessity. And even if empirics are sometimes led by inductions to universally true propositions, this nonetheless happens only accidentally, not by the force of entailment."

—*Gottfried Leibniz, from "Reflections on the Souls of Beasts"*

Gottfried Wilhelm Leibniz (1646-1716)

sophist's rules, you may hear the familiar cry, "*Cheater,* you are violating the rules!"

The rules of sophistry: (1) Don't challenge the axioms of the game. (2) Just play by the rules and be the better player.

Indeed, sophists set the rules of the debate and impose them harshly, or they just change the definition of something, to make it fit what they want to prove. If a crack in the argument of a sophist appears, he then comes up with more rules to support his assumption—an assumption which is secret, and not to be known.

For instance, think of the Econ 101 class: "A good economy is a balanced budget." Well, we can do that easily: Cut health care, cut transportation, leave part of the city to rot! Soon your budget will be balanced! A good economy, right? Or, "A good economy = wealthy citizens; wealthy citizens = ability to buy; if I have more credit cards I am more wealthy." Axiom: Economy is about money. "Now let me show you how this economy will get you money."

"But this is genocide! This is crazy!" You might say.

"But it works," says Econ 101. "The definition of a good economy is money; who cares what 'form' it takes to get it? I can prove that this economy works." If a free-trade economy fails, the escape remains open that the reason for this is, "the invisible hand."

But what is a good economy? Isn't it arbitrary anyway? No! We want nothing less than to increase the understanding of humanity's role and potential in the universe. In the subject of economy, if your discussion is not centered around human beings, you must be working for George Shultz, Alan Greenswindler or Milton "received the certified idiot award" Friedman. So with mathematics, if your discussion is not aiming at discovering the paradoxes that arise, and getting a new view through these windows which lead you to physical principles, you must be sitting indoors with the shades drawn, like Euler, d'Alembert, and so on.

So, how does one cut the sophist's net? When dealing with a suspected sophist, you must always situate yourself in the geometry of intentions. Quickly ask, "What's your intention, Sophist?" The sophist is disarmed! Because the sophist's intention is to impose his will on you! A sophist crushes your ability to make discoveries. The sophist has turned into a bestial creature of arbitrary rules who has lost his soul.

To skip over anomalies, creating assumptions to enforce a system which denies people the ability to discover the principle generating the paradox, is evil. If this sophistry is allowed, what is the intention? It's simply base. Soon you'll find your cognition destroyed,

The Granger Collection

Abraham Gotthelf Kaestner (1719-1800), Gauss's teacher at Göttingen.

and you are doing *math equations* proving that you find some symbol after manipulating equations and calling that a solution.

Call $2\sqrt{-1}$ the solution for $x^2+4 = 0$. How does that prove what you want? You must first be able to prove that your equation $x^2+4 = 0$ has any relevance to the physical universe! You must demonstrate that a principle of action is defining the equation, showing that it can be correctly situated into the geometry of true intentions of the physical universe. Like doubling the line; you can argue about the right length, but unless you show what generates lines, you can't know how to double the line. Unless you find the principle that makes areas, you can't know how to double all squares. In order to prove what something is, you have to prove what generated it! You have to discover the generating principle.

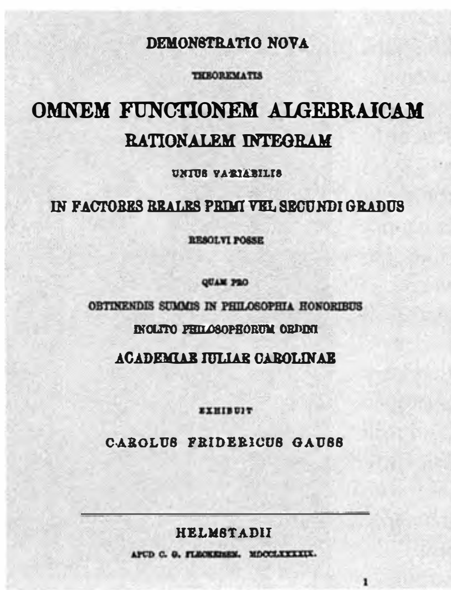
Following in the footsteps of Gauss, we can defeat all forms of ignorance and political tyranny by locating the generating principles and drawing out the deeper causes of events. Power lies in knowing these generating principles, not in proving your opinions by coming up with a logical system that supports your axioms.

3. Gauss's Attack on Sophistry

As you can see, Gauss's paper was a devastating exposé of how absurd a whole paradigm had become. It was also an attack on the method with which the paradigm had been enforced. The substance of the paper lies not only in the axioms Gauss points out, but in the method with which he attacks those axioms.

After asking what unstated hypotheses Gauss must have had that he made the exposure of sophistry two-thirds of his paper, I asked another question. What is the unspoken method behind Gauss's presentation of his proof, his attack? Now that we've visited the Beast in his lair and exposed the mental disease it spread, how does Gauss attack those axioms?

In Section 2 of Gauss's paper, he says he is going to free his proof from any help of imaginary numbers. In Section 3, he says he will include "imaginary" and "real" quantities under the title "possible" quantities. And again in Section 15 of the paper, Gauss says he considers it worth the trouble to prove the theorem without the $\sqrt{-1}$. Well, what is Gauss doing here? He spends two-thirds of the paper tearing apart false proofs which all deal with $\sqrt{-1}$ in the wrong way, and then he is just not going to deal with $\sqrt{-1}$ at all? When you start reading through Gauss's own proof, you may find yourself asking, "What happened to the paradox of the $\sqrt{-1}$?" We saw that it was a paradox. It



DEMONSTRATIO NOVA

THEOREMATIS

OMNEM FUNCTIONEM ALGEBRAICAM

RATIONALEM INTEGRAM

UNIUS VARIABILIS

IN FACTORES REALES PRIMI VEL SECUNDI GRADUS

RESOLVI POSSE

QUAM PRO

OBTINENDIS SUMMIS IN PHILOSOPHIA HONORIBUS

INCLYTO PHILOSOPHORUM ORDINI

ACADEMIAE IULIAE CAROLINAE

EXHIBUIT

CAROLUS FRIDERICUS GAUSS

HELMSTADII

APUD C. G. FLECKEISEN. MDCCLXXXXIX.

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The frontispiece of Gauss's published paper, in Latin.

was what the entire discussion was about for two-thirds of the paper. So why does Gauss not explicitly say what the $\sqrt{-1}$ is in his proof and solve the paradox? *First, let's see what Gauss thought about the* $\sqrt{-1}$.

> These investigations lead deeply into many others, I would even say, into the Metaphysics of the theory of space, and it is only with great difficulty can I tear myself away from the results that spring from it, as, for example, the true metaphysics of negative and complex numbers. The true sense of the square root of −1 stands before my soul fully alive, but it becomes very difficult to put it in words; I am always only able to give a vague image that floats in the air.

As you can see, this was not a dry topic for Gauss! The paradox of the $\sqrt{-1}$ was a metaphysical question into what is the mind's relationship with all of number and space. Gauss was not looking at a dead world of objects; his concept of powers in the equations of x, is not just one more number in a series, but a new manifold of action, as can be seen in Gauss's surfaces. In fact, Gauss knows that all numbers are of the form $a + bi$ and the so-called, "real" number domain is only a special case of complex action, the "infinitesimal" moment that occurs when a circular action crosses the number line (a horizontal axis of the circle)! And even complex numbers are only moments in a process of extensible magnitude combined with circular action: self-similar spiral action. As you can see, every number has a higher bounding principle, a unity, a principle which generates it. What seems "imaginary" and quite a mathematical paradox within the limited view of number for the sophists, is actually a gateway to making a discovery of a higher manifold of number.[8,9]

If Gauss had this conception of number, then why does he write the 1799 paper the way he does? Why does he hold back and speak their language for two-thirds of the proof? Why doesn't he explain it better? What is behind Gauss's method?

The second question then to ask is, what is the context in which he is writing his paper; who was Gauss at the time? Gauss was in the middle of writing the *Disquisitiones Arithmeticae,* the most rigorous and profound work on number theory yet. He had already been to the mountaintop, leaving the "cave" in his early years. Think of Book Seven of Plato's *Republic.* When one has freed oneself from the chains and climbed the slope into the sunlight of truth and freedom, what is the next step? Yes, it is true, most people cringe at the thought, but as all agapic thinkers must, it's back down into the dark world of the shadow

Continued on page 60

Euler and the Economic Hit Men

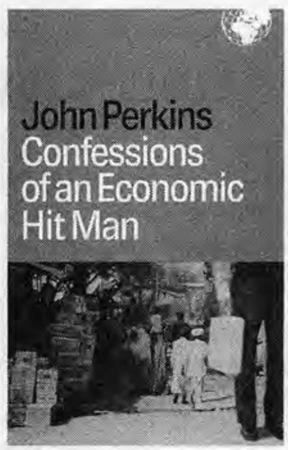
by Aaron Halevy

In November 2004, a book was released that would provide an inside witness to the 40-year fight Lyndon LaRouche has waged on the pro-fascist Synarchist insurgency that is currently influencing the United States government.

The book, *Confessions of an Economic Hit Man,** written by John Perkins, is an autobiography of a real life "Leperello," whose job it was to go to foreign countries and pile upon them massive amounts of debt, subsequently luring them into the modern Free-Trade Financial Empire. It wasn't until Sept. 11, 2001, that Mr. Perkins could muster the courage to finally publish this book. The book shows more than the structure of Free Trade; it also inadvertently describes the psychological method that this beast-system uses and how it can destroy its victim's souls. Just like Euler and those like him, Perkins notices the corruption instantly, but for fear, is subdued.

"I also realized that my college professors had not understood the true nature of macroeconomics: that in many cases helping an economy grow only makes those few people who sit atop the pyramid even richer, while it does nothing for those at the bottom except to push them even lower. . . . If any of my professors knew this, they had not admitted it—probably because big corporations, and the men who run them, fund colleges. Exposing the truth would undoubtedly cost those professors their jobs—just as such revelations could cost me mine"(p. 26).

Because the job he held wasn't the easiest to justify, instead of standing up for the truth he bought a mathematician. . . . "I brought a young MIT mathematician, Dr. Nadipuram Prasad, into my department and gave him a budget. Within six months he developed the Markov method for econometric modeling. . . .



"It was exactly what we wanted: a tool that scientifically 'proved' we were doing countries a favor by helping them incur debts they would never be able to pay off. In addition, only a highly skilled econometrician with lots of time and money could possibly comprehend the intricacies of Markov or question its conclusions. The papers were published by several prestigious organizations, and we formally presented them at conferences and universities in a number of countries. The papers—and we—became famous throughout the industry" (p. 102).

As you see, Perkins, like Euler, was totally "justified" in his rape of these nations because he was the authority. No one could say he was wrong; the mathematics agreed with him, academic popular opinion as well, and so must, therefore, the universe. The numbers can't lie you know.

Notes

* John Perkins, Confessions of An Economic Hitman, (San Francisco: Berrett-Koehler, 2004).

New York Public Library Picture Collection

Carl Friedrich Gauss (1777-1855)

J. Chapman

Leonhard Euler (1707-1783)

UNDERSTANDING A SOPHIST'S MIND

Euler's False Proof of the Fundamental Theorem

Part I

First, Euler (E.) takes an equation X of degree $2m$ (where m is any power of 2).

$X = x^{2m}+Bx^{2m-2}+Cx^{2m-3}$. . . etc.$+M = 0$.

Note no second term Ax^{2m-1}, *the whole proof rests on this rule.* Then E. assumes two factors:

(1) $x^m-ux^{m-1}+\alpha x^{m-2}+\beta x^{m-3}+$. . . etc. $+M$.

(2) $x^m+ux^{m-1}+\lambda x^{m-2}+\mu x^{m-3}+$. . . etc. $+M$.

All we have to prove, says E., is that real values can be given for these unknown quantities, u, α, β, λ, μ, etc. that can satisfy the equations. Then he sets the product of these two factors equal to function X.

For our purposes here, and since it is relevant to Gauss's critique, we will use an example where $m = 2$. Our factors will then be:

(1) $x^2-ux+\alpha$.

(2) $x^2+ux+\lambda$.

Their product equals:

$x^4+(\alpha+\lambda-u^2)x^2+(u\alpha-u\lambda)x+\alpha\lambda = 0$.

Does this match the original?

$x^{2m}+Bx^{2m-2}+Cx^{2m-3}$. . . $+M = 0$.

Yes . . . so now compare the coefficients (achieved through standard manipulations):

$\alpha+\lambda-u^2 = B$.

$u\alpha-u\lambda = C$.

$\alpha\lambda = D$. (Their final coefficient = $2m-1$).

Euler is a genius, Eh! Now we have three equations and three unknowns. E. says to assume we know u, then we can find the rest! "If we know one unknown through manipulation and 'rational' operations, we discover all the hidden values."

Okay, hold tight; at this point, E. resolves his equation,

$x^4+(\alpha+\lambda-u^2)x^2+(u\alpha-u\lambda)x+\alpha\lambda = 0$,

to an equation he calls U, where U will be an integral function of u and of known coefficients only.

You need not follow all the steps as we go. The math and the rules do seem unbearable, but that feeling is coming from the seemingly dizzying height of E.'s mathematical Ivory Tower. To you, from so low it looks like an unconquerable height; the secret? . . . that tower is imaginary! It exists only in the masturbatory fantasies of mathematical oligarchs, and those that want to share these fantasies with them. It is possible to understand all this without going through the process of manipulation, but it is highly recommended that you work on it. Keep in mind, all of these symbols have first a physical action behind them, and the numbers are just the shadows left behind from the passing of a principle.

Remember: comparing coefficients is fun!

$B = \alpha+\lambda-u^2$.

$C = u\alpha-u\lambda$.

$D = \alpha\lambda$.

Now we want only u as a variable! So use the equations *B* and *C,* and let's manipulate, shall we?

Step 1: solve *C* for alpha:

$C = u\alpha-u\lambda$.

$\alpha = C/u+\lambda$.

We've solved for alpha; one eliminated, one to go.

Step 2: insert that result into *B* and solve for lambda (λ):

$B = (C/u+\lambda)+\lambda-u^2$.

$B = C/u+2\lambda-u^2$.

Step 3, isolate λ:

$2\lambda = B-C/u+u^2$.

$\lambda = (B-C/u+u^2)/2$.

This changes into,

$\lambda = B/2-C/2u+u^2/2$.

Step 4: Abra cadabra! Multiply each term by *u/u* to make the denominators equal:

$\lambda = Bu/2u-C/2u+u^3/2u$.

$\lambda = (Bu-C+u^3)/2u$.

Step 5: We've solved for α and λ, now plug in these reorganized values for equation *D:*

$D = \alpha\lambda$.

$\alpha = C/u+\lambda$.

Substitute the values for λ into the α equation:

$\alpha = C/u+(Bu-C+u^3)/2u$.

Multiply both sides of the equation by 2/2 to make the denominators equal, then rearrange and simplify terms:

$\alpha = 2C/2u+(Bu-C+u^3)/2u$.

$\alpha = (Bu+2C-C+u^3)/2u$.

$\alpha = (Bu+C+u^3)/2u$.

Therefore, substituting our α and λ values into *D:*

$D = [(Bu+C+u^3)/2u][(Bu-C+u^3)/2u]$.

Step 6: Multipy the factors together.

$D = (B^2u^2+CBu+Bu^4-CBu-C^2-Cu^3+Bu^4+Cu^3+u^6)/4u^2$.

Step 7: Rearrange and simplify the terms.

$D = (u^6+2Bu^4+B^2u^2-C^2)/4u^2$.

Step 8: Remember, there's a denominator of $4u^2$, and we want the equation to equal zero, so multiply both sides by $4u^2$. Hocus Pocus!

$4Du^2 = u^6+2Bu^4+B^2u^2-C^2$.

And move $4Du^2$ to the other side of the equation by subtracting from both sides. Tada!

$u^6+2Bu^4+B^2u^2-4Du^2-C^2 = 0$.

Step 9: Rearrange, simplify, and rename the equation *U*.

$u^6+2Bu^4+(B^2-4D)u^2-C^2 = U$.

So now we have an all *u* equation! Cryptic!

After this magic show, E. has his equation of big *U*. His next trick . . . is to show why his last term in big *U* is *always* negative: "Whence it is well known to follow that the equation has at least one real root, or that *u* and consequently α, β, etc., λ, μ, etc. can be determined as real numbers in at least one way." That is E.'s proof.

Part II

The rest of what Gauss reports, is E. proving why the last term is always negative. Let us follow Gauss . . . why is this so crucial to E.'s proof?

Take an equation:

$x^2+1 = 0$.

The last term, 1, is positive.

$x^2 = -1$; $x = \sqrt{-1}$ . . . hmmm, an imaginary solution. Take another equation:

$x^2-1 = 0$.

The last term, –1, is negative.

$x^2 = +1$; $x = \sqrt{1}$ . . . ahhh, a snug little real number.

Or, look at it in this way:

$x^4+3x+4 = 0$, hence $x^4+3x = -4$.

$x^4+3x-4 = 0$, hence $x^4+3x = 4$.

Therefore all the factors multiplied together will equal a positive number, if the last term is negative. On the other hand, imaginary quantities multiplied together equal a negative quantity, as in the example,

$x^4+3x = -4$.

OK, let that suffice for now.

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Proof: Then E. says to pick values of u from the factor of the function of X:

$x^m - ux^{m-1} + \alpha x^{m-2} + \beta x^{m-3}$ . . . etc. $+M$.

(u = the sum of the roots. As the rule goes, *the second term is always equal to the sum of the roots with negative sign.*) Key: "I omit the not difficult proof."

Remember, our original X equation had $2m$ roots, so you can pick any m different values of u from $2m$ roots using a combinatorial method: For our example equation of degree 2:

$m=2$; $2m=4$.

$[(2m)(2m-1)(2m-2) \ldots (m+1)]/[(1)(2)(3) \ldots (m)]$,

or

$(4)(3)/(1)(2) = 12/2 = 6$.

So this number 6 is twice 3, an odd number, which is always true.

Recall the equation where u is raised to degree 6:

$U = u^6+2Bu^4+(B^2-4D)u^2-C^2 = 0$.

E. calls the amount of values of u equal to $2k$, and k is always odd. So, now remember since in $X = 0$ there was no second term, the sum of $2m$ roots equals zero. Since the roots have to equal zero, E. says, "picking from $2m$ roots if p is one then $-p$ must be another since $2m = 0$, so you have $-p+p$, $-q+q$, $-r+r$ . . . etc." Therefore it is the same with our equation $U = 0$. There are $2k$ roots in $U = 0$, so E. asserts correctly that there are double k amount of factors (since they must equal zero). $(u-p)(u+p)$, $(u-q)(u+q)$, $(u-r)(u+r)$, . . . etc.

Because $(u-p)(u+p) = u^2-p^2$ and the last term $-p^2$ is negative, you can easily see an odd number of these negatives. The product of these k doubled factors, $(u^2-p^2)(u^2-q^2)(u^2-r^2)$ . . . etc. will equal an equation where the last term has a negative sign, since a (negative)(negative)(negative) = (negative).

And we see that in:

$u^6+2Bu^4+(B^2-4D)u^2-C^2 = 0$.

Notice that C^2 is negative—the last term is negative!

