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### HYPERINFLATION LIKE WEIMAR 1923

# World System on Weimar Collapse Curve

*by Lyndon H. LaRouche, Jr.*
April 20, 2006

*Already on Sept. 21, 2005, Lyndon LaRouche issued a warning of the expanding commodities bubble, "Hyperinflationary Patterns," published in* Executive Intelligence Review, *Sept. 30, 2005. LaRouche wrote, "The world is presently gripped by a hyperinflationary wave-front of a Riemannian type," and provided a graphic depicting the "hedge fund-driven shock wave" of inflation propagating into the entire economy.*

*For the references which follow, "M3" is the broadest definition of money supply (p. 2). The Brookings Institution is a Democrat Party-linked think tank in Washington, D.C. October 1987 saw the greatest stock market crash in U.S. history, while Fannie Mae and Freddie Mac are quasi-governmental behemoths specialising in mortgages.*

The fakery of the outgoing Alan Greenspan administration, in burying the "M3" report, was clearly intended to conceal the fact that the rate of rate of increase of world prices of primary materials has the world as a whole currently on the same kind of "least-action pathway" curve of hyperinflation which gripped Weimar Germany during the second half of the year 1923 (Figure 1).

Comparing the present rates of rates of increase of primary materials prices with the pattern for Germany 1923, indicates the likelihood that, under present U.S. and European policies, the world system could reach a point of collapse of the monetary system by not much later than September 2006, if not earlier.

Under the present trends in policy-making in the U.S. government, both in the careening economic- financial lunacy of the current Bush Administration, but also the "Alfred E. Newman"-like diffidence of a negligent U.S. Congressional fraction of the Democratic Party, the likelihood is that the world system as a whole will be in a U.S.-dollar-triggered collapse-phase before Autumn.

The point is not to predict what could happen by Autumn; the point is to kick the relevant political circles in the Democratic Party with the proverbial two-by-four prescribed for reluctant donkeys, and to do so hard enough, soon enough, and often enough, to move to the kind of emergency reform of U.S. policy which could stave off an otherwise onrushing general breakdown-crisis of not only the U.S. system, but the world system as well.

There is a relative handful of persons, typified by the Brookings Institution-based Hamilton Project team, who are capable of understanding this, and who already have command of most of the essential facts to be considered. There are professionals in other parts of the world, who could begin to understand this quickly, if they were kicked hard enough to come to the necessary state of wakefulness.

The world is thus, now, in the terminal phase of a hyperinflationary collapse of not only the dollar-system, but the world-system as a whole. To bring this into focus, consider the elementary features of the way in which Federal Reserve Chairman Greenspan's lunacy orchestrated the 1987-2006 phase of the relevant hyperinflationary cycle. Keep three illustrative curves in view: 1.) my "Triple Curve," which, since January 1996, has described the general characteristics of the ongoing collapse-function of the 1995-1996 interval (Figures 3-4); 2.) The curve of 1923 Weimar, Germany hyperinflation (Figure 1); and, 3.) The current hyperinflationary rate of rate of increase of primary commodity prices, as led by petroleum and metals (Figures 2 and 5).

*Continued Page 2*

FIGURE 1
**Weimar Hyperinflation in 1923: Wholesale Prices (1913 = 1)**
(logarithmic scale)

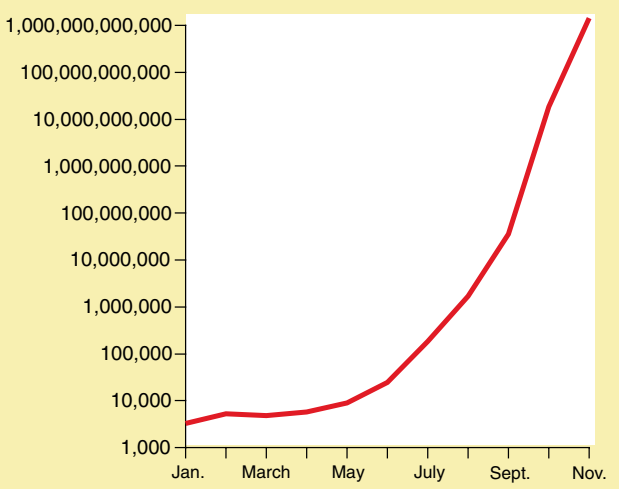
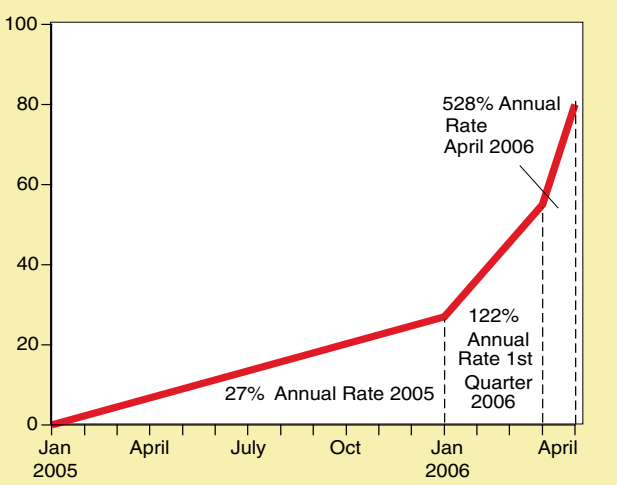