Q.E.D. Euler states that this proves the fundamental theorem of equations, so therefore, we can always resolve our equations to real roots of degree m. E. creates conditions, as you can see, where, because the last term is negative, the roots will be real, and he doesn't have to worry about the $\sqrt{-1}$. He relies on the wonderful system of algebra, which creates the most suitable conditions for generating the exact form that he needs. Gauss does a more elaborate refutation of E's proof in his fourth refutation. See Gauss's Fundamental Theorem of Algebra, at www.wlym.com.

Continued from page 57

dwellers that one must return if one is truly human.

Such it is with the Platonic thinker, Gauss. Think of the approach he takes to those reading his paper at the time, those who had apparently been caught using the method of Euler and Lagrange. How could he get the academic world, which had submitted to being "symbol"-minded, to break free from their mental shackles? Does one go down into the cave and explain to the chained ones that they are living in a fantasy world? You'd scarcely come out alive, as Plato says, and surely bring no one out with you.

Curing a sophist or victims of sophistry (all of academia) is not an easy task.

After identifying the axioms as Gauss does, how do you get someone to realize that those axioms are false? It's one thing to point out and expose a sophist. Now the question is, how do you cure the mental disease? How do you really challenge axioms? You've got to juxtapose the axioms with an idea that challenges them, creating a paradox in the person's mind. Well, how do you do that? *What is the method Gauss used?* Lyndon LaRouche says it best:

> The point emphasized here, is that it would be an intellectually fatal tactical mistake, to attempt to show a devout reductionist an argument for the Gaussian complex domain "in terms he is willing to accept": terms which are bounded by the essentially linear, axiomatic assumptions of arithmetic reductionists such as Euler and Lagrange. Therefore, for such an errant discussion partner as one of the latter ideologues, only that kind of Classically Socratic argument for the relevant hypothesis, which would blow his beliefs apart emotionally, could actually show him the

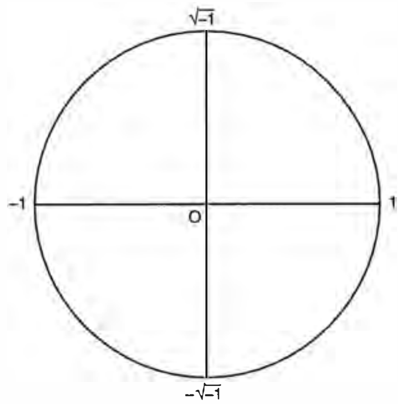


Figure 1
THE UNIT CIRCLE OF ACTION IN GAUSS'S COMPLEX DOMAIN

The origin is denoted by 0, and the horizontal diameter-ends by 1 and –1. The square root of –1 is found by halving the rotation between 1 and –1, and reducing the radius by the square root. Think carefully, and you will see that $\sqrt{-1}$ and $-\sqrt{-1}$ are represented by points on the circumference which are halfway between 1 and –1.

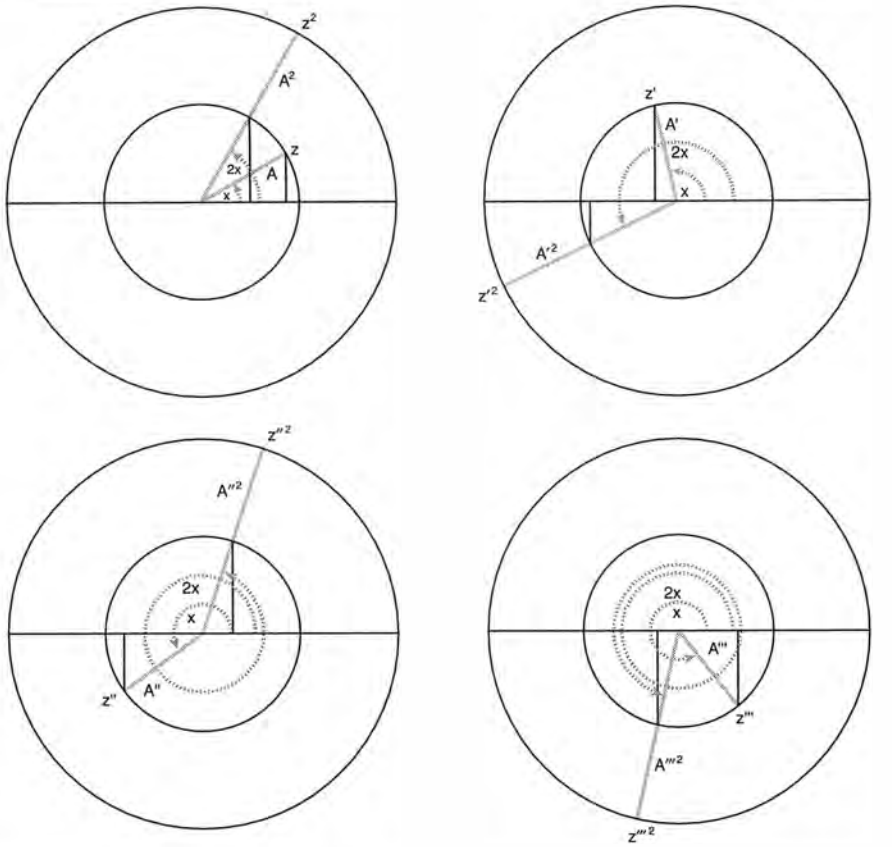


Figure 2
THE EFFECT OF SQUARING A COMPLEX NUMBER ON THE BEHAVIOR OF THE SINE AND COSINE

Within Gauss's circle of action in the complex domain, the complex number z is "squared" when the angle of rotation is doubled from x to 2x, and the length squared from A to A^2. As angle x is rotated through 360°, and the sine and cosine each become 0 and 1 twice, the angle 2x completes two revolutions, and the sine and cosine each become 0 and 1 four times. The figure illustrates variations of the sine and cosine for four quadrants, as angle x rotates from 0° to 360°. (See note 11.)

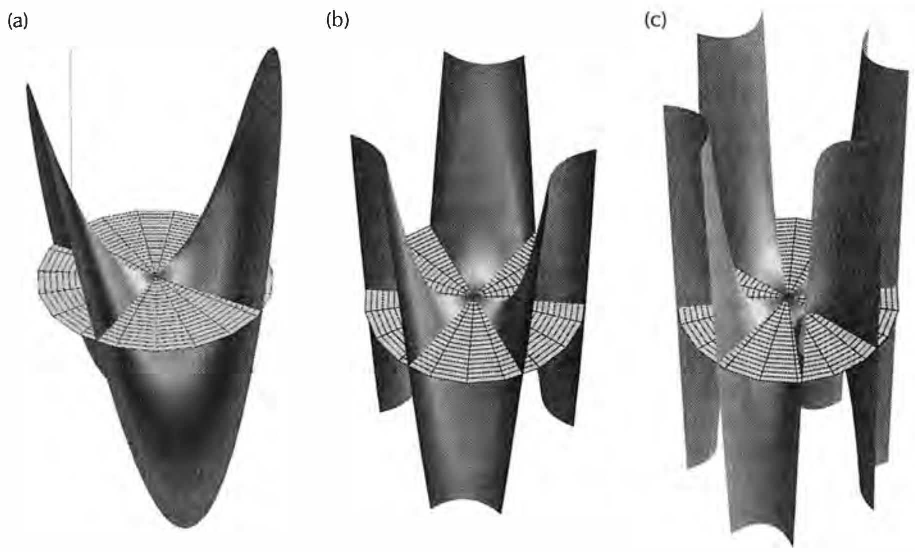


Figure 3
GAUSSIAN SURFACES: BRINGING THE SHADOWS TO LIGHT

Rotate a radius around a circle. Every time you do this, the sine and cosine both become zero twice—sine at 0° and 180°, and cosine at 90° and 270° (see also, Figure 4). Therefore, for every possible magnitude having that angle, it will lead to an intersection across the plane, or what Gauss calls, a curve. The surfaces for x (a first power equation) will then intersect once together. Hence X = 0.

If we build surfaces for x^2 (a second power equation) as in (a), we then have a double rotation of the radius around the circle; and if we then project the sine perpendicularly, we find that it will reach its maximum and minimum double that of x. The sine surface will cross the plane and become zero four times (see also Figure 2). This will be true as well for the cosine.

If we then construct this surface for every value of the radius, we will see curves intersecting twice (see also, Figure 5). Hence, one can easily see that every added power of rotation in the equation adds an intersection of the surfaces on the plane, and thereby a new root, or solution, to the equation. The Gaussian surfaces for third and fourth power equations are depicted in (b) and (c). (See note 11.)

incurable folly of Euler's, and his own argument. . . . The use of this method of hypothesis means attacking the falseness of the reductionist's fixed ontological assumptions, not in his choice of method, deductively, but *epistemologically: emotionally, rather than merely deductively.*

—Lyndon H. LaRouche, Jr. in "Visualizing the Complex Domain," in 21st Century, *Fall 2003.*

What kind of emotional reaction must the arithmetic "reductionists" have had when they read through Gauss's paper in 1799? Think of what these sophists were trying to prove: "Resolve Algebraic Functions into Real Factors." Euler, using algebraic rules of a system he hasn't proven valid, creates the conditions where the $\sqrt{-1}$ doesn't arise, and therefore proves he can resolve functions down into "real" factors. Gauss flanks this problem altogether. First, why answer in his false idea of "real?" Wouldn't you then be trapped as a fish? Second, the question: Can we resolve all equations down to "real" roots? Is that the right question to ponder?

Look at Gauss: How does he answer the question? In E.'s idea of real, does he prove that he can find the roots, the factors of all equations for whatever degree? Then, what was Gauss trying to prove? He doesn't use charts and graphs. He doesn't explain anything. Does Gauss say, "Hey guys, you have been wrong, but this is really what the $\sqrt{-1}$ is?" No, he doesn't explain what manifold it really comes from. Gauss ironically never mentions

What Really Is a Sine?

So, what are these sines and cosines, anyway?

Historically, sines are related to chords on a circle, a chord being a line cutting through a circle and dividing it into two arcs, or curved segments. (A diameter is merely a chord which divides the circle into equal arcs, or segments.) If you look at the circle here, you'll see a chord (*BE*) cutting the circle into a larger and smaller segment. If you send two radii, from the center of the circle (*A*) to *B* and to *E*, you have created a triangle (*ABE*),with the chord as a side.

If you then bisect that chord (*BE*) with another radius (*AD*) emanating from the center of the circle, where it intersects the chord at *C*, two right angles have been created, and we have generated two equal right triangles: *ABC* and *AEC*. The sine is defined as the perpendicular line from one of the two points where the chord touches the circle (say *B*) to the intersection of the bisecting radius (*AD*) with the chord at *C*. Therefore, the sine (*BC*) is half the chord in length, and the right triangle of which it is a side, is half the triangle *ABE*. The Greeks called the sine a demichord.

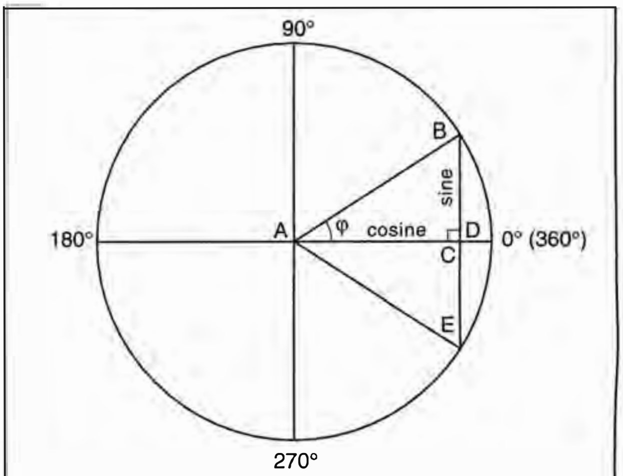


Figure 4
THE ORIGIN OF SINE IN THE UNIT CIRCLE

If you were to imagine the chord reduced to zero length, you would see that the length of the perpendicular we call sine, which is half the chord length, would also be reduced to zero, and the right triangle would have been reduced to a horizontal radius line. Now, if we were to increase that chord length to its maximum—the diameter of the circle—the vertical sine length would grow at that maximum to the radius (which is, indeed, half the diameter).

What we have done by this process is to rotate the angle (*BAC*, or φ) through an arc of the circle from 0° to 90°. By symmetry, if you were to reduce the chord by moving it to the left, until it again becomes zero (in effect rotating angle φ from 90° to 180°), the sine would decrease again to zero, leaving a line of radius length. This means that, in the traditional unit (radius = 1) circle, the sine varies periodically as we rotate through the 360° of the circle, with a maximum of one at 90° and 270°, and a minimum of zero at 0° and 180°.

Now, what about those cosines? You might have noticed, as you rotated that angle φ around the circle, that, as the vertical sine line (*BC*) of the triangle *ABC*, got larger, the horizontal line (*AC*), got smaller, and vice versa, so that, when the sine reached the maximum of the radius, one, *AC* became zero, and when the sine was reduced to zero, the line *AC* became the radius, one. That horizontal line is the cosine.

For those of you who learned trigonometry by memorizing formulae, you might be wondering how those sines and cosines you manipulated mindlessly in homework assignments relate to those we just looked at in the unit circle. Because of the proportional properties of the sides of similar triangles—those having equal angles, but of different size—sine/hypotenuse of our unit circle equals, in any similar triangle, the side opposite our angle φ/hypotenuse of our similar triangle. Therefore, because our hypotenuse in the unit circle is one, sine/1 = opposite/hypotenuse of any similar triangle. This sine, which we refer to the angle under rotation in the unit circle, φ, is not a line, but a ratio of two lines determined by a circle. Similarly, the cosine is the ratio of the adjacent line to the hypotenuse. Does that ring a bell?

—Christine Craig

the $\sqrt{-1}$ in his whole proof![10] He's interested in more than just the finding roots and coefficients to "solve" equations. Instead, he leaves the domain of arithmetic and goes straight to principles of action.

After humorously pointing out the assumptions they make and the technical flaws, Gauss, without explanation, ironically demonstrates the transcendental relationship that generates where the algebraic system, and hence, all the equations, come from. Gauss's construction of surfaces demonstrates the principle which makes an infinite amount of powers possible. Reflecting an infinite amount of powers onto his complex number plane, Gauss proves, not that he can calculate the precise value of the roots, but that the roots will exist. The topology of these ironical surfaces demonstrates that it is the highest power in an equation which determines the number of rotations crossing the plane, and thereby determines the number of roots in any equation, where the sine and cosine surfaces intersect on the plane. (See Figures 3 and 5.)[11]

Gauss was a breed of scientist of the only true kind, a student of Plato's epistemology and a seeker of the deepest metaphysical questions of the universe. Now, using the methods of Plato, Gauss, and LaRouche, is it an "imaginary" concept and a fantasy, to save this republic and launch a global renaissance, or is it "possible"? Well, do you have the *intention?*

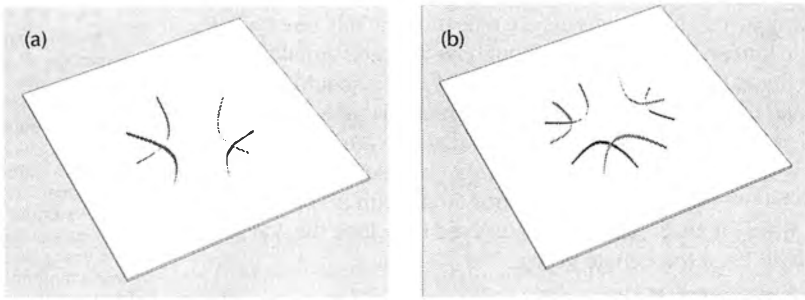
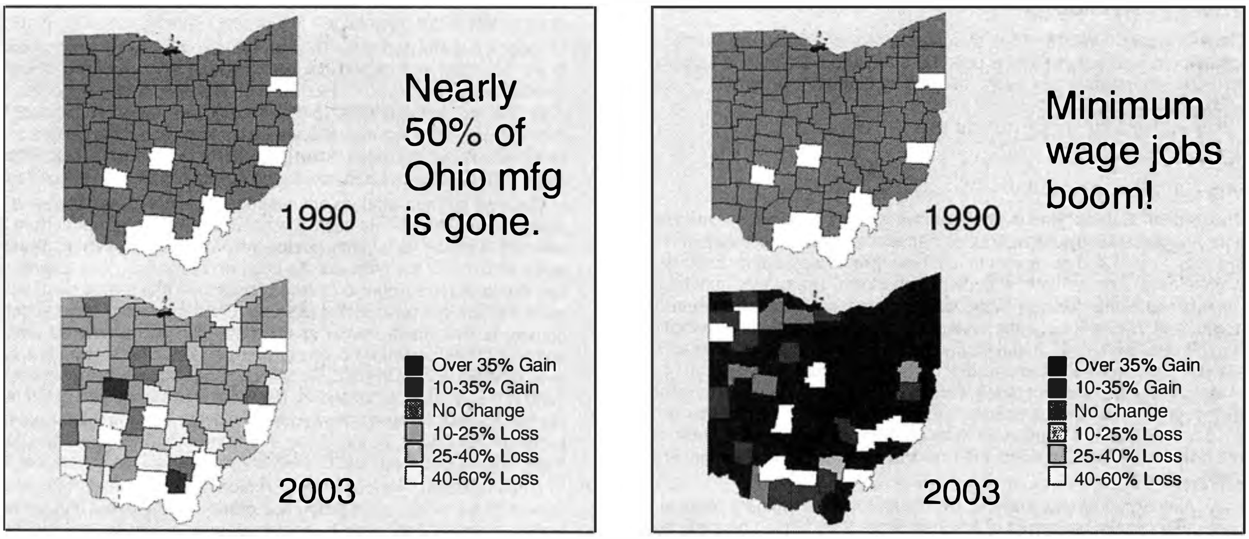


Figure 5
DEPICTING ROOTS TO ALGEBRAIC EQUATIONS
(a) Intersection of the Gaussian surfaces for the second power with the flat plane.
(b) Intersection of the Gaussian surfaces for the third power with the flat plane.

Epilogue—Organizing in the Complex Domain

Think of yourself in the street, and you've caught yourself debating with a free-trade economist in his own terms about why the economy is finished. How could you flank this sophist? Well, what if you use LaRouche's animations? (See Figure 6.) If you demonstrate the transformation, you wouldn't have to have a sophist's debate. He'd see the unseen relationships in his mind of the different principles interacting that generate the end effect of what you are debating; the effects of free trade and its transformation of the United States into a post-industrial junk heap would be undeniable.

Imagine: Everyone has been trying to prove all day, what is beautiful music? You go out to the organizing table with big signs, diagrams about bel canto, quotes from respected people on how beautiful it sounds (no really, respected scientists). You



(a) Ohio Counties: Rate of Gain or Loss of Industrial Jobs (1990-2003)

(b) Ohio Counties: Rate of Gain or Loss of Hotel and Restaurant Jobs (1990-2003)

Figure 6
THE COLLAPSE OF INDUSTRY IN OHIO (1990-2003)
Nearly 50 percent of Ohio manufacturing is gone, while minimum wage jobs boom!
Source: "Our Economics Policy: Animation and Economics," by Lyndon H. LaRouche, Jr. (Washington, D.C.: LaRouche Pac, November 2004)

describe the sounds of violinists. You talk about how the human singing voice and its registers are reflecting the different qualities of the human mind. You talk about how it creates a dialogue like true human communication, and that *all* music should reflect the human mind, and therefore: Classical music is superior. Will you convince anyone? At the end of the day you are furious that all the world is so stupid as not to accept your explanation.