FIGURE 2
**Futures Market Mean Price Inflation for 14 Primary Commodities, January 2005-April 2006**
(% Rise from January 2005)




Sources: www.thefinancials.com; ICIS Chemical Business; *EIR* files.

## LaRouche: Reorganise U.S. Auto Industry as Key to Global Recovery

*by Kelly-Ann Paull*

May 14—Under the title, "Emergency Legislation, Now!", Lyndon LaRouche on May 2 issued guidelines for "economists, legislators, and labor", for draft legislation to save the vanishing U.S. auto industry. Simultaneously, he put his entire U.S. movement on an emergency "war-room mobilisation" to force the necessary legislation through the U.S. Congress in the weeks and months ahead, to forestall the otherwise-inevitable global hyperinflationary blowout now underway. This is no mere issue of the U.S. alone: for historical and cultural reasons, LaRouche has stressed, if the present, disastrous "globalist" system of de-industralisation and misery is to be defeated, the U.S. must spearhead that defeat. And that must begin by saving the vital machine-tool sector of the U.S. economy, which is centred in the auto and aircraft industries, but particularly in auto.

Machine tools are the tools that make other tools. Without them, the U.S. becomes a third world nation. And, as the U.S. plunges into misery, it will drag the rest of the world with it. The collapse of the U.S. auto industry is breathtaking: in an initial survey, LaRouche's staff at *Executive Intelligence Review* magazine found that a staggering 65 major auto plants, with over 75 million square feet of machine-tool capacity, are being shut down this year or next. And, for every auto worker still employed as of today, five others have already lost their jobs since 1985. Just in the past five years, over two million industrial workers have lost their jobs!


LaRouche with members of his youth movement.

Hearkening back to the methods by which U.S. President Franklin Delano Roosevelt pulled the U.S. out of the 1930s Depression, LaRouche specified in his May 2 memorandum, "What is needed, therefore, is the creation of a Federal Public Corporation, by Act of Congress. This action should adopt the elements of the automotive industry which are being discarded by the automobile corporations…" This new federal corporation would take up the approximately 65% of unused auto capacity, and retool it to produce all the essential elements of an infrastructure-centred national economic recovery. Highly-skilled machine tool operatives from the auto industry have repeatedly emphasised to LaRouche's representatives, "You tell us what you want, and we can build it." This includes nuclear power plants; a new high-speed railroad grid featuring mag-lev rail systems; and key elements of the vital U.S. water transportation grid, among other things. Without machine tools, none of this will happen.

LaRouche's "Emergency Legislation, Now!" is already on the desks of all U.S. Congressmen and is under serious consideration by at least half a dozen of them to be drafted into concrete legislative form. As part of the mobilisation, LaRouche's Political Action Committee (LPAC) has just released a DVD on auto retooling, "Auto and World Economic Recovery" (available from