What would be a better method? Sing! With 20 people, sing the "Jesu Meine Freude!" Then let's see how long the *Metallica* fan will keep the debate going.

Acknowledgements

Bruce Director is the "Apollonius" of the LaRouche Youth Movement. In the case of our generation, the great problem has been rousing the responsibility to become true "adults," and gain the power of mind to take responsibility for all of civilization, thus facing our true immortality. LaRouche has said he prescribed Gauss's paper to gain an understanding of the history of "ideas"; to understand a scientific dialogue over centuries. On this regard it is my pleasure to thank openly and with great veneration, Bruce Director. He has made accessible, and drawn the humor and the irony out of, the profound ideas in the history of science. Bruce is completely deficient of the Baby Boomer ego, "Look at me, I'll wow you with my knowledge," mental disease. Rather, it has been Bruce's youthful humble personality and ego-less pedagogical method which has inspired "platoons of mass leadership" to realize that it is *fun* to become wise. He has made these ideas accessible to thousands of youth around the world. His method is a lesson to be learned to all who are intent upon transmitting knowledge.

I'd also like to thank Jason Ross and Sky Shields; Aaron Halevy for his help on organizing E.'s Proof, and adding a crucial attack making clear the Beastman role of E.; Niko Paulson for helping me sharpen to a significant degree, without which I'd probably have put off finishing this essay for a long time; and Rianna St. Classis for her help editing this paper—my teammate in actually understanding much of the substance of the proof, and breaking through E.'s magical "equation with all U"!

Notes

1. To follow this report, get a copy of the Gauss paper from the internet at www.wlym.com. Go to the "Classics" link and scroll to Gauss. "New Proof of the Theorem That Every Algebraic Rational Integral Function in One Variable Can Be Resolved into Real Factors of the First or the Second Degree," is translated from the Latin by Ernest Fandreyer, M.S., Ed.D., and available freely on the Internet.

2. Sections 4 and 14 of the paper show clearly:

   $X = r^m \sin m\varphi + r^m \cos m\varphi$.

3. Gauss's paper consists of his statements of the subject and theme, followed by a summary of the "proofs" by d'Alembert, Euler, and Lagrange, with Gauss's refutation of each, followed by Gauss's own proof.

4. Example of this paradox:

   $x^2 + 4 = 0,\ x^2 = -4,\ x = \sqrt{-4},\ x = 2\sqrt{-1}$.

   Or:

   $x^2+1 = 0,\ x^2 = -1,\ x = \sqrt{-1}$.

5. This is from Euler's "Recherches sur les racines imaginaires des equations," published in the *Memoires de l'Academie des Sciences de Berlin* in the year 1749. I add an insight to just how fake E. was acting. Euler didn't want to dirty his proof with "shadows of shadows." He "proves" that he can resolve equations down to "real" roots by creating conditions where the anomaly of $\sqrt{-1}$ will not arise, using logic that supports his assumption. "I can't deal with $\sqrt{-1}$, it makes my system lose credibility, I have to create conditions in which the paradox doesn't come up."

   Before the public, Euler didn't want to dirty his proof with such uncouth quantities. But behind the scenes, he admits they are useful! Euler is like the immoral Bernard Mandeville, who denounced whores as a public evil, but behind the scenes used them to obtain a better knowledge of his libido. Euler writes:

   > "Although it seems that the knowledge of the imaginary roots of an equation would be devoid of any use, since they furnish no (real) solutions to any problem, nevertheless it is very important in analysis to become familiar with the imaginary quantities because we thereby not only obtain a more perfect knowledge of the nature of equations; but the analysis of the infinite can enjoy considerable benefits."

6. As LaRouche aptly observed:

   > "You must choose between truthful knowledge and learning, or, under present conditions of global crisis, be prepared to give in to a curious impulse to swarm over the edge of the now waiting cliff, squeaking in gregarious ecstasy on the way to doom, as the fabled lemmings would." (Lyndon LaRouche "The Next Generations," in *EIR*, Nov. 22, 2002, Vol. 29, No. 45, p. 43.)

   As the doomed cry out, "Bring us death!" fleeing into an orgasmic fit like lemmings off a cliff, ignorant of how to challenge those assumptions which have brought them there, I call on Americans to employ the method of Gauss bringing the mental disease of free trade to self-conscious examination.

7. Dead. No magnitudes. No principles. What is revealing of E.'s nature, and why he looks at numbers as symbols, can be found in his attack against Leibniz's "Monadology." He reduced monads down to a point on a line. How small? As small as you want them, you can always divide a line into smaller parts! He led a fight to destroy the monadology! To destroy this, Leibniz's political statement, defending the view of humanity as made in the image of the Creator, that human beings can make discoveries, and know the principles determining the operation of material things. Just on that basis, the fact that he was the judge for who got the best prize for refuting Leibniz, is revealing as to Euler's Satanic tendencies. (See David Shavin's review of a book about Maupertuis, a contemporary of Euler who participated in the scandal: "Maupertuis: The Man Who Tried to Flatten Leibniz," in *21st Century*, Spring 2004, p. 48. This is also available at the magazine website, www.21stcenturysciencetech.com.)

8. So what did Gauss think about number? His teacher Abraham Gotthelf Kaestner was in the tradition of Plato, Cusa, Kepler, and Leibniz. Gauss certainly saw flaws in math at the time, but was he just a rebellious youth? What allowed him the insight? Some insight into how Gauss thought, can be found by looking into the feud between his teacher Kaestner and Euler. In Kaestner's 1758 *Anfangsgrunde der Mathematik*, which was a standard reference for the teaching of mathematics at the time when Gauss began his studies at the Carolineum in Braunschweig, Abraham Kaestner introduced negative numbers in the following manner:

   "Opposing magnitudes are magnitudes of the sort, that arise through consideration of such conditions, in which one magnitude reduces another—for example assets and liabilities, forward and backward motion, etc. One of the magnitudes, whichever one chooses, is called positive or affirmative; the opposite is called negative or negational."

   Compare that with Euler's approach, in his algebra text from 1770: "It remains still to solve the case where (−) is multiplied by (−) or, for example (− *a*) by (− *b*). It is obvious initially that as for the letters, the product will be ab; but it is dubious still if it is the sign + or well the sign − that it is necessary to put in front of the product; all that one knows, is that it will be one or the other of these signs. However I say that it cannot be the sign −; because (− *a*) by (+ *b*) gives (− *ab*) and (− *a*) by (− *b*) cannot produce the same result that (− *a*) by (+ *b*); but it must result the opposite from it, i.e. (+ *ab*); consequently we have this rule: + multiplied by + made +, just as − multiplied by −."

   Did Euler know? Was it simply an accident that 12 years *after Kaestner*, he turns numbers into dead symbols? Did he know that numbers weren't objects, but about magnitude? Is this why Gauss is attacking him?

9. Number is a lawful part of how human beings measure our actions and ideas in the universe, and as you discover the bounding principles of any given manifold, it is like a lever to discover even higher bounding principles, seemingly "infinite" or "impossible" to the manifold you are in. A classical thinker thinks, "Okay, what assumptions are being made about the causes of particular phenomena, which are making it impossible to find the solution to a paradox." When that is realized, we are on our way to finding the solution.

   Once we can see what we are missing, whole new possibilities and potentialities open. The $\sqrt{-1}$ is such a window to realize that our current understanding is limited, and demonstrates the nature of humanity: to discover the lawful ordering of the universe! As in an economy that goes against natural law, eventually this higher bounding principle will make itself clear; usually in ways that are not pleasant for posterity. But the beautiful thing about being human, is that these bounding principles can be discovered before the entropy of being stuck in one set of axioms sets in. That is why this is the best of all possible worlds! Were Euler and Lagrange human, not rabid empiricists living in a shadow world of effects, they could have wondered at the generating principles of the axiomatic system of algebra, proving the necessity of its existence. Of course, in their case, they'd have had to leave the Church of Satan first! Maybe Bush and Cheney should learn a lesson from them!

10. In Gauss's paper it is completely ironical that he doesn't talk about the square root of $\sqrt{-1}$ in his proof. The paradox disappears inside the more truthful manifold, and one is left wondering, where is the $\sqrt{-1}$?? What happened? There is a method behind the comparison of a false method and a truthful method. The question I had was, is it always true, that such irony is produced when looking at a false set of axioms from the standpoint of true ones? Is there an inherent irony produced by the juxtaposition of a manifold and its higher generating manifold? Or does the irony come about only if it's intentional by the composer?

11. For more information see Bruce Director's article on "The Fundamental Theorem of Algebra: Bringing the Invisible to the Surface," in *Fidelio*, Summer/Fall 2002.

China Takes the Lead in Nuclear Energy

by Marsha Freeman

The People's Republic of China is implementing an energy program which will bring online as many as 30 new nuclear power plants over the next 15 years, putting China in the forefront of world research and development in nuclear science and engineering. This effort stands in stark contrast to the situation in the United States, where the Bush Administration's "pro-nuclear" energy plan is to try get *one* new commercial power plant built over the next decade, and to delay development of advanced reactor systems—some of which the U.S. tested decades ago—into the indefinite future.

The Chinese economy has been growing at an average rate of 8 percent per year, with electricity demand growing twice that fast. The Ministry of Electric Power has estimated that 15 to 20 percent of China's present energy demand cannot be met, and that 100 million Chinese have no access to electricity. Last year, China's State Electricity Regulatory Commission warned that the situation was worsening, as the country faced, in the Summer of 2004, a shortfall twice as large as that of the year before. To keep up with its rate of economic growth, China estimates that it will have to double its electric-generating capacity every decade. At 385,000 megawatts (MW) of current online capacity, China has an electric grid system second only to the United States.

Simply expanding the use of coal to meet this growing demand is not an option. Already 40 percent of China's railroad capacity is dedicated to hauling more than 1 billion tons of coal per year (two-thirds of China's energy is produced from burning coal). Although China is the world's sixth-largest producer of petroleum, it now imports one-third of its oil. As far back as the late 1970s, China knew it had to go nuclear; now it is systematically carrying out the multifaceted program that will make it a world leader in nuclear energy technology.

© AREVA/Liesse

China's Ling Ao 1 and 2 nuclear plants in Guangdong Province. Both 1,000-MW pressurized water plants were supplied by AREVA, and commissioned in 2002. China plans to build 30 more nuclear reactors by 2020.

China Goes Nuclear

China's multi-pronged nuclear strategy follows the same strategy as its program in space exploration. First, rather than reinventing the wheel, China has imported commercial power plants from Russia, France, and Canada, to have the immediate benefit of nuclear energy, and to train its own cadre of engineers and operators. Today, China has nine reactors operating and two under construction, with nuclear energy accounting for about 2 percent of its total electricity output.

In the late 1990s, as the large-scale construction of nuclear plants was under way, Chinese officials were already planning for the 21st Century. China plans to choose one reactor design (and supplier) for its next group of nuclear plants, to enable it to standardize its nuclear operations, rather than continue with the widely varying designs now in place, from different suppliers. The goal is to have an increase of nearly sixfold in nuclear capacity, up to 40,000 MW by 2020, from 8,700 MW today.

Because of the size of China's electric system, even this aggressive effort will bring nuclear's share up to only 6 percent of installed electric-generating capacity. This program requires that at least two new reactors come online each year, over the next 16 years. By 2050, China plans to have 150,000 MW of nuclear capacity, equivalent to 150 large power plants. (There are about 440 nuclear reactors today, worldwide, and 103 in the United States.)

Critics of all political persuasions have insisted that such "breakneck" speed in nuclear power plant construction cannot be achieved. John Moens, an analyst at the U.S. Department of Energy, differed. On Jan. 15, he told the *New York Times:* "In 1970 we had a net capability of 7 million kilowatt hours [of nuclear generating capacity in the U.S.], and by 1981 we had reached 56 million kilowatt hours. So the rate of growth [the Chinese] propose is not only conceivable, it has been done before."

Tsinghua University

Scientists at Tsinghua University (below) power up China's high-temperature gas-cooled pebble bed reactor (HTR-10) for testing in December 2000. At right is the reactor building in Beijing.

According to officials from the China National Nuclear Corporation (CNNC), the decision has not yet been made as to how many reactors in the next group of imported plants will incorporate the newer, recently licensed next- or third-generation technology, and how many will use the current-generation designs, with "some improvements." CNNC estimates that for quick expansion, the most efficient approach is to add more plants at existing sites, using the same reactor design as the operating units.

More advanced, next-generation reactors will likely be chosen for new power plant sites. This program is of such national priority that, according to *China Business Weekly,* delegations which included Chinese President Hu Jintao have been visiting existing and potential sites for nuclear plants along China's coastal areas.

In July 2004, the government approved the construction of four nuclear plants, and in September, CNNC director Yu Jianfeng, during an interview at the World Energy Congress in Sydney, Australia, said that China will soon award an $8 billion contract for the four nuclear reactors, with work to begin in 2007. Each set of two reactors will be located in Guangdong and Zhejiang provinces, which have been suffering from power shortages; the reactors are expected to come online in about 2012. Yu said that about 70 percent of the equipment for the reactors will be Chinese-made.

China has invited Westinghouse, the French-based Areva, and Russia's AtomStroyExport to bid on the first four plants. In September 2004, the government also approved construction of another four reactors.

Indigenous Capability

As a second aspect of its overall effort, at the same time that China has been importing commercial-scale nuclear plants to add to its electricity grid, domestic programs have been under way to develop indigenous conventional nuclear power plant designs, in order to give China an independent production capability for domestic use, and also for export.

The 300-MW reactor at Qinshan, designed in China and built with 70 percent of its components produced domestically, began operation in 1991, and helped create a Chinese nuclear industry. In Phase II of its domestic R&D program, two 600-MW indigenously developed reactors were installed at Qinshan, and became operational in April 2002 and May 2004.

In July 2004, Ye Qizhen, chief designer of the second phase of the Qinshan nuclear project, and a member of the Chinese Academy of Engineering, said that Chinese engineers could "easily develop" a 1,000-MW reactor, based on the 600-MW design, if they introduced foreign-developed design software. *China Business Weekly* reported in February that China plans to build its 1,000-MW reactor before the first foreign third-generation nuclear reactors are built, around 2012.

China's program to develop its own nuclear power plant production infrastructure is aimed at export, as well as domestic deployment. In 1999, the Chashma-1 nuclear reactor became operational, 167 miles south of Islamabad, in Pakistan. The 300-MW reactor had been completed with help from China. In 2004, China's First Heavy Industries Company won a public bid to supply the Chashma-2 reactor's pressure vessel, which will be built in Dalian and completed in 38 months.

The international nuclear non-proliferation mafia has tried to bully China into reneging on the latest Pakistan nuclear plant project, but because that reactor will be under the inspection regime of the International Atomic Energy Agency, and the United States is eager to procure at least part of China's $8 billion construction program, no threats have yet been made.

Versatile High-Temperature Reactors

A third facet of the program, occurring at the same time that the Chinese are importing commercial nuclear plants, and developing their own capacity to build and export them, is the research and development program in which

China is engaged, intended to push forward on the next-generation nuclear technologies.

Energy produced from the fission of nuclei is typically captured as heat and used to boil water for turbine-generator sets to produce electricity in a power plant. This is the least efficient use of the energy from nuclear fission: Two-thirds of it is wasted in the thermal-to-electricity conversion process.

If the temperature that can be extracted from a nuclear reactor is higher, in the 800-1,000°F range—perhaps three times that of a conventional reactor—that higher-quality heat can be used to produce hydrogen from water to be used for fuel, direct electrical production, and desalination.

China started a high-temperature gas-cooled reactor research and development program in the 1990s at Tsinghua University in Beijing, often described as China's MIT. Tsinghua also has a very active space engineering program, and has designed satellites and space experiments.

A $30 million, 10-MW high-temperature gas-cooled pebble bed reactor (HTR-10) began construction in 1995, and started thermal testing in December 2000. In 2003, the reactor was incorporated into the power grid. In the Fall of 2004, Chinese scientists proudly displayed their HTR-10 to an international group of nuclear experts, and carried out a demonstration, showing that it is "passively safe." In other tests, the coolant for the reactor has been switched off, and the reactor cooled down safely by itself.

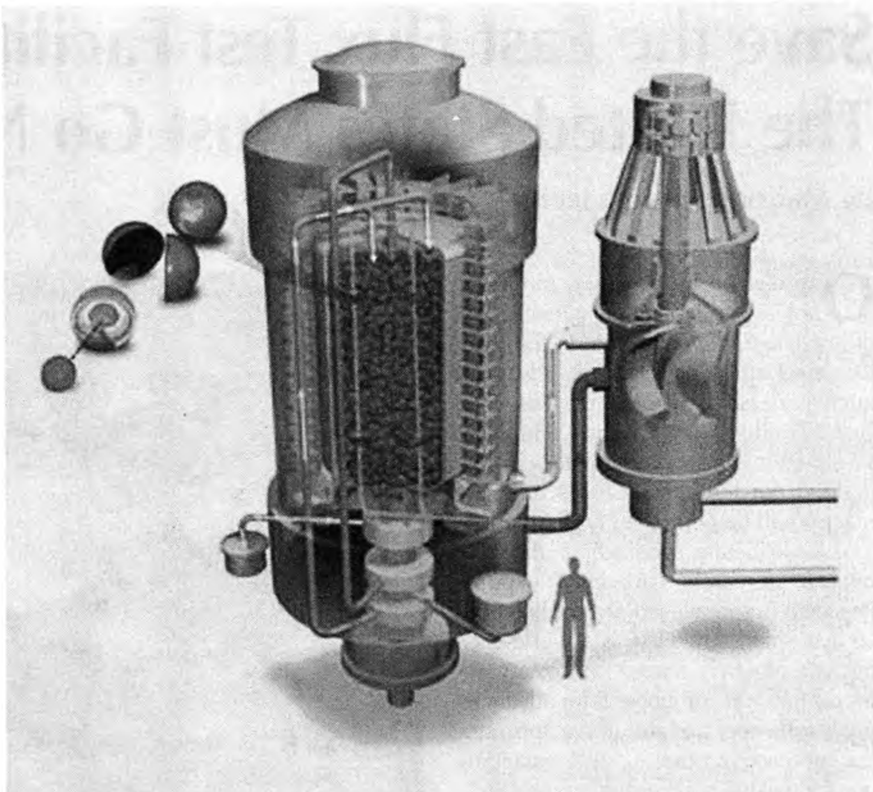
The "pebbles" in the reactor are the 27,000 graphite billiard-sized balls that enclose the fissionable uranium, insulating each particle and dispersing the fuel. Instead of circulating water, with its miles of pipes, the reactor is cooled by the circulation of helium gas, which can withstand higher temperatures. The reactor does not have to be shut down for refuelling, because the spent fuel balls can be automatically removed, and new ones inserted while the reactor is operating.