*Continued Page 2*

FIGURE 3
**LaRouche's Typical Collapse Function**

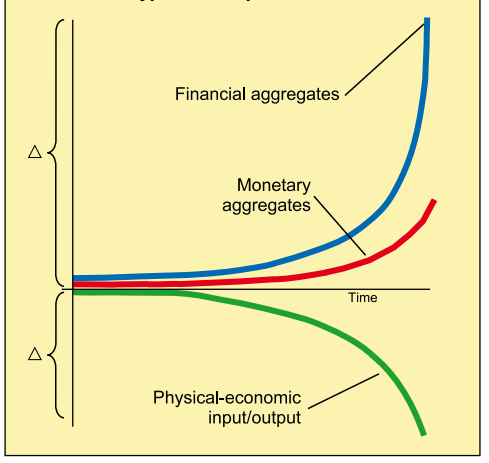



FIGURE 4
**The Collapse Reaches a Critical Point of Instability**

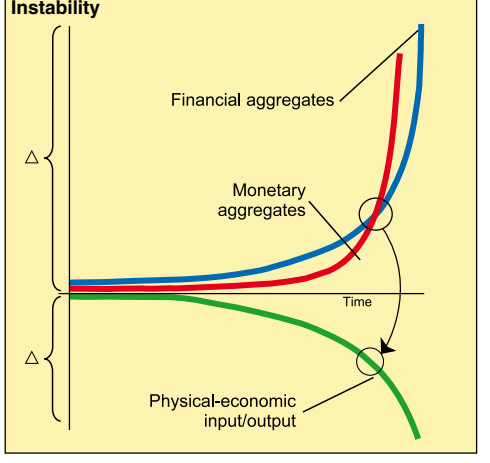
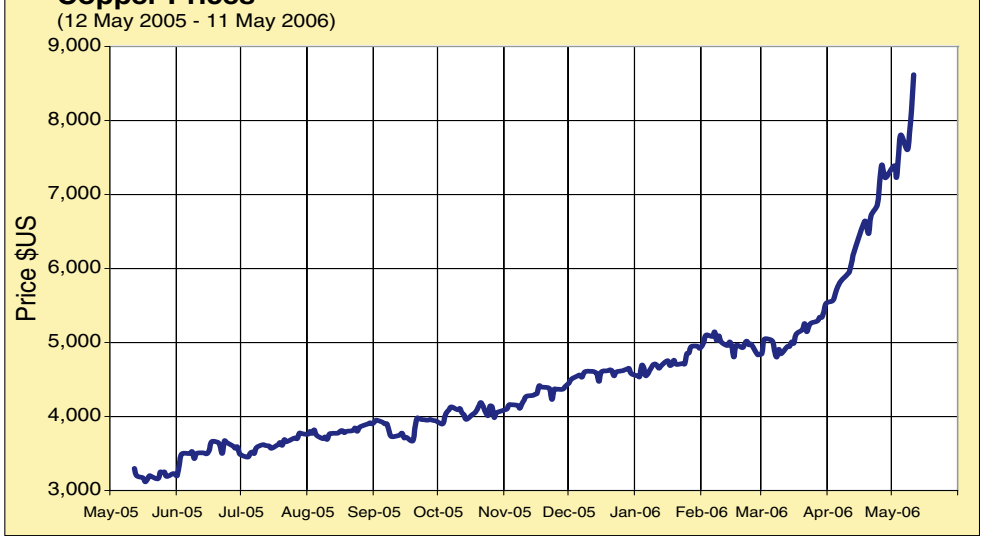
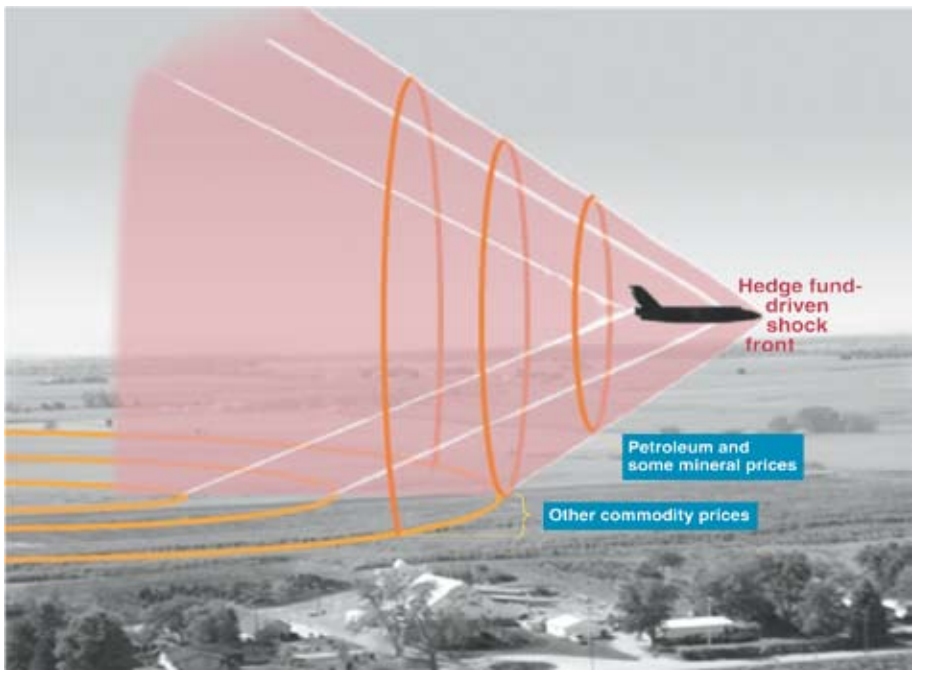



FIGURE 5
**Copper Prices**
(12 May 2005 - 11 May 2006)




## LaRouche-Riemann Conical Shock Wave Model of Hyperinflation




The present hedge-fund driven hyperinflation is comparable to a sonic boom moving across the landscape. At the tip of the cone, where the shock front forms, is the speculative bubble in hedge funds and related derivatives, orders of magnitude larger in monetary value than the physical economy. The commodity price inflation, led by petroleum and certain minerals, is dragged along in the opening conical tail.