China is not the first country to build or test this advanced-design high-temperature reactor. Rudolf Schulten designed a pebble bed high-temperature gas-cooled reactor prototype that was built in what was then West Germany, in 1985. The United States also had a high-temperature test reactor in that period, built by General Atomics in Colorado. But anti-nuclear hysteria and the decline in energy growth, because of growing depression economic conditions in the past 30 years, left those, and other, experimental reactors, shuttered or dismantled. In the mid-1990s, Eskom, the government national utility company of South Africa licensed the German pebble bed reactor design, and has been developing a prototype modular reactor.

China chose Tsinghua University to be its center for the development of the technology, and plans to have a full-scale 195-MW version of its HTR-10 on line by the end of this decade, at an estimated cost of $300 million. Half of the financial stake in the joint venture building the plant has been taken by one of China's largest electricity generators, Huaneng. Concrete will be poured in the Spring of 2007.

China's nuclear industry plans to sell these 200-MW-size reactors to utilities and in rural areas as modules which can be mass-produced and assembled quickly, with additional modules grouped together as electricity demand grows. Wang Yingsu, an official of Huaneng, told the *Financial Times* during a recent tour of the HTR-10: "If it succeeds, we can then spread this technology both at home and to the whole world."

Some policymakers are concerned that China may make progress in its space program fast enough to send their citizens to the Moon before George Bush's go-slow Moon-Mars mission gets the United States back there. In the nuclear field, China has already pulled ahead.



Andrew Kadak, MIT; Institute of Nuclear and New Energy Technology, Tsinghua University; World Nuclear Association

A schematic of a pebble bed reactor. Thousands of billiard-ball-size fuel pebbles power the reactor, each coated with impermeable silicon carbide and packed with 15,000 tiny flecks of uranium dioxide, each of which is encased in its own silicon carbide shell. The pebbles flow through the reactor vessel, heating helium gas, which, in turn, flows into the water-cooled conversion unit and pushes a turbine (right), generating electricity. The gas then cycles back to the reactor vessel to be reheated.

China's High Temperature Reactor (HTR), a pebble bed design, is the leading edge of China's long-term nuclear program.

Save the Fast Flux Test Facility! The United States Must Go Nuclear

by Marjorie Mazel Hecht

One day in the next two months—unless we stop it—engineers will drill a 1-inch-diameter hole in the reactor vessel of the premier U.S. advanced nuclear research reactor, the Fast Flux Test Facility (FFTF) in Hanford, Washington. The sodium coolant will be drained out through the hole, and the reactor will be permanently disabled.

This deliberate sabotage of the U.S. nuclear research capability exposes President Bush's alleged pro-nuclear policy as a sham. The FFTF is a world-class nuclear research reactor, necessary for testing fuel and components for advanced nuclear breeder and fusion reactors, producing medical isotopes, and expanding our knowledge of neutrons.

The FFTF was conceived in the 1960s and built in the 1970s, to serve what was then assumed to be a nation whose future energy supply would be provided by advanced nuclear technologies. Its signature capability—production of fast neutrons—makes it crucial for understanding nuclear processes and creating more efficient future fission and fusion reactors. Although the FFTF performed flawlessly for ten years, it was put on death row in 1990, when the Department of Energy (DOE) ruled that it should be shut down, because there was no "long-term" mission to justify its operating costs (about $100 million per year).

The FFTF *is* America's energy future. Nuclear is the only alternative to oil-dependence. Without it, we cannot sustain the United States or the world population. Neutrons have always been key to nuclear development. Understanding them will allow us to design more efficient reactors, to breed more nuclear fuel in nuclear and hybrid fusion-fission reactors, and to develop the materials that can withstand the higher temperatures of fusion energy.

The FFTF is a national treasure. Without it, the United States is headed for a New Dark Age. There is not much time left—but the DOE decision still can be reversed. A group of FFTF supporters has been battling for years to save the FFTF, and to counter the fear-mongering of the anti-nukes as well as the cupidity of some local citizens who would prefer to get $2 billion in clean-up contracts from the DOE than to fight to save a key national research facility.

DOE

The Fast Flux Test Facility, at Hanford near Richland, Washington. The white dome is the containment building for the 400-megawatt test reactor.

The FFTF Achievements

The Fast Flux Test Reactor is a type of reactor known as a breeder, a reactor that generates power from its uranium and plutonium fuel, and produces more nuclear fuel in the process than it consumes. It is the answer to energy shortages for years to come. If hooked up to a steam turbine, the 400-megawatt reactor could power a city of 30,000. The FFTF's purpose, however, is not power production, but the production of neutrons, at all velocities and density of flux.

The FFTF was completed in 1978, and began full-power operation in 1982, under the management of Westinghouse Hanford. For ten years it tested materials and fuel components for fast breeder and fusion reactors under actual operating conditions, so that their performance could be known before being built into new reactors. The FFTF was also used to transmute high-level nuclear waste, to test space nuclear fuel systems, and to produce 60 special isotopes for life-saving medical use and for industry.

This isotope production is essential for supplying both frontier cancer-treatments and routine diagnostic testing (in the United States there are 36,000 diagnostic tests with radioisotopes per day). Right now, the United States has to import 90% of its medical isotopes from Canada and Europe, and many are hard or impossible to get.

The FFTF was working on an advanced fuel design using new alloys, that would have an operating lifetime three to four times longer than previous fuel systems. This would bring the cost of future breeder reactors near to that of conventional reactors. The new fuel system, using new materials that are resistant to radiation damage, would stay in the reactor core three to five years (instead of one year). At the time, Westinghouse estimated that the fuel cost would decrease from about 13.5 mills per kilowatt/hour to less than 7 mills. Also being tested were new safety features, such as passive systems that ensure reactor shutdown and core cooling without operator intervention and without electrical power, if a problem arises.

But, the DOE axe fell in 1990, ordering the FFTF to shut down, and stopping—without advance notice—a Japanese project to test components for its fast breeder reactor that was in progress under a paid contract. Local residents mobilized to save the FFTF, and through legal actions and political pressure have kept the FFTF alive, although it is still on death row. FFTF supporters have searched for private contracts to keep the facility in operation, and came up with a potential buyer, an isotope production company. But despite a Bush Administration that promotes "privatization," and despite the millions of dollars proffered by this company to buy the FFTF as "government surplus," the DOE said "no" to the offer in 2004. The DOE is standing by its decision to kill the FFTF.

At the same time, the anti-nuclear groups targetted the FFTF-shutdown as a "trophy kill," understanding that if the United States were to have an advanced nuclear capability, it would need the FFTF. The anti-nukes understand that the shutdown would greatly damage U.S. nuclear capability, and would disperse a specialized workforce of scientists, engineers, and technicians—which dispersal is desirable from the anti-nuclear point of view. These well-funded Luddite groups assailed the public and elected officials with the usual propaganda and lies, playing on fear of anything nuclear.

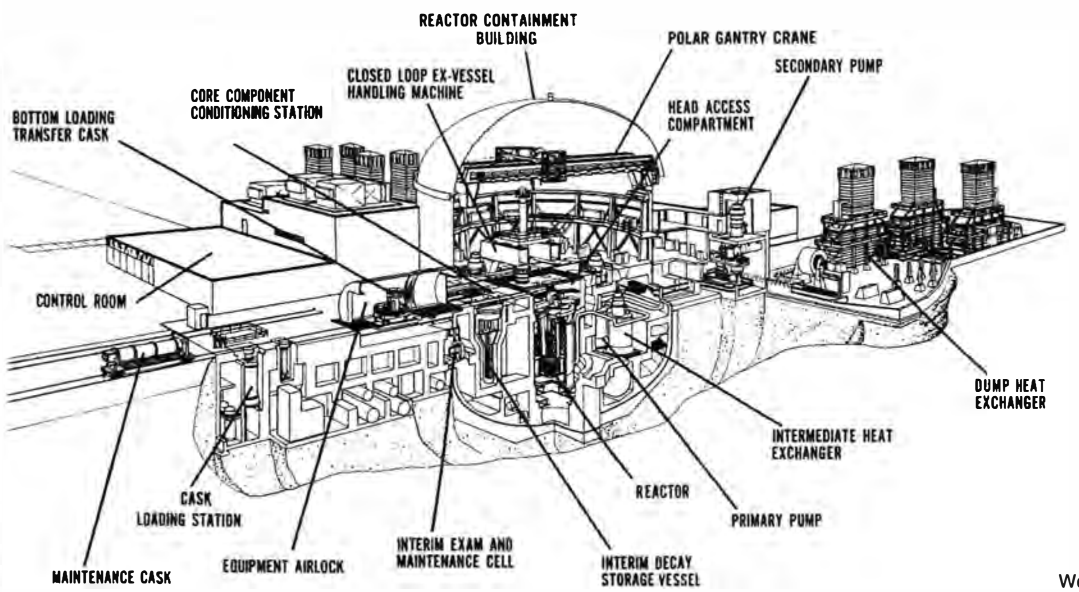
This FFTF battle has raged now for 15 years.

The Revolution of Breeder Reactors

Breeder reactors, also called fast reactors (because of their fast neutrons) produce power at the same time that they create new nuclear fuel. For a country without oil or uranium (like Japan), the breeder offers a way to become self-sufficient in supplying energy for an industrial economy. And as Enrico Fermi said in 1945, "The country that first develops a breeder reactor will have a competitive advantage in atomic energy." In 1951, the United States was the first to demonstrate the technical feasibility of breeding fuel in the experimental breeder reactor, EBR-I, in Arco, Idaho. This reactor was also the first reactor to produce electric power from nuclear fission. Thirty years later, the United States made a decision to drop that competitive edge and ditch the breeder concept.

A nuclear reactor is an efficient way of generating heat to boil water and make steam, which turns turbines that turn generators to produce electricity. In conventional power plants, the heat comes from burning coal, oil, or natural gas, using up these resources and spewing by-products into the atmosphere. One tiny pellet of uranium fuel (1.6 grams) can generate as much electricity as 6.15 tons of coal. The heat of a nuclear plant comes from nuclear fission, the splitting up of the uranium nucleus by slow-moving neutrons. Each time a uranium nucleus splits, it generates heat in the form of fast-moving particles made up of lighter elements. Each fission also produces several additional neutrons. If these can be slowed down, they will cause another fission, and another, and another—a chain reaction.

In a conventional reactor, a moderator, such as water or heavy water, slows down the fast neutrons produced by the fission reaction to a rate that is optimal for maintaining a chain reaction. If the neutrons are too fast, they go right through the fissile material (uranium-235 or plutonium-239), without causing fission. The neutrons have to stay around long enough to hit a fissionable atom, which splits it into two fission



The FFTF is a liquid-sodium-cooled reactor with a fuel of mixed uranium oxide and plutonium oxide. Fast flux refers to the speed of neutrons produced in the reactor core during the fission process. The reactor vessel is located in the dome-shaped containment building.

Westinghouse Hanford Co.

products and several neutrons. These neutrons go on to hit other fissionable atoms, or to form plutonium-239.

In a breeder reactor, these neutrons are not moderated, or slowed down, but are caught in a "blanket" of uranium or thorium surrounding the reactor core. There, the neutrons produce new fissile material, such as plutonium-239. At the same time, the heat produced by the fissioning is used to generate electricity.

The FFTF has the temperature and fuel characteristics of a fast breeder, but it does not breed fission fuel. Its purpose is to test components and fuel for the breeder and fusion reactors, and to give us a better understanding of neutrons.

Life on Standby

In 1993, the FFTF, a billion-dollar facility, was again sentenced to death by the DOE. Since then, the FFTF has been on "standby," not yet irretrievably dismantled, as the DOE has pursued various steps for the shutdown execution and environmental impact statements. From 1994 through 1997, the nuclear fuel was removed from the reactor and stored in above-ground dry storage casks. Some of its systems were shut down, but the DOE then wanted the facility to remain on standby, in case it could be used to produce tritium for the weapons program. (The FFTF had not previously been involved in producing tritium.) In 1998, it was decided that this would not be done, and, pending environmental impact studies, that the shutdown should proceed. There were other brief halts, as the DOE was legally challenged or as it considered other possible missions, but the "deactivation" has been proceeding.

In a breeder reactor, liquid sodium is used to carry the heat from the reactor core, where the fission takes place, to where it is wanted. Sodium is used as the coolant because it does not slow down the fast neutrons, and it efficiently moves the heat generated in the fission process.

In the last two years, the liquid metal sodium in the FFTF has been drained from both the primary and secondary cooling systems, but thousands of gallons of sodium still remain in the reactor vessel itself. The last 16,000 gallons of sodium have to be drained by a June 30, 2005 DOE deadline. The most efficient way to keep the last amount of sodium hot until it could be drained, was to keep it at 385°F. in the reactor vessel, where there are immersion heaters. (Sodium melts at 208°F.)

Once the last 16,000 gallons are drained out, the FFTF cannot be restarted. Draining requires drilling a 1-inch-diameter hole in the 3-inch plate of steel at the bottom of the vessel. That hole, and the metal shavings it leaves, will disturb the flow pattern of sodium around the vessel. In addition, the shavings are dangerous to have in the system, and could potentially mess up pumps or clog portions of the flow in fuel assembly, which would cause the fuel to overheat.

At any point before the drilling of that hole, the reactor could be restarted, and the sodium could be put back into the cooling system. But the longer the pipes sit, exposed to the atmosphere, the more chance there is for corrosion.

Bad Faith of the DOE

Local citizens who have been fighting since the 1990 death sentence to keep the FFTF alive, recently discovered through Freedom of Information Act inquiries, a July 15, 2002 memo from Kyle E. McSlarrow, DOE Chief of Staff, which states: "On December 19, 2001, Secretary Abraham directed that actions be taken to proceed immediately with the deactivation, decontamination, and decommissioning of the fast flux test

Why the FFTF Is Unique

The FFTF is unique because it produces a lot of neutrons, fast: at peak, 7.5×10^{15} neutrons per square centimeter per second. That's 750 times as much as other research reactors, which have a neutron flux of 1×10^{13} neutrons per square centimeter per second. This means, that if you want to test how a particular material would stand up in a commercial power reactor, you could subject it to neutrons in the FFTF, and in a few days or longer (depending on the material and its use) simulate the long-term effects of neutrons on that material.

The fast flux of neutrons, its large target volume, and the high energy of its neutrons make the FFTF ideal for producing medical and industrial isotopes in quantity. Because of the high flux, there are higher reaction rates, so more of the targetted material can be converted to the desired isotope. The FFTF can also produce multiple neutron capture reactions to produce more exotic isotopes, and it can produce isotopes that are created only with very energetic neutrons. Some isotopes can also be produced in an accelerator or cyclotron, but not all of them, because the the neutron flux is not high enough.

To take one example: One of the most widely used medical isotopes is technetium-99m; there are 7 million diagnoses per year in Europe and 8 million per year in the United States using technetium-99m, which has a half-life of *six hours*. Right now, the United States imports almost all of this isotope—which created a serious problem after 9/11, when the supply was disrupted.

Life-Saving Isotopes

Technetium-99m can be produced in a cyclotron, but to do so requires a starting material that is a rare and costly form of molybdenum. However, production of technetium-99m in a fission reactor begins with the less expensive enriched uranium (U-235), which then produces molybdenum-99. The technetium-99m is supplied to hospitals and other institutions in an insulated container of this molybdenum-99, which has a half-life of 66 hours, and which decays to technetium-99m. So, delivery of the molybdenum-99 to medical sites can be weekly, with institutions extracting from it the technetium-99m that they need.

The FFTF will lower the cost of supply of molybdenum-99 even further, because production would be through a "capture" process, without requiring enriched uranium targets.

reactor." However, there was no such order by Secretary Spencer Abraham. Instead, as FOIA requests showed, the Secretary ordered only "deactivation." The difference is important: Deactivation is not necessarily permanent; it would not kill the FFTF, but would permit the possibility of its coming back into operation in the future.

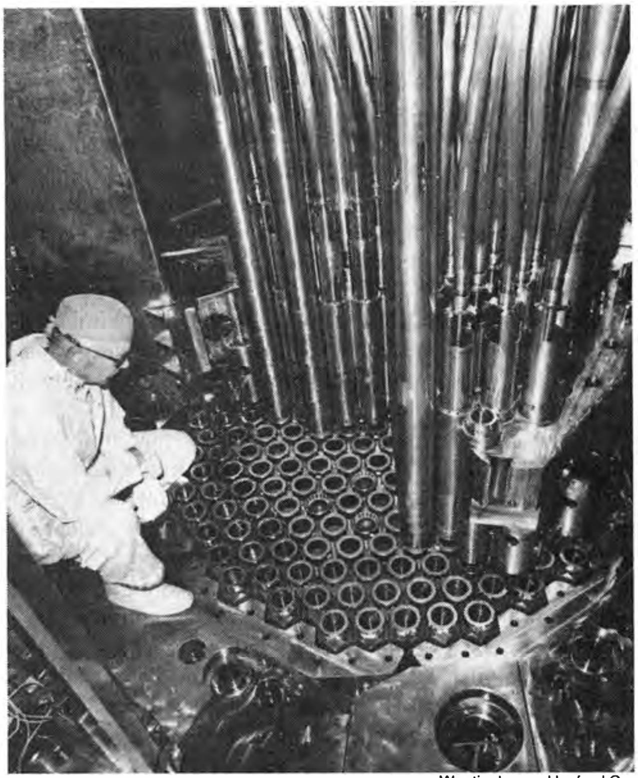
A spokesman for the Department of Energy's Press Office assured this writer that McSlarrow would never have written such a thing unless it were true, but when pressed for more specifics, has not called back.

FFTF supporters also uncovered the fact that former DOE Secretary Abraham made a trip to France in August 2004 in search of a supply source in the advanced French breeder reactor for testing the advanced fuels and materials that the doomed FFTF was designed to test! As a press release Aug. 24, 2004 states: "Secretary of Energy Spencer Abraham today signed an agreement with France's Atomic Energy Commission Chairman Alain Bugat [which] . . . specifically provides DOE access to the Phenix fast spectrum test reactor, which has a capability that no longer exists in the U.S." The release goes on to say, "The cooperation has provided access to French R&D that has saved the U.S. tens of millions of dollars."

But, has it? The real cost of this technology outsourcing is the nation's future as an advanced industrial economy—a fact that eludes this Administration, even as it mouths pro-nuclear statements.

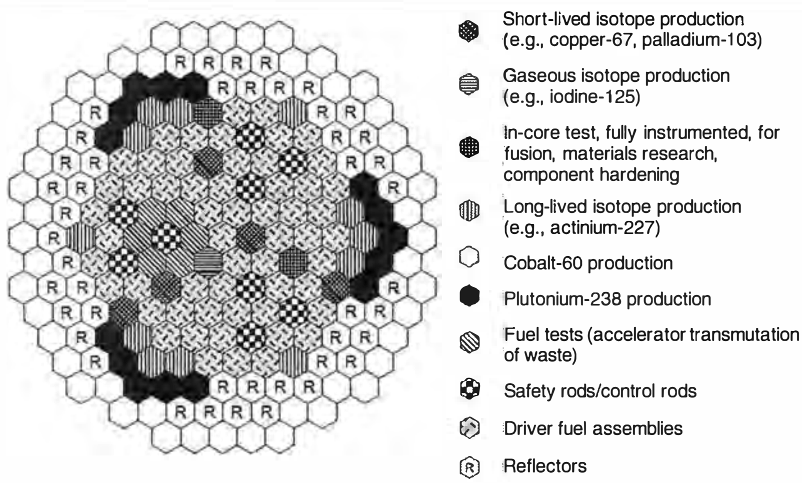
Another outsourcing fiasco in the works is that the DOE is looking for facilities abroad to test new types of nuclear fuel for the one new reactor that is planned for the future. This is a job that the FFTF was designed to handle, and as one of the scientists in charge of testing new fuel components wrote about the difficulties of outsourcing: "It will inevitably prove to be more difficult and constraining than we imagine early on. . . . [W]e are finding that experiment to be more time consuming and cumbersome than originally envisioned, and the benefit will be considerably more limited than a similar test that we would have performed in EBR-II [now shut down] or FFTF. . . ."

Even a cursory look at the DOE's record on the FFTF indicates its bias.



Westinghouse Hanford Co.

The FFTF fuel assembly grid (below) with reactor operating equipment (above). Pelletized fuel of mixed uranium-plutonium oxide is stacked in a 3-foot column inside stainless steel tubes to form fuel pins, which are arranged in 217-pin assemblies for insertion into the core. Samples of nuclear fuel and other breeder reactor materials are placed in the core for testing.



Schematic of FFTF test core, with multiple missions. The hexagonally shaped ducts contain fuel rods, control rods, isotope production experiments, fuel tests, and so on. Production of some isotopes requires slower neutrons, which is achieved by placing appropriate materials around the irradiation target. Some of the test locations are designed to have direct-contact instrumentation during the reactor operation, for example, for rapid retrieval of short-lived isotopes.

Source: D.L. Nielsen, Appendix D, *Fast Flux Test Facility Data Request in Response to Data Call for Nuclear Infrastructure Programmatic Environmental Impact Statement*, BWHC-9958233, B&W Hanford Co., Richland, Wash., 1999.

One scientist familiar with the project since its inception stated flatly that the staff throughout the middle levels of the DOE is anti-nuclear, and has been since the Carter days. Now, no one at the top wants to admit that the decision to shut down the FFTF was wrong, he said, because then they would be responsible for the lives lost because of the lack of isotopes for medical treatment that could have been provided by the FFTF.

The DOE is riddled with anti-nuclear staffers, and has been since the days after Dixy Lee Ray left the Atomic Energy Commission in 1975. But equally to blame is the monumental stupidity of a government bureaucracy that uses a cost-benefit analysis measured in instant gratification. For example, the DOE Assistant Secretary for Nuclear Energy, William H. Young, stated at Congressional hearings on the FFTF, March 7, 1990:

"Production of medical and industrial isotopes at FFTF cannot be economically justified, and even together with other options, cannot significantly offset FFTF operating costs. . . . In view of the substantial cost savings resulting from a shutdown of the FFTF, and particularly in view of the intense competition for limited budget resources, the Department cannot justify FFTF's continued operation, and regrettably its shutdown is our only prudent course of action."

Meanwhile, the DOE's own studies, such as the "Expert Panel" convened in March 1999, forecast a coming crisis in isotope availability, and lamented the brake put on medical advancement because of the lack of a reliable isotope supply. The 1999 report produced by the Expert Panel spelled out the tremendous savings in lives and dollars that would come from new technologies using isotopes:

"It has been demonstrated that the use of myocardial perfusion imaging in emergency department chest pain centers can reduce duration of stay (12 hours vs. 1.9 days) and reduce charges ($1,832 per patient) compared to conventional evaluation (*J. Nucl. Med.,* 1997, Vol. 38, p. 131). F-FDG PET has been studied for detecting and staging recurrent ovarian cancer. Potential savings were estimated at $8,500 per patient with PET (*J. Nucl. Med.,* 1998, Vol. 39, p. 249). Non-Small-Cell-Lung Cancer (NSCLC) can be staged with whole body FDG PET 'resulting in fewer invasive procedures and a savings-to-cost ratio of more than 2:1' (*J. Nucl. Med.,* 1998, Vol. 39, p. 80).

"These examples illustrate that a lack of knowledge is very expensive. Nuclear medicine can offer improved patient care at reduced cost over conventional treatments. Though the cost of providing a reliable and diverse supply of isotopes for medical use may seem expensive, it will surely pay for itself in reduced patient care costs, improved treatment, and improved quality of life for the millions of patients that will take advantage of this technology."

The DOE's bias and illogic jump out in everything the Department writes about the FFTF. For example, the *Federal Register* Aug. 13, 2004, giving notice of DOE's intent to prepare an environmental impact statement for the decommissioning of the Fast Flux Test Facility at the Hanford site, states in part: "Other reasonable alternatives that may arise during public scoping and preparation of the draft EIS [Environmental Impact Statement] would also be considered. Because DOE has made a programmatic decision to permanently shut down and deactivate FFTF, and is currently performing deactivation activities consistent with this decision, restart of the FFTF is not considered a reasonable decommissioning alternative. . . ."

Greed and Fear

The DOE's nuclear program in the United States is now centered on billions of dollars of "clean-up" money to clean up the nuclear sites from the Manhattan Project and the Cold War years. These are unscientific programs, emotionally driven, involving an army of staff, operating on the perception that no level of radiation whatsoever can be tolerated. The Hanford Nuclear Reservation is one of the main clean-up sites.

Given this situation, one of the more disgusting aspects of the FFTF issue is the capitulation of some local citizens to greed. Instead of fighting to keep the FFTF alive, they are fighting for a piece of the burial contract. The issue is whether the huge decommissioning and clean-up contract for the FFTF should be awarded to a local or an "outside" firm. About $2 billion is involved, and reportedly, political figures in the state have responded to the greed-mongers by agreeing to oppose the FFTF. How deep this opposition is remains to be seen.

Having made this clean-up boondoggle their fight, these locals are now saddled with the enormous baggage of lies about the "clean-up" of the Hanford Nuclear Reservation, on which the FFTF is situated. It means suspending one's reason and entering the fear-land of the nuclear radiation bugaboo, where any radiation is seen as dangerous. Such fear-land inhabitants don't understand that human beings can't live without radiation, that zero-radiation is not possible, and that there are scientific ways to determine whether something is actually dangerous.[1]

A Paradigm Shift

Let's look back at the time when the FFTF was conceived and built. In the 1960s and early 1970s, the spirit of the Atoms for Peace program still prevailed. Nuclear energy and its advanced applications were envisioned as ways to provide a better living standard for growing populations worldwide. We had already put a man on the Moon, and there were plans to explore and colonize space. In the United States, more advanced nuclear reactors were planned, to provide a safe and reliable source of electricity, and many applications of nuclear technology—space propulsion, food irradiation, nuclear medicine, desalination, agriculture, to name a few—were under development. It was assumed that advances in fundamental science—understanding the complex behavior of neutrons and their interactions with nuclei—would lead to all sorts of future advances, including more efficient ways to generate nuclear power

Fusion energy was seen as the next-generation nuclear technology to be developed by 1990. Children's books were written about rocket science and the world of the atom, because that was the world children wanted to be part of when they grew up.

The FFTF came on line in 1980, and it performed all its tasks well until 1992, including the production of specialty isotopes used in innovative and successful cancer treatments. But since its conception and authorization in the 1960s—in a time of scientific optimism and progress—and its coming on line in 1980, the political situation had drastically changed. Instead of the Atoms for Peace idea, where the United States would complete the nuclear fuel cycle, reprocessing spent fuel and breeding new fuel in breeder reactors, the United States was being pushed into a "post-industrial" mode.

The U.S. breeder program was stopped in midstream, by the overtly anti-nuclear Carter Administration, which launched a fear campaign against

FFTF technicians in 1986, working on a fuel assembly. Each fuel pin is less than a quarter-inch diameter and about 8 feet long. The fuel pins are gathered into 217-pin assemblies, like the one shown here, which are housed in hexagonally shaped ducts in the reactor core.

nuclear "proliferation." The breeder reactor was labelled by its very nature as "bad." (In fact, when the FFTF, the nation's first industrial-size breeder reactor, achieved criticality—the start-up of the chain reaction—on Feb. 9, 1980, the anti-nuclear DOE didn't even take notice.)

The Reagan Administration continued Carter's anti-breeder policy, by "privatizing" the breeder to death. Without some form of government support, and in an increasingly hostile environment, no individual company was willing to invest in developing a demonstration breeder reactor, especially given the well-funded and growing anti-nuclear environmentalist movement. The Clinch River Breeder Reactor in Tennessee was mothballed in 1983.

The same mentality that shut down the Clinch River Breeder, squeezed nuclear plant construction to death with high interest rates and environmental interventions that had nothing to do with the environment, and stopped the spread of Atoms for Peace to the developing sector, is clearly not going to worry about advancing cures for cancer. If the nation valued its citizens, it would be pursuing the best options for understanding cancer by carrying out fundamental research, and treating it with the best means we have, such as the new cell-targetted therapies. Marlene Oliver, a biologist and member of the Nuclear Medicine Research Council and National Association of Cancer Patients, and one of the FFTF supporters, estimated that thousands of lives are lost in this country yearly because we are not developing the radioisotope technologies now being developed and used in Europe. The savings in lives, and in money now wasted on more costly and less effective technologies, would be in the billions, she has calculated—enough to pay for many FFTFs.

A Nuclear Renaissance

We need a nuclear renaissance now! It can't be done without the FFTF for materials testing, and new, even more advanced facilities, like the FFTF. It can't be done without a training facility for future nuclear scientists and engineers. Dr. Alan E. Waltar, former president of the American Nuclear Society, stated the case eloquently in 1990 at Congressional hearings on the FFTF:

"This reactor has no equal in the United States as an educational facility. Our nation stands at a critical turning point in education. Projections of an engineer shortage of approximately one half-million by the year 2010 and declining enrollments in 'hard' sciences in our colleges and universities are causing justifiable alarm in the halls of technology and academia. At the same time, engineering departments, especially nuclear engineering departments, are being deprived of their training reactors, crucial laboratory facilities, and qualified faculty by hard-pressed administrators faced with increasingly harsh budgetary constraints. Thus begins the vicious cycle. Student numbers reduce even further as programs disappear; the size of the scientific community diminishes; advanced technology with its attendant human benefits and comforts becomes no longer available to a declining economy.

"As the most advanced multipurpose operating reactor in the United States, the FFTF *must* remain available and operating if the men and women who are to design and run the progressive reactors of tomorrow are to be fairly served."

The nuclear renaissance is not just on Earth. To move out into space and return to an aggressive policy for space exploration and colonization will require more plutonium-238 for space nuclear generators and heat sources—something the FFTF can produce and test.

Information technology and outsourced labor are not going to bring about a renaissance. We need to train new generations of nuclear scientists and engineers to build the required nuclear reactors here and around the world. The United States now does not even have the industrial capability for building a large pressure vessel for a reactor, much less an infrastructure for mass producing fourth-generation nuclear plants or fusion plants.

The FFTF is a symbol of what this nation once dreamed about with Atoms for Peace. If we don't make the FFTF a reality now, we are on our way to the nightmare of Third World status and a New Dark Age.

Notes

1. For details on the Hanford cleanup, see Michael Fox, Ph.D., "Why Hanford's Nuclear Waste Cleanup Wastes Your Money," *21st Century Science & Technology*, Summer 2004.

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BOOKS REVIEWED

Viewpoint

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dard of length of the velocity of sound. It has nothing to do (as seems to have been assumed in one of the letters read to the meeting) with 32 feet as the length of an organ pipe, supposed (but very erroneously) to yield its fourth lower octave. If we would introduce extraneous considerations of this kind, we might take as a fundamental unit, on the French metrical system, a wave length of one meter, or its binary multiples or submultiples. This would give (taking the velocity of sound in dry air at freezing temperature at 1,090 feet) an E of 664.4 vibrations for the nearest approach to the new French E, corresponding to an A (tuned as a fourth above it) of 886 vibrations, the difference between which and the French standard lies in the wrong direction, and which coincides exactly with the Bordeaux pitch, as stated in reports of the French commission. Again, if we take the velocity of sound at the British standard temperature (62 degrees) at 1,124 feet or 342.6 meters, we shall be led to an F of 685.2 vibrations, corresponding to an A of 856, and a C of 514, a very near approach indeed to our own proposed C.

Or again, if we combine the British standard yard as a wave length, with a velocity of 1109.6 feet per second, corresponding to the mean temperature 49.27 F. at Greenwich, so as to get a purely British fiducial note, we are led to an F sharp of 739.7 vibrations, corresponding to a C of 526, which, though nearly approximating to the French C, lies above it, and is on that account objectionable. As the origin of a musical system, moreover, it would be an anomaly to take as the fundamental (or, more properly, fiducial) note of the diatonic scale the sharpened fourth of its key note. And a similar objection, *mutatis mutandis,* lies against both the former modes of derivation. Theoretically speaking, also, as the mean velocity of sound varies in different climates, all such modes of humoring or cooking the fundamental note into conformity with a predetermined result must be condemned.

I am, &c,,

J.W. HERSCHEL

Collingwood, June 14, 1859

Was Atlantis Near the Canary Islands?

by Charles Hughes

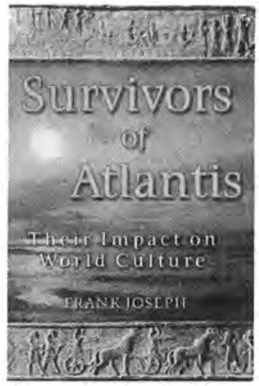
Survivors of Atlantis
by Frank Joseph
Rochester, Vt.: Bear and Company, 2004
Paperback, 262 pp., $16.00

This book is on the subject of the destruction of the fabled Atlantis, which Frank Joseph considers to have been a Bronze Age advanced civilization that was destroyed, not in a day and a night, as Plato states in the dialogue *Timaeus,* but in a series of natural catastrophes—huge tidal waves and earthquakes— over the period from about the 4th Century B.C.to the 2nd Century B.C.

Joseph situates the location of Atlantis in an area of the Atlantic Ocean, in proximity to the present day mid-Atlantic ridge, and possibly close to the coast of Morocco. A meteor strike by a body some five miles in diameter would generate not only huge tsunamis, perhaps hundreds of feet high, but also violent seismic shocks, causing entire land masses in the Atlantic to sink below the ocean surface. A similar earthquake and tidal wave disaster occurred in the Indian Ocean basin in December 2004, which killed more than a quarter-million people. With this recent disaster in mind, a disaster on a larger scale is not so difficult to believe!

Atlantis was diminished over the course of three millennia, Joseph writes; its location was on a plateau, now submerged, and there was an extensive founding of colonies going on throughout this time period. Supposedly, this culture of Atlantis had the most influence on Egypt, the Bosporus (Troy), and the Etruscan civilization in Italy—not to mention Mexico and the Caribbean. The actual location of the civilization, says Joseph, was near the location of the present-day Canary islands and Madeira, on a plateau that most probably included the Azores and other parts of the mid-Atlantic ridge.

Incidentally, Joseph presents some very interesting facts about the Canary Islands, which indicate possible influence on the culture of the inhabitants, the Guanches. Every island of this group possesses a step-type pyramid, and at least one of the main islands had large megalithic stone



walls and temples. The natives also practiced mummification of the dead, and had an ancient oral tradition that they had survived a terrible flood by climbing to the top of Mt. Tiede, the highest mountain in the island group—and the highest mountain in Europe as well, at over 14,000 feet above sea level.

This mountain is an inactive volcano, now snow-capped. Joseph is in general agreement with Plato as to the location of Atlantis, but of course, not the time frame; here I think Joseph is about 5,000 years too late! I find the discrepancy of time between Joseph and Plato to be the most serious fault of this book.

Joseph attempts to link other sea-people-type of cultures in connection to Atlantis. He seems to believe that the period of the Trojan War and the attack by the sea peoples on Egypt, about 1200 B.C., as well as the Exodus of the *Old Testament,* led by Moses, was the time of the final destruction of Atlantis. The sea peoples were migrating into the Mediterranean because their homeland had sunk. He also equates the war between Greece and Troy with the war between Atlantis and Athens described to Solon by the Egyptian priests at Sais, which Plato tells of in his dialogue *Timaeus.*

However, many sea cultures were known throughout the ancient world, which may or may not have had Atlantis origins. Take all the sea peoples who attacked Egypt about the year 1190 B.C., and were defeated in the battle of the Nile Delta, by Ramses III. Also, sea-type or maritime-type cultures survived into modern times; for example the Vikings of northern Europe.

This book is worth reading if only for the parts concerning the megalithic ruins located on the coast of Morocco, but I must protest Joseph's disputing Plato's insistence that Atlantis was destroyed sometime in the 10th Century B.C. The Greeks of Plato had histories and traditions of several flood disasters, namely the flood of Porcey, and those of Ogyges and Deucalon.

Plato states in the two dialogues that pertain to the destruction of Atlantis, the *Timaeus* and the *Critias,* that the information was gathered in Egypt from the priests of the temple of Ammon at the city of Sais in the Delta region. The priests gave the history to Solon of Athens, who composed a poem on the subject of Atlantis, which was passed on to Plato. As the *Timaeus* states, the priests chide Solon about his ignorance of very ancient history. They know very well the Greek flood traditions, but these were not the biggest catastrophes—the destruction of Atlantis, along with Athens, was—and they occurred on the same day!

I think that the priests who informed Solon were accurate both as to time of occurrence and location of Atlantis. The 10th Century B.C. date coincides with the end of the last Ice Age, a time of floods and seismic disasters in the Atlantic Basin. As for Joseph's argument that there were no large cities in the time period that Plato indicates, I point to the discovery of a city in India's Bay of Cambay, estimated to have been as large as Boston!

The location of Atlantis in the Atlantic, on which Joseph agrees with Plato, is described in Plato's dialogues as a volcanic area with stones white, black, and red in color (in modern geological terms, tufa, basalt, and lava). Such geology can be seen today in the Canary Islands. Plato also mentions hot springs as characteristic of this same Atlantic region.

The book has a good bibliography, but no index. For those interested in ancient civilizations, I would recommend reading it, in spite of Joseph's opposition to Plato's chronology.

NASA/JPL/ Cornell

When the Spirit rover snapped this photograph on its 89th Martian day, or sol, on Mars, in March 2004, scientists did not expect the rover to be able to make the nearly 2-mile trip to the distant Columbia Hills—but it did, arriving there in June.

A YEAR IN THE LIFE OF TWO ROVERS

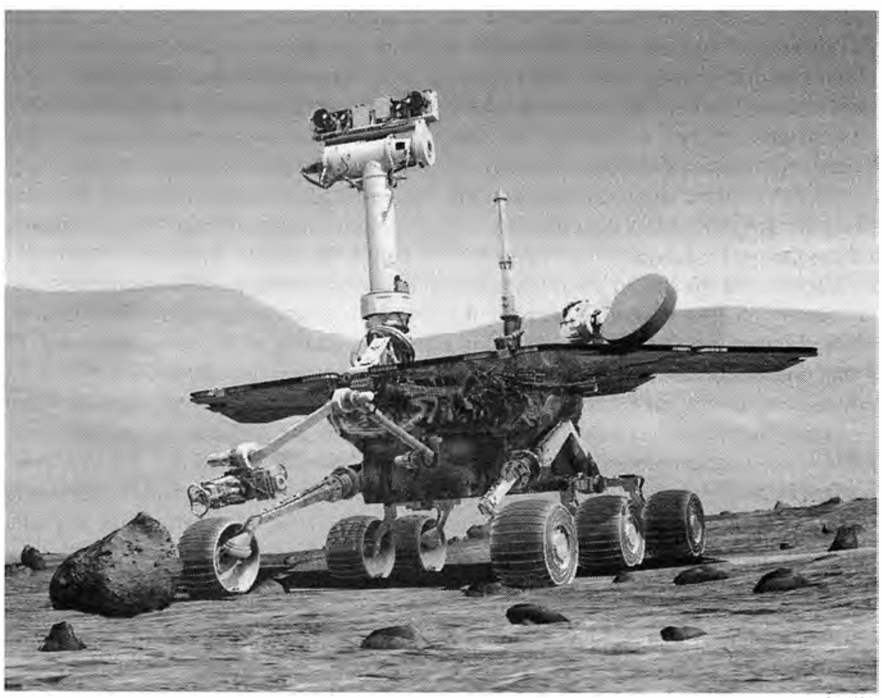
Now We Know There Was Water on Mars

by Marsha Freeman

What scientists have long suspected to be true has finally been confirmed over the past year by the *Spirit* and *Opportunity* rovers: At some time in its past, there was liquid water on the surface of Mars. This planet-shaking announcement was made at a special briefing held at NASA headquarters in Washington, D.C., on March 2, 2004. Scientists announced that data returned by the Mars Exploration Rover *Opportunity* provided "ground truth" to substantiate the suggestive photographs that had been taken from orbit. The presence of water, science leader Dr. Steve Squyres stated unequivocably, means this "was a habitable place." Water is described as "the elixir of life," Dr. Squyres stated, and Meridiani Planum was once "drenched."

The new data had been collected by *Opportunity* at the outcrop of ancient bedrock inside the 72-foot diameter Eagle Crater, dubbed Opportunity Ledge. The small formation, only as tall as a sidewalk curb, provided a look back in time in Mars's history.

The Mars Exploration Rovers have been aided in their mission by two already-orbitting NASA spacecraft—



NASA/JPL

Each Mars Exploration Rover stands 5 feet tall, with panoramic cameras at the top of its mast that take photographs with a resolution comparable to that seen by the human eye. Its Instrument Deployment Device, protruding near a rock on the lower left, takes the spectrographic measurements that reveal the composition of rocks and soil.

Mars Global Surveyor and *Odyssey*—which helped scientists choose the landing sites for the rovers, provided real-time weather data to help the rovers descend through the atmosphere and safely land, and have been the communications relays for them to transmit their data back to Earth. And recently, the even more capable European *Mars Express* orbiter has returned data providing its own confirmation of water present in the history of the red planet.

At every upcoming 26-month Mars launch opportunity, this armada of spacecraft will be joined by a succession of increasingly more complex and capable orbiters, landers, and rovers. These craft will now attack the most profound question: Did life exist on Mars?

First, *Spirit*

NASA's *Spirit* rover was launched toward Mars on June 8, 2003. Seven months later, on Jan. 3, this highly complex and extraordinary representative of man's intelligence arrived in a large crater, named after the 19th Century Russian astronomer Matvei Gusev. From its full stand-up height of nearly 5 feet, *Spirit* transmitted to Earth full-color, three-dimensional photographs of Gusev Crater, comparable in resolution to what human eyes would see.

Choosing the Gusev Crater landing site for *Spirit* and Meridiani Planum for *Opportunity* was a long and arduous task. More than 100 sites were considered by as many scientists and engineers, over a period of two years, using orbital imaging and other data from Mars *Odyssey* and *Global Surveyor*. Although the site had to be scientifically interesting, the most important criteria, as science team member Dr. Matt Golembek stated, were "safety, safety, and safety." There was no point in choosing the most scientifically exciting site if there were little chance that the rover would survive the landing.

Gusev Crater was chosen because there is evidence that this depression—the size of the state of Connecticut—once was home to a lake, or some standing body of water. An asteroid or comet impact created Gusev Crater as long ago as 4 billion years, and on its 95-mile diameter floor, there are younger impact craters. There is a branching valley, called Ma'adim Vallis, which leads directly into the crater, through a breach in its southern rim.

Scientists surmised that water flowing down the valley could have pooled in Gusev Crater, leaving behind sediments from the highlands and from the river's trip into Gusev, before it exited through a gap in the crater's northern rim. They

A Mysterious Meteorite

In 1865, a rock found in India was determined to be chemically different from any other rock on Earth. It was classified as a meteorite—a remnant of a body from elsewhere in the Solar System that had found its way to Earth. Since then, more than 22,000 meteorites have been collected, but until the 1970s, there was little indication as to their origin.

NASA's Viking program provided the answer for 30 of the space rocks. By comparing the gas bubbles trapped in those meteorites to the chemical composition of the atmosphere from the *Viking* spacecraft, scientists verified that pieces of Mars had been blasted off Mars and landed on Earth.

After the find of the Shergotty meteorite in India, two more meteorites from Mars were discovered. These Shergotty, Nakhlite, and Chassigny meteorites form what are called the SNC class of Mars meteorites, and so far, 12 of them have been found on Earth.

Scientists announced on April 14 that *Opportunity*'s latest target—Bounce Rock—is unlike any other rock found on Mars, and bears a striking resemblance to one of the SNC meteorites, labelled EETA79001. This basalt lava rock, nearly indistinguishable from many Earth rocks, was found in Antarctica in 1979, in the Elephant Moraine area of that frozen continent. *Opportunity* has now provided "ground truth" for the meteorite's origin.

A 600,000-Year-Old Rock

Scientists estimate that EETA79001 was launched into space from Mars 600,000 years ago, when the impact of an asteroid threw debris into space with enough force to escape Mars's gravity. The 17.4-pound meteorite is actually comprised of two rocks fused together, known as Parts A and B. The mineralogy of Part A does not match that of Bounce Rock, but Part B does. Although for years scientists were confident the SNC meteorites had come to Earth from Mars, the examination of Mars with orbiters and previous surface missions had never found anything on the surface like them—until Bounce Rock.

Opportunity used its Rock Abrasion Tool to grind away the surface of Bounce Rock in order to expose its unweathered, subsurface layers. The spectral signature of the minerals beneath the surface, revealed a composition that is 69 percent pyroxene, 20 percent plagioclase, and 11 percent olivine. This mineral concoction is so different from the other rocks at Meridiani Planum that scientists assume it came from another region of Mars.

One possibility is that it is debris that emanated outward from a 16-mile-wide impact crater that lies about 31 miles southwest. The high percentage of olivine in Bounce Rock, which gives the rock a transparent, shiny green appearance, was an unexpected find, because olivine does not survive weathering well. It is susceptible to chemical changes, and alters to form other minerals, decomposing in the presence of water. Does this contradict the prior evidence that there was water at Meridiani Planum?

Not at all, Dr. Bill Hartman, a member of the Mars Global Surveyor science team, told *Astrobiology Magazine*. It is just a question of dates, he explained. Apparently, fresh unweathered rocks, such as lavas, have found their way to the surface of Mars. This does not discount the possibility that there was water on the surface. After all, he pointed out, the Earth has whole beaches of olivine-rich sand, and you would hardly conclude that there is not flowing water here.

From orbital mapping, it has been found that about 3 percent of the surface of Mars contains abundant olivine.

hoped to find samples of layered sedimentary rocks that would tell the history of the site.

Through its first panoramic photographs, *Spirit* revealed that Gusev Crater has only 3 percent of its surface covered with rocks, versus 20 percent rock cover at the 1970s *Viking* and 1997 *Pathfinder* landing sites. There were no large boulders present. As a result, *Spirit* has been able, virtually unhampered, to travel more than 2.5 miles from its landing site.

Principal Investigator Squyres outlined the primary objectives of each of the rover working science teams, at a briefing from NASA's Jet Propulsion Laboratory on Jan. 13, 2004. Of immediate importance, he reported, was that the atmospheric science team was studying the observations of the sky, taken by the rover's thermal emission spectrometer, to refine their understanding of Mars's dynamic atmosphere and weather. These data were important in fine-tuning the landing of the *Opportunity* rover on Jan. 24, as well as generally improving weather forecasting on Mars, he explained.

By Jan. 13, the scientists had assembled the entire 360° color 3-D panorama of photographs from the rover, seeing details that were invisible in the first, black-and-white, lower-resolution navigation images. On the horizon, in an easterly direction from *Spirit*, sat a cluster of eight rolling hills. The nearest lay almost 2 miles from the landing spot, or about five times the distance that the rover was designed to travel. Dr. Squyres stressed that even if the rover could not get there, the view and detail will "get better and better," as the rover is sent closer and closer.

At this early stage in the Mars Exploration Rover mission, the scientists were yet to learn what these two remarkable machines could accomplish.

Meet the Field Geologists

The Mars Exploration Rovers are the most complex robotic devices for planetary study ever deployed. Each is designed to explore the red planet for at least 90 Mars days, or sols (equivalent to 92 Earth days), and cover a distance of up to 300 feet per day. Unlike the diminutive 22-pound *Sojourner* rover, which depended upon a nearby lander for communications with Earth, the *Spirit* and *Opportunity* rovers, each 384 pounds and golf-cart-size, can communicate with two overhead Mars orbiters and directly with the Earth. Thus, they have no limit on the distance they can travel from the landing site. The amount of data, including images, that each rover can send back in a day, using all three available communication links, is more than 10 times that retrieved in total from *Sojourner* in 1997.

The prime objectives for the rovers were chosen to find out whether water were persistent on Mars. This requires a thorough characterization of the diversity of the rocks and soil; the search for minerals that could have been deposited by water flow or precipitation; the search for minerals created in the presence of water; and the extraction of clues from its geologic investigation that relate to the environmental conditions when liquid water was present on the surface of Mars, such as erosion, or rock fracturing.

To meet these objectives, the rovers have identical scientific payloads, called *Athena,* which include two instruments that survey the general site. The first is a pair of high-resolution color stereo cameras, to provide a long-range view of the surroundings. The second is a miniature Thermal Emission Spectrometer, or Mini-TES, which sees objects in the infrared. From afar, Mini-TES determines the mineral composition of Martian features, peering through the dust that coats the rocks, to see their spectral signature. Mini-TES also measures the gross heat emitted by objects, and helps characterize the texture of the soil, by obtaining a profile of its absorption of heat during the day, and its release at night.

The rover has an arm (and hand and fingers), which can reach out and deploy

NASA/JPL/Cornell

The first meteorite ever identified on another planet was found by the Opportunity *rover and photographed on Jan. 6, 2005. It is about the size of a basketball, and is composed of mostly iron and nickel.*

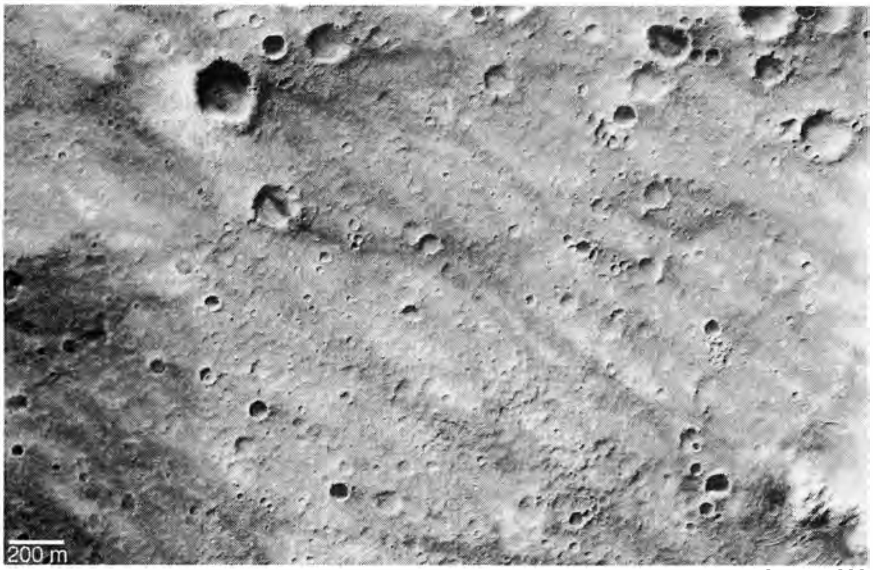
Another 3 percent is coarse-grained hematite, giving Mars its characteristic redcolor, and constituting likely evidence that water was present on the Martian surface in the past. Making more precise estimates of the ages of these surfaces will help geologists narrow down the range of wet periods in Mars's history.

Then in January this year, *Opportunity* made another unexpected discovery: a rock dubbed Heat Shield Rock, sitting in Meridiani Planum near the rover's landing site, landed on Mars from somewhere else. The pitted, basket-ball sized rock is made of mostly iron and nickel, and is the first meteorite ever found on another planet.

"I never thought we would get to use our instruments on a rock from someplace other than Mars," Steve Squyres remarked on January 19. "Think about where an iron meteorite comes from: a destroyed planet or planetesimal that was big enough to differentiate into a metallic core and a rocky mantle." Dr. Sqyures stressed that the key is not what the scientists would learn about meteorites, but "what the meteorites can tell us about Meridiani Planum."

How winds are reshaping Mars may be revealed by studying the population and abundance of meteorites on the surface. If sand is continually blowing and being deposited on the surface, it may be burying objects while it is building up terrain over time. In that case, meteorites would be covered, and few would be seen. But if the surface is continuously being stripped away by the wind and swirling dust devils, there should be an accumulation of meteorites.

Another interesting possibility is raised from *Opportunity's* discovery. It is clear that material from Mars was blasted from the planet, travelled through interplanetary space, and landed on Earth. Could there be a chunk of the ancient crust of the Earth lying somewhere on the surface of Mars?



NASA/JPL/MSSS

The Mars Global Surveyor *took the two photographs from orbit that make up this composite showing* Spirit's *wheel tracks (the dark streaks) around Gusev Crater. One was taken on March 30, 2004, when the rover was near the south rim of Bonneville Crater (upper left), and then on Aug. 18, 2004, when the rover was climbing the Columbia Hills' western spur, in the bottom right.*

three instruments for *in situ* measurements. These are the Microscopic Imager—a combined microscope and camera, which produces an extremely close-up view of rocks and soils; the Mössbauer Spectrometer, to determine the composition and abundance of iron-bearing minerals, and the magnetic properties of surface materials; and the Alpha Particle X-Ray Spectrometer, to determine the elements that make up the rocks and soil.

To clear the way for looking behind the surface and into the interior, the Rock Abrasion Tool grinds away the top layer of rocks, and exposes fresh material underneath for the arm's instruments to investigate.

With this scientific armamentarium, the two rovers began their intensive study of Mars.

First Hints of Water

On Jan. 24, 2004, the *Opportunity* rover joined its sister on Mars. Its target was near the equator, in one of the smoothest, flattest regions on Mars. The Oklahoma-sized plain, Meridiani Planum, was chosen, because orbital reconnaissance had observed a rich abundance of gray hematite there. This iron oxide mineral usually forms in the presence of water on Earth.

As the first photographs from *Opportunity* arrived back at Earth, the scientists were stunned. Not more than a few yards away, on the wall of the small crater in which the rover rested, sat a ridge of exposed ancient Martian bedrock. Even from a distance, rocks with layers could be seen, which promised to reveal a process that, over time, could have depended upon flowing water.

Ten days after *Opportunity* landed, on Feb. 4, the science team announced results from the examination of a patch of soil in this small crater. The soil near the rover's landing spot revealed strikingly spherical pebbles among the mix of larger particles sitting on a bed of fine sand. The spherules were intriguing, as "there are only so many ways to make really round grains," Dr. Squyres explained.

The spherules could have accreted from minerals precipitated from a liquid water solution; or they could have formed into droplets from material heated and thrown up into the atmosphere, from volcanic eruptions or meteor impacts. Some of the small pebbles had holes in them, perhaps produced by volcanic processes, when gas bubbles formed in the solid material, according to Dr. Squyres.

Just five days later, on Feb. 9, scientists presented their report from *Opportunity*'s first foray to the outcrop of bedrock. Microscopic images of the part of the outcrop dubbed Stone Mountain revealed yet more tiny spherules, embedded in the layers of the rock, "like blueberries in a muffin," as Squyres described them. And the photographs provided one explanation as to why *Opportunity* found these tiny spheres in the soil.

The layers in the rock, Squyres reported, are made of a fine material, either dust or sediment, which are only fractions of an inch thick. The spherules appear to be made of a different and harder material than the rock's primary layered material, or matrix; the matrix is a tan or buff color, and the tiny spheres are very gray.

Apparently, millions of years of sandblasting from the periodic dust storms that rage on Mars, had exposed many of the spherules embedded in the rock; in the images, some are seen just barely hanging on to the matrix material. Also visible in one microscopic image is a string of tiny embedded spheres, which may have cracked the apparently softer matrix rock layers. Dr. Squyres proposed that the spherules *Opportunity* had first found in the soil had fallen off the outcrop of rocks nearby and rolled downhill. But how did they form in the first place?

It was now possible to start to eliminate hypotheses, because the same phenomenon was found in two different contexts. Losing favor, Squyres said, was the idea that the spherules formed when ash from a volcanic eruption was suspended in the air, agglomerated, and fell from the sky. This would tend to produce spherules of the same material as the rock's matrix, which now seemed unlikely. The most interesting possibility is that they may have formed along with the formation of the layer of rock, concreting as dissolved minerals flowed through the rock. This, Dr. Squyres said, could have precipitated granular nucleation points which then grew over time into spheres.

Mars Was Once 'Soaked'

One class of data was returned from three of the scientific instruments located on the deployable arm on *Opportunity*. Each set of data from these spectrometers takes at least 10 hours to collect, and then two or three days to transmit back to Earth—while scientists patiently wait for the results of their experiments.

It is only natural that the scientists studying the features on Mars rely on what they know about the geology, chemistry, and history of the Earth to try to inform their understanding of Mars. But there is another exciting possibility. Lyndon LaRouche has posed the possibility that the distribution of elements and other features of the physical chemistry on Mars may not be comparable to that of the Earth. In his article titled, "On the Subject of Tariffs and Trade" (*EIR*, Feb. 13, 2004), he discussed the challenge faced by the human race, to overcome the limited supply of indispensable minerals natural to Earth, that will be increasingly depleted as population grows.

"We need a physical chemistry which does not continue to rely upon blind faith in 'magic numbers' to seem to explain away how the Solar System actually generated the repertoire of what is already known as the naturally found Periodic Table of the Solar System," LaRouche wrote. "We must get out of the intellectual prison of our current textbooks, and go to Mars, hoping to find the different physical chemistry, which will help us to develop a physical chemistry—including a nuclear physical chemistry—beyond what we know from studies on Earth."

The rovers were making a start.

Opportunity's Alpha Particle X-Ray Spectrometer, or APXS, which reveals the elemental composition of rocks and soil, identified large amounts of sulfur in the outcrop rocks. The rover spent a few days at the part of the outcrop called El Capitán; and in that region, a rock named McKittrick was found to contain the highest concentration of sulfur ever observed on Mars.

The APXS uses radioactive curium-244 to bombard a target area with alpha particles and X-rays, causing a cascade of reflective fluorescent X-rays. Each chemical in the soil or rock is identified by a unique spectrum, or footprint, reflecting the energy level of the radiation produced.

If the sulfur concentration were found only on the surface of McKittrick as a coating, that would have been interesting, but not conclusive. In fact, the sulfur was found inside the rock, after the rover's Rock Abrasion Tool (RAT), drilled a circular hole about 0.16 inches deep and 1.8 inches in diameter. The spectra from McKittrick also showed the presence of bromine.

The examination of another section of El Capitán, at the rock dubbed Guadalupe, found similarly high concentrations of sulfur, but with very little bromine. This "element fractionation" typically occurs when a watery brine slowly evaporates and various salt compounds precipitate out, in sequence, over time.

In addition, data collected by the Miniature Thermal Emission Spectrometer (Mini-TES), which identifies the minerals present, showed that the sulfur is present in the form of mineral sulfates. The scientists think the salt that is probably most prevalent is magnesium sulfate, which one finds on Earth in the form of Epsom salt. The salt content may be as much as 40 percent, an "astounding amount," which would mean the water it precipitated from is "like the Dead Sea," stated Dr. Benton Clark from Lockheed-Martin.

A third instrument, the Mössbauer spectrometer, contributed to the mission by the University of Mainz in Germany, detected the presence of jarosite—an hydrated iron sulfate, which contains water in the form of an hydroxyl as part of its structure. Typically, jarosite spends time in an acidic lake or acidic hot spring environment on the Earth.

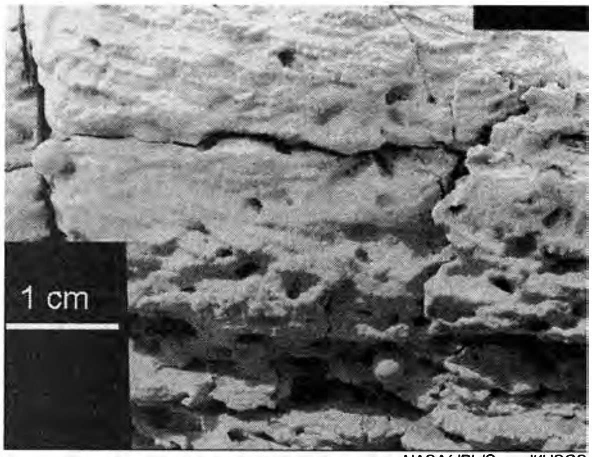
The scientists could find no explanation for these results other than that water was involved in the history of the ancient bedrock. There are two possibilities, reported Dr. Squyres: that the rocks were formed through the deposition of volcanic ash into layers that were porous, and that ground water later percolated through the rocks, changing their chemistry; or, that the rocks were formed out of sedimentary layers, when salts and minerals that were dissolved in water periodically precipitated out into solid form.

If there were a salty sea in the region of the crater where *Opportunity* sits, there is no topographic evidence for it today; there is no basin that could hold an ocean, nor is there an observable shoreline. But, Dr. Squyres cautioned, that does not mean that the topography was not quite different in the past.

The salty chemistry of the rocks was the most convincing, but not the only evidence presented of water on Mars. Dr. Benton Clark noted that detailed photographs taken by the rover's Microscopic Imager revealed that inside the outcrop rocks are tiny holes, or voids, called "vugs." These voids, he explained, match the distinctive appearance of hollows that form in rocks on Earth, where crystals of minerals grow when the rocks sit in briny, or salty, water. Later, when the crystals themselves disappear, because they are eroded by the wind or dissolve in water, the holes or molds that they created are left behind.

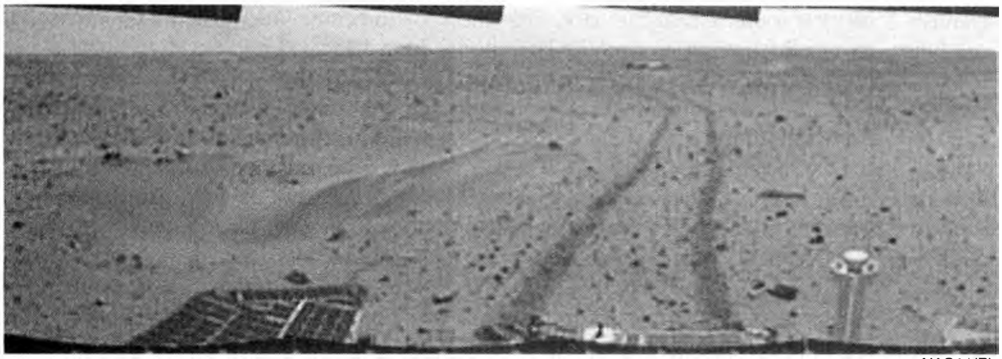
Some of these Mars vugs have disk-like shapes, with wide midpoints and tapered ends. This is consistent with sulfate minerals that crystallize within the rock matrix, either pushing the matrix material aside, or replacing it.

When *Opportunity* first imaged the outcrop, geologists recognized that many of the rocks were made up of lay-



NASA/JPL/Cornell/USGS

In early March 2004, Opportunity*'s Microscopic Imager took this photograph of the rock Last Chance. The crossbedding of the thin layers of the rock indicate a process of cross-lamination, evidenced by the dipping planes, most likely created by flowing water-caused ripples in the underwater sediment. Spherules made of hematite are visible on and inside the layers.*



NASA/JPL

Examining rover wheel tracks yields a wealth of information about the soil conditions on Mars. This photograph is part of a 360-degree mosaic panorama image, taken on Feb. 11, 2004. It includes a view of the lander, which is more than 300 feet from the rover in the distance.

ers. They proposed that the layering could have been produced by periodic depositions of volcanic ash, or sediments of minerals that precipitated out from a briny water solution. The layers provided the third piece of evidence that there had been water on Mars.

On its 17th day on Mars, Feb. 10, 2004, as *Opportunity* had rolled to within striking distance of the rocks at the outcrop, the panorama photographs showed clearly that the layers in the bedrock were not always parallel to each other, like a perfect layer cake. Instead, the layers appeared to have cross-bedding, or different thicknesses within a layer, indicating that their formation would have been from some sort of flowing motion.

This motion could have been from wind, or water. Standing water, such as a lake or ocean, could have created the layers, as the water evaporated, leaving the minerals behind. Or they could have been the result of the periodic action of water—in ebbs and flows.

One of the most interesting outcrop rocks for the study of layering was called Last Chance. It has evidence of a geologic feature known as ripple cross-stratification. The thin layers (0.4 to 0.8 inch thick) at the base of the rock are dipping down toward one side. In the upper right corner of the rock, layers also dip to the right, giving the rock a weak concave geometry. The combination of this thin, cross-layered bedding, combined with the concave geometry, suggests the action of small ripples with sinuous crest lines.

Although the wind can produce ripples, on Earth such ripples rarely have crest lines, and never form steep, dipping layers at such a small scale. The most probable explanation, the scientists stated, is that the ripples were formed in the presence of moving water.

Until early March 2004, the scientists were entertaining three possible processes for the creation of the curious spherules that had been found in the soil and rocks: first, that they were droplets of molten volcanic glass, called *lipilli,* cooled into a "volcanic hailstorm," and dropped from the sky; second, that they were droplets of soil material that became heated and tossed into the atmosphere from a meteor impact, and then fell from the sky; or third, that concretions were formed inside the rocks around small grains of material that were dissolved in water and precipitated out.

At the March 2 briefing, the science team members presented new material concluding that the process of concretion, in a water environment, had created the rounded spherules. They observed that the spherules found in the rocks, when the rover's Rock Abrasion Tool drilled down inside, did not deform the softer rock layers in which they reside. This indicates that the spherules did not come bounding in from the sky. Similarly, their presence throughout the rock's interior indicates that the spherules formed inside the rock and were not imported.

After further intensive study, *Opportunity* would reveal that the gray spherules are made of the hematite that had been identified from orbit.

NASA/JPL/Cornell

When the Mars mission scientists saw photographs such as this one, taken as Spirit *neared the Columbia Hills, the evidence of layered bedrock led to the hope that the rover would find evidence for the action of water in its formation, as* Opportunity *had found on the other side of Mars, at Meridiani Planum. They were not disappointed.*

Spirit Finds Water, Too

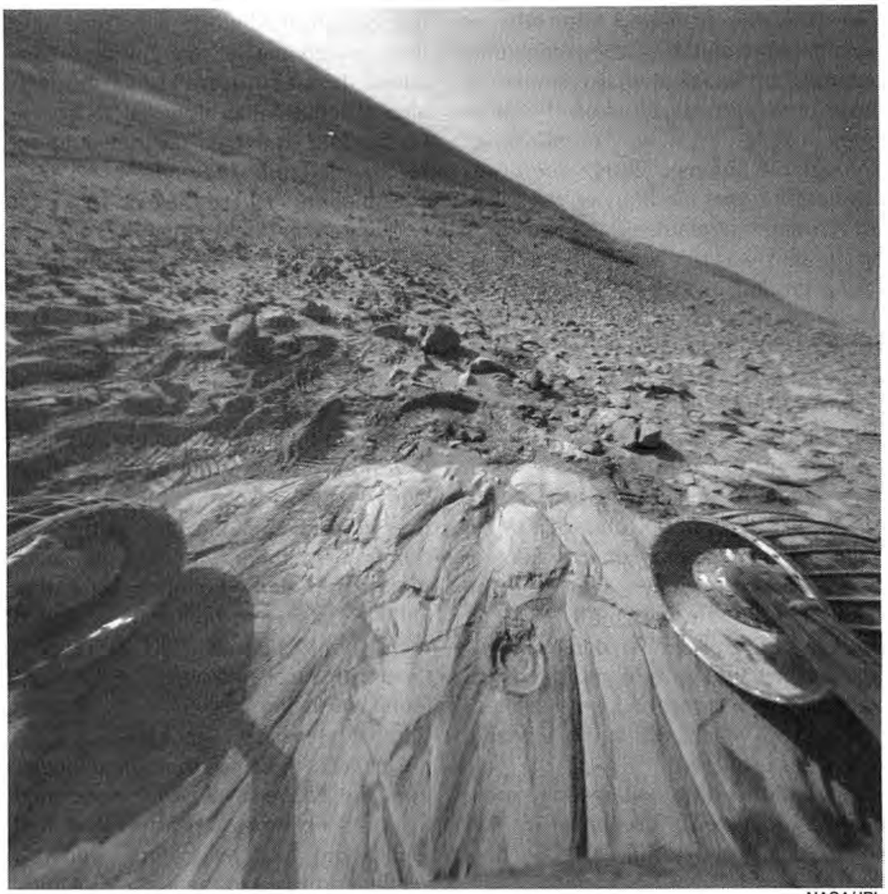
Just as the Apollo astronauts left their footprints on the Moon, *Spirit* left its wheel tracks on Mars. Although *Spirit* would turn out to be a "late bloomer," because its early results were not as dramatic as those from *Opportunity,* there were hints early on of a history of water.

Navigation engineers, responsible for safely guiding the rover around its terrain, noticed from the first post-drive images that the soil seemed to be sticking to the rover's wheels. It is possible, scientists believe, that this cohesion in the soil could be from layers of dust that have been compacted; or, that brine, or salty water, has created a kind of cement, and the soil could be "sticky" from salty water oozing from underground.

At the end of February 2004, after a few weeks on Mars, as engineers and scientists were examining *Spirit's* tracks, Dr. Lutz Richter of the German Space Agency, a rover science team member, said: "I would compare the rover tracks to the boot prints of geologists walking around on Earth. They immediately give us information about the nature of the material on which we are roving. The material we are on," he explained, "has given way to the weight of the rover in some places. We can measure the amount of sinkage, and that tells us the strength of the material we are on. So far, we have seen a lot of variation."

Their analysis has led the scientists to believe that the surface material at Gusev Crater contains a thin crust covering the soil. Dr. Richter reported that preliminary chemical analyses indicated high amounts of chlorine and sulfur on the topmost layer of the soil. He said that there must have been at least trace amounts of water at work to produce this chemistry.

On its 45th day on Mars, on Feb. 17, *Spirit* returned images of some fine-grained soil it was studying in a small depression called Laguna Hollow. Inside the Hollow, scientists could see irregular patterns of lines and polygons. Such patterns are found on the Earth, Dave Des Marais from the science team explained, when you have freeze-thaw activity, "such as in tundra. You can also get that in a salt flat, where the salt, by warming, or by wetting and drying, expands and contracts. This forms a very characteristic polygon pattern. You can do it with mud flats."



NASA/JPL

Measurements of the interior of rocks in the Columbia Hills, such as this one dubbed Clovis, indicate higher levels of sulfur, bromine, and chlorine salts than the volcanic rocks found on Gusev's Crater's plain. This leads scientists to believe that Clovis was chemically altered by fluids flowing through the rock.

Des Marais speculated that because these patterns are still visible on the surface today, they could be caused by an active, ongoing process on Mars.

At a briefing at the Jet Propulsion Laboratory on March 5, 2004, scientists discussed another hint that small amounts of water existed at Gusev Crater. The interior of a dark volcanic rock named Humphrey, which was examined after the rover's Rock Abrasion Tool had scraped away the surface, contains bright material in cracks and crevices that looks like minerals crystallized out of water, reported Dr. Ray Arvidson.

"If we found this rock on Earth," Dr. Arvidson explained, "we would say it is a volcanic rock that had a little fluid moving through it." The amount of water suggested by Humphrey's crystals is far less than that indicated in the mineral structures found by *Opportunity,* although it could be a hint of more extensive findings.

But the best was yet to come.

Six months after landing on Mars, the *Spirit* rover reached a milestone that engineers did not think was possible. Spirit's first panorama of its surroundings had shown rolling hills, less than 2 miles from the rover's landing spot. They were later named for the Columbia astronauts who were killed in the 2003 Space Shuttle accident.

"We have arrived," reported *Spirit* mission manager Mark Adler on June 13: *Spirit* finally stood at the foot of the Columbia Hills. At a region scientists have dubbed West Spur, *Spirit* was steered slightly up the hill to start its inspection of a series of targets of scientific interest. There, *Spirit* would hit paydirt.

As the rover neared the hills, it became apparent that they contained outcrops of rocks, perhaps similar to those under investigation on the other side of Mars by *Opportunity*. Throughout Summer 2004, *Spirit* was engaged in what Dr. Squyres described as "Martian mountaineering." The climb up the hills was difficult, with the rover losing ground at times, slipping down the hills instead of going up, sometimes going backwards to gain a better grip.

Spirit perched at the Longhorn outcrop, where scientists could see from the first photographs that there were two distinctly different kinds of rocks. Some appeared to be similar to the hard, clean, gray basalt rocks of volcanic origin that *Spirit* had encountered on the floor of Gusev Crater. But others seemed to be "crumbling, cruddy, brown rocks," as Dr. Squyres put it. The two different rock types, sitting side by side, indicated that some of the outcrop had been altered, perhaps by water, while the volcanic basalt was unaltered.

One particularly interesting rock, dubbed Clovis, on a portion of the hill about 30 feet above the flat plain, was under intensive examination by the rover. So far, it is the most altered rock found on the "West Spur" outcrop of the Columbia Hills, which at its peak, is 180 feet higher than *Spirit's* landing site. *Spirit* deployed its rock Abrasion Tool to the surface of Clovis, and by digging a hole, learned that the rock is very soft. It was able to make a hole 0.4 inch deep, which is a new record.

Dr. Doug Ming, from the Johnson Space Center, pointed out during an Aug. 18, 2004 briefing, that elemental measurements at Clovis, using the rover's Alpha Particle X-Ray Spectrometer, showed a greater concentration of sulfur, chlorine, and bromine than in the basalt rocks. These elements are "very mobile," he explained, and are water-soluble. He suggested that these elements may have been emission gases from volcanoes, which mixed with water. They could have passed through the rock material, and migrated into them, or been present at the rock's formation.

So far there are "intriguing clues of a history of interaction with water," Dr. Squyres said, but was the water hot or cold? Was it in a vapor or liquid phase? It is possible, Dr. Squyres said, that all of the rocks formed at the same time, and then underwent a "nonuniform alteration." It is also possible that the less-altered rocks came along later, "so the starting and ending chemistry would not be expected to be the same."

Comparing the studies of rocks on Gusev's crater floor to the hilly outcrop, Dr. Squyres said that on the plains there was evidence of "a little water percolating through the soil." But the Columbia Hills data are "the most compelling evidence" for the history of water, he said.

After an hiatus in operations, because of restricted activity during the Martian Winter, and a solar conjunction that interrupted communications with Earth during September, the science team reported in early October 2004 that although they were looking for unaltered rocks on the Columbia Hills, to compare them with the altered ones that *Spirit* had found, even the freshest rocks showed signs of "pervasive water alteration."

On Dec. 13, Dr. Goestar Klingelhoefer from the University of Mainz reported that his spectrometry measurements had found the water-signature mineral, goethite, in rocks in the hills. "Goethite, like the jarosite that *Opportunity* found on the other side of Mars," he reported, "is strong evidence for water activity." As far as is known, it forms only in the presence of water. From there, *Spirit* was commanded to further heights, to try to determine if the water altering the rocks was only underground, or if it had ever pooled above the surface, as it has at Meridiani.

Meanwhile, after months of intensive study at its Eagle Crater landing site, *Opportunity* arrived in May at the much larger, stadium-sized Endurance Crater. It circled around examining the rim. Peering inside, *Opportunity* spied a field of layered, outcropped rocks that were deeper, taller, and undoubtedly older, than the outcrop it had explored at Eagle Crater.

After careful consideration of the risks and a series of rehearsals, mission engineers at NASA's Jet Propulsion Laboratory gave *Opportunity* the green light on June 4, to start maneuvering down the rim of the 66-foot-deep crater, to take a closer look.

As it surveyed the inside of Endurance, *Opportunity* observed an outcrop with a stack of layered rocks between 15 and 33 feet tall, which are much larger and older than those in the small Eagle Crater. NASA made the bold decision that the potential scientific value of a close-up examination of layered rocks on the crater's slopes, outweighed the possibility that the rover would not be able to crawl back out of Endurance Crater.

By mid-August 2004, the scientists were able to analyze the differences between the layers near the rim, and those deeper down, through progressively older layers of the crater's bedrock. Dr. Rolf Gellert, from the Max Planck Institute in Mainz reported that there was a "different composition in the different layers." The concentration of chlorine, for example, increased threefold in the mid-layers compared to the upper layers, and the concentration of magnesium and sulfur declined in parallel. This suggested, Dr. Gellert said, that these two elements may have been dissolved and removed through the action of water.

Spherules have been found to be plentiful inside Endurance Crater, but they have a rougher texture, and vary more in size and color than those at Eagle Crater. It is possible that they are eroding, and that a water-related process has added a coarser outer layer to the gray hematite.

In early October, scientists reported that at Endurance, some of the rocks may have dried up, eroded, and then been wet a second time. A rock named Escher and its nearby neighbors are plate-like rocks that bear a network of cracks, which divide up the surface into polygons. Dr. John Grotziner from the Massachusetts Institute of Technology reported that these are similar to areas of cracked mud found on Earth. "When we saw these polygonal crack patterns, right away we thought of a secondary water event significantly later than the episode that created the rocks."

In December 2004, reports were made on the results from *Opportunity* at Burns Cliff, at a still-lower portion of the crater wall, where, Dr. Squyres reported, the "layers show very strong indications that they were last transported by wind, not water, like some of the layers higher up. The combination suggests that this was not a deep-water environment, but

NASA/JPL/Cornell

Escher rock, on the southwestern slope of Endurance Crater, shows fractures which divide the surface into polygons. These may have been created when the rock became wet a second time, long after it had intitially formed. Opportunity *took this image on Aug. 24, 2004, its 208th day on Mars.*

more of a salt flat, alternately wet and dry," he said.

Having gone as far down inside the crater as was considered safe, the rover exited Endurance, and on Jan. 3, 2005, began driving toward the heat shield that had protected it during atmospheric entry and which was shed before the rover landed. By the time of its one-year landing anniversary on Jan. 24, *Opportunity* had completed a more than 20-day inspection of the heat shield and was back on the road, driving south to examine a circular feature named Vostok, and a small crater named Argo. *Spirit*, meanwhile, was climbing yet higher into the Columbia Hills.

So far on their journey, the rovers have returned more than 50,000 photographs to Earth. *Opportunity* has driven a total of 1.3 miles, and *Spirit,* a total of 2.52 miles.

Looking Up

During the first week of March, one year ago, the rovers took a break from looking down and, for the first time, took a look up at the celestial objects in Mars's neighborhood—its two tiny moons.

During a briefing at the Jet Propulsion Laboratory on Feb. 26, 2004, Dr. Jim Bell of Cornell University reported that the rovers would be doing some "nighttime astronomy," as the "eclipse season" was to start on Mars. The panoramic cameras will take images of Mars's moons, Phobos ("Fear") and Deimos ("Terror"), as well as of stars. The camera will also catch the two small, irregularly shaped moons as they pass in front of, or transit, the Sun, as seen from the position of the landers on the surface of Mars, he reported.

On the Earth, when our Moon passes in front of the Sun, the relative size of each to the Earth observer is so similar, that the eclipse allows the Moon to blot out virtually the entire disk of the Sun. This has enabled astronomers to make important discoveries about the outer layers of the star.

The Martian moons—Phobos and Deimos—are so small and irregularly shaped (approximately 16 miles by 11 miles, and 9 miles by 6 miles, respectively), that even though they are much closer to Mars than the Moon is to the Earth, they cannot blot out the Sun completely. This is described as a transit, rather than an eclipse. Their small sizes and very dark surfaces had made Phobos and Deimos difficult to initially discover.

Because the Martian moons are only a few thousand miles from the surface of Mars, (as compared to nearly 240,000 miles from the Earth to the Moon), their orbital periods are very short (7 hours, 30 minutes for Phobos, and 30 hours, 18 minutes for Deimos), so they whiz past the Sun in the Martian sky very quickly.

Dr. Bell estimated that the smaller and more distant Deimos will appear as just a black spot moving across the face of the Sun, over a period of just 40 seconds to one minute. Phobos will be more interesting, he told this writer on March 1, since it is closer, and will cover about half the face of the Sun. Its irregular outline should be visible. On March 3, *Opportunity* started a series of observations of Deimos, and on March 12, *Spirit* also began taking eclipse photographs.

Johannes Kepler had proposed in 1610 that Mars would have two moons, "as the proportion [of moons to planets in the Solar System] seems to require." In 1726, Jonathan Swift posited in "Gulliver's Travels," that there were two small moons of Mars. In 1877, working at the Naval Observatory in Washington, D.C., Asaph Hall finally found them.

The observer standing on Mars would not see a "moonlit" night on Mars, as we do during the full Moon on Earth, because Mars's moons reflect so little sunlight. In the Martian night sky, Phobos would likely appear as bright as Venus does when seen from Earth, and Deimos would resemble the star Vega, in the Earth night sky. The rovers did not disappoint astronomers in their first attempt at astronomy from the surface of Mars.

Like astronomy from the surface of the Earth, observations of stars are distorted by the Martian atmosphere. While it would be highly unlikely that startling new discoveries about celestial objects in the Martian night sky would be made, these observations reveal details about the atmosphere of Mars itself. Dr. Bell reported that images of stars whose brightness and features are known, will shed light on transient features of Mars's atmosphere, such as ice or dust clouds, when observed through different rover filters.

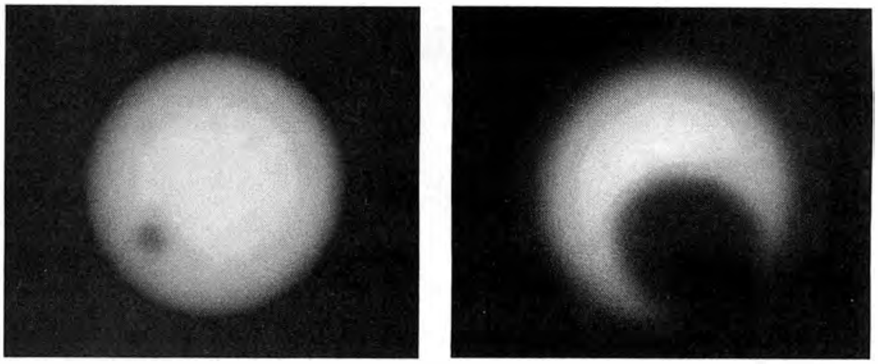
At a briefing on Feb. 26, 2004, Dr. Bell released images of a Martian sunset taken by the panoramic camera on board *Opportunity*. The sequence of photographs shows the progressive obscuring of the Sun as the atmosphere becomes murkier, the closer it comes to the horizon of Mars. Such photographs allow scientists to estimate the amount of dust in the atmosphere.

As the dust is illuminated by the setting Sun, the sky is blue on Mars, as it is on Earth, as a result of the same phenomenon. Although we are accustomed to seeing a pinkish or salmon-colored Martian sky, that is the case when the sunlight comes from overhead, or at less of an oblique angle than at sunset, when the reddish color of the Martian soil is reflected back to the sky.

With no liquid water on its surface today, the agent of change on Mars has been its weather—the daily and seasonal variations in temperature that change the composition of its atmosphere as ice sublimes, and create winds and violent global dust storms on the planet.

The two rovers on the ground each carry a miniature thermal emission spectrometer, or Mini-TES, a smaller version of the same instrument carried on the orbiting *Mars Global Surveyor*. By designing experiments to coordinate observations from orbit looking down with data from the rovers looking up, atmospheric scientists planned to produce a seamless weather map for Mars, from the ground to a few hundred miles above the surface. Refining the prediction of the weather on Mars is critical for the high-precision landing of future spacecraft. In addition, ongoing geologic processes on Mars will be better understood, such as how the layered bedrock at Meridiani Planum is being eroded, allowing the "blueberry" spherules to drop out on to the soil.

During a briefing at NASA's Jet Propulsion Laboratory on Feb. 12, 2004, Dr. Don Banfield from Cornell University presented data taken by the Mini-TES aboard the *Spirit* rover on its 12th day on Mars, as it "stared" at the sky. Measurements were taken every two seconds, producing data of changes taking place about 100 feet and at nearly 1,000 feet above the surface, midmorning local time at Gusev Crater.



NASA/JPL/Cornell

The rovers engaged in some Martian astronomy in early March 2004. On the left is tiny Deimos passing in front of the Sun. It arrived about 30 seconds earlier than expected, allowing scientists to refine their knowledge of the orbit and position of the small moon. On the right is the transit of the larger moon, Phobos, partially blocking the Sun.

Dr. Banfield reported that very significant changes (7° Fahrenheit) in temperature were measured, passing intermittently over the rover. As the ground warms in the morning Sun, the hot air rises through convection, moving away from the surface, and is replaced by cooler air. The change is such, he said, that, were you standing there, you would feel the difference in temperature. These periodic temperature changes are called thermals on Earth, and it is the first time they have been seen on Mars. Dr. Banfield said that these warm air pockets rise to about 300 feet.

The rovers are now into their second year on Mars. According to Dr. Squyres, the science team is planning out another year's worth of investigative goals for the rovers, although they could suffer any one of a number of equipment failures, at any time. But their lasting legacy, he stated, is the recognition now that with the evidence of past liquid water on Mars, "Mars once had habitable conditions on its surface."

In an interview in November, Dr. Squyres was asked about the future goals for the rovers. "A rover's work is never done," he replied. "It's a big planet, and a very tiny vehicle, so we're never going to run out of things to look at."

Preparing for Human Habitation

In Summer 2005, NASA plans to launch the *Mars Reconnaissance Orbiter*, to carry out a remote sensing study of the planet, with detail comparable to that of the continuous remote sensing of the Earth. It is designed to combine the big-picture perspective of an orbiter with the level of local detail previously only obtainable from landing a spacecraft on the surface.

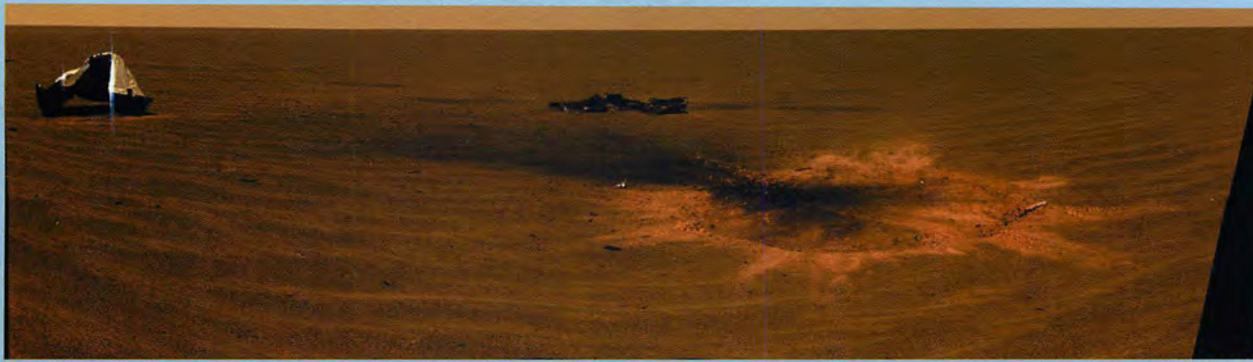
The *Phoenix Mars Scout*, scheduled for the next launch opportunity in 2007, will send a spacecraft, for the first time, to a non-equatorial landing spot, at the icy northern, arctic part of the planet.

After the *Mars Reconnaissance Orbiter* conducts its high-resolution examination of thousands of Mars locales, the nuclear-powered, precision-landed *Mars Science Laboratory* will be deployed in 2009, to intensively study the surface for a full Martian year or longer; it will be able to cover a distance on the ground an order of magnitude larger than the current set of rovers.

During the same 2009 launch window, the *Mars Telecommunications Orbiter* will be sent to Mars. It will be the first interplanetary spacecraft whose primary mission will be to provide a communications link for other missions. Its first task will be to provide the capability to dramatically increase the amount of data that the Science Laboratory can send back to Earth.

As other nations also plan missions to build up the infrastructure on and around Mars, the foundation is being laid for the human exploration of the planet, perhaps 20 years from now.

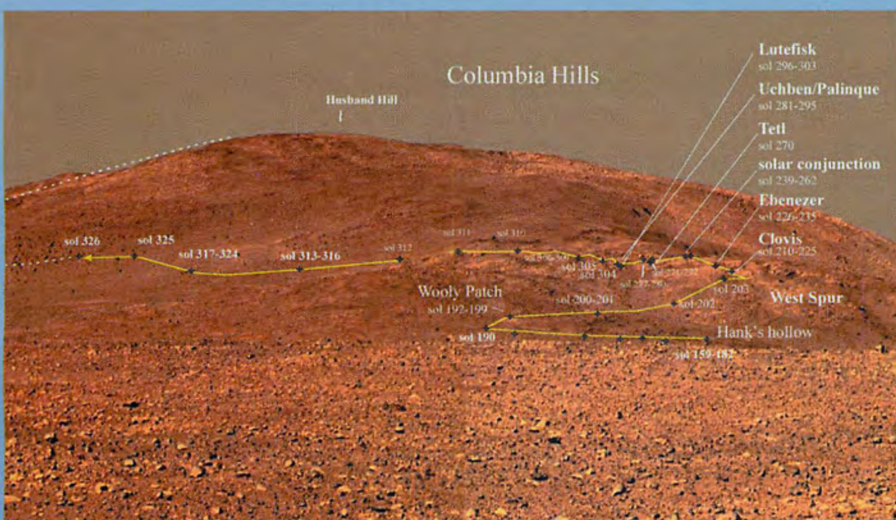
A ROVER'S VIEW OF MARS



NASA/JPL/Cornell

OPPORTUNITY EXPLORES THE IMPACT SITE

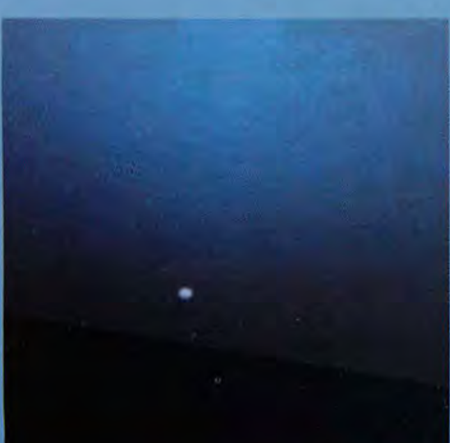
Opportunity *returned on Dec. 28, 2004, to investigate the impact site where its heat shield had hit the ground on Jan. 24, 2004, south of Endurance Crater. The main heat shield piece (at left) is inverted and reveals its metallic insulation layer, glinting in the sunlight. Another flat piece of debris is near the center. The impact excavated a large amount of reddish subsurface material. This is an approximately true-color mosaic taken with the rover's panoramic camera.*



NASA/JPL/Cornell/NMMNHS

SPIRIT'S JOURNEY IN THE COLUMBIA HILLS

The yellow line shows the terrain Spirit *had traversed, as of June 11, 2004. The labels give the informal names of rocks the rover studied along the way. The images used to make this approximately true-color mosaic were taken with Spirit's panoramic camera from about 984 feet away from the base of the hills.*



NASA/JPL/Cornell

SUNSET ON MARS

This still image was taken by Opportunity*'s camera on Feb. 26, 2004, showing the Sun just over the Mars horizon.*

THE NEXT GENERATION: A MOBILE LABORATORY

Although similar to the rovers in appearance, the Mars Science Laboratory *(MSL), to be launched in 2009, will be twice as long and three times as heavy. The mobile laboratory, which includes contributions from Russia, Canada, Spain, and Germany, will examine Martian soil and rocks for organic compounds such as proteins and amino acids.*

NASA/JPL

Earth's Next 50 Years


Stuart Lewis/EIRNS

In our cover story, economist and statesman Lyndon LaRouche elaborates a vision of global economic development based on "The Peaceful Concept of Technology Transfer" (page 8). The ideas summarized there are the germ of subsequent writings, culminating in his new book, *Earth's Next 50 Years.*

Here LaRouche develops the concept of the Noösphere, first proposed by Russian biogeochemist Vladimir Vernadsky in a 1943 essay, which we reprint here for the first time in full English translation (page 16).

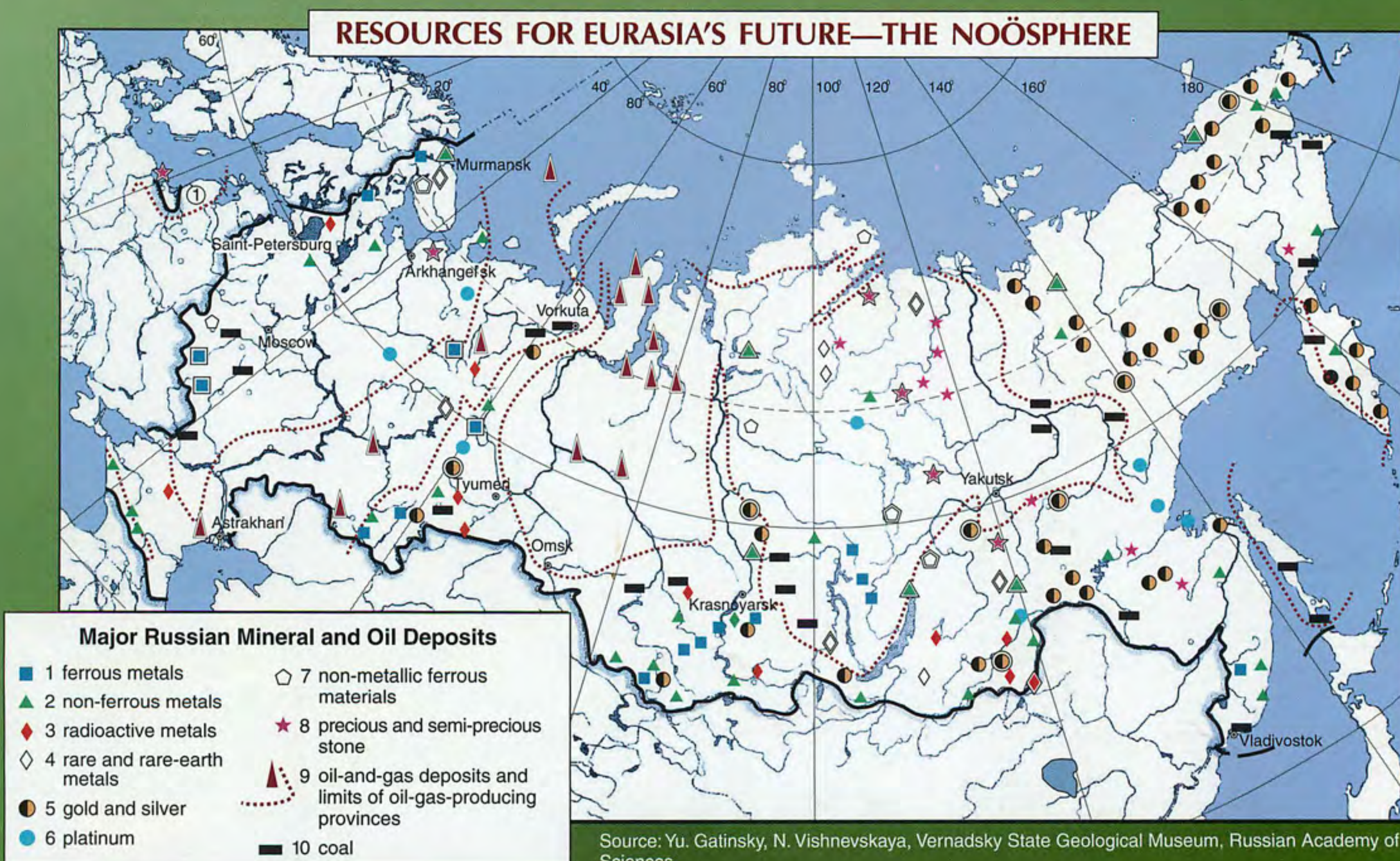
In LaRouche's 50-year vision, the unique potential of Russian science to develop the mineral resources of the Siberian shield will play a crucial role in the material and spiritual development of Eurasia.


Taipei Times

A station worker shows a visitor the 430-kilometer-per-hour Shanghai maglev just before the start of commercial operation in early 2004.

Peasants ride a bullock cart in inland China.


Grigory Kubatyan



Source: Yu. Gatinsky, N. Vishnevskaya, Vernadsky State Geological Museum, Russian Academy of Sciences