Prices of other commodities and consumer goods lag behind in time and are diffused as they spread out in the conical opening.

As in the Gauss-Riemann representation of the complex domain, visible or empirically determinable measures (in this case prices) are actually being determined in the non-visible, complex domain. A Riemann-type shock front forms at the cone-shaped boundary layer where the rate of increase of out-of-control speculation confronts the declining rate of real physical economic growth.

*from Page 1*

(Leave the "supply-and-demand" freaks, and other statisticians from Swift's Island of Laputa, to play with themselves behind the barn, where they will be happy.)

Essentially, what Greenspan did, was to bail out the banks whose coffers had been emptied by the events of October 1987, by laundering the mortgage-based securities packages of Fannie Mae and Freddie Mac. The real-estate bubble was built up to its presently cancerous proportions for this continuing purpose. This, in turn, provided the baseline of monetary and derived financial emission for what was to become a hyperinflationary expansion of a physically contracting economy. (See my Triple Curve.)

In the end, this became the core of a global financial-monetary bubble comparable to that of medieval Venice's tool, the Lombard League of Europe's Fourteenth-Century collapse into a New Dark Age. However, in this case, the end-game phase of this hyperinflationary process was cornering of the world market in primary materials. For those shrewd enough to recognize that the present world financial system is already hopelessly doomed, the witting class of predators must have a "landing place" outside the bounds of such a general financial-monetary collapse. Essential raw materials represent that landing-place. Therefore the rate of inflation of the rate of inflation in the market for primary commodities is the characteristic curve of the present world monetary-financial system. This rate of rate of inflation, as reflected in the concealed behaviour of M3, is the curve which corresponds to the Weimar Germany hyperinflationary curve of June-November 1923. Underneath it all, is Leibniz's catenary-cued principle of physical least action, the fundamental principle of the Leibniz infinitesimal calculus and Leibniz's original discovery of the natural-logarithmic function derived from the double-catenary characteristic of the least-action principle. The comprehension of such systems in general, is found in the work of Riemann on hypergeometries.

# Central Banks Open the Flood Gates

Figure 2 (p.1) shows the average annualized rate of inflation of the futures-market prices of a basket of 14 "primary commodities," into which speculative funds' money has been flooding, while their last gulf—the U.S. real estate/housing bubble—has started to shrink. The rates are shown for three periods: a year, followed by a quarter; followed by a month; graphically illustrating the continuing acceleration of the rate of inflation in those commodities. The commodities are: Brent crude oil, propane, and gasoline; the common plastic base HDPE (high-density polyethylene extrusion); the metals zinc, copper, aluminum, tin, lead, nickel, and platinum; and the precious metals gold, silver, and palladium. Figure 5 shows the actual futures price of one of those—copper—over the last 12 months, as a sample which shows the same increasing rate of the rate of inflation as the basket of 14, without the brief, wild fluctuations shown by some of them along the way.

For 2005 as a whole, the futures prices of the basket of 14 primary commodities inflated by 27.3%; then in just the first quarter of 2006, they inflated by another 22.2%; and in April 2006 (actually, in just the first 19 days of April), by a further 14.9%.

The modern-era's model for this accelerating inflation—hyperinflation—is 1923 Weimar Germany (Figure 1), particularly the June-November period of that year which ended with Reichsmarks losing their value entirely.

The driver for this hyperinflationary process is hedge funds and commodity index funds pouring speculative money in, irrespective of any "fundamentals" of supply or demand. While forecasts had been that speculative funds flows into commodity index funds would increase from $80 billion in 2005 to $120 billion this year, the figure appears to already have reached $100 billion by April. And these index funds are only one part of the huge flows from banks, hedge funds, private equity funds, derivatives speculators, and even the now-besotted "conservative" institutional funds like pensions. This flood of funds begets a second inflation driver—mergers. In gold, for example, since September 2005, there have been at least 20 significant mergers and/or acquisitions (M&A) in the global gold industry alone (compared to just 5 in the first half of 2005), reports Merrill Lynch. The same is true for aluminum, nickel, and especially energy companies.

Central bank monetary emissions are fueling this bubble process, the extreme point shown in Figure 3 of Lyndon LaRouche's Triple Curve Collapse Function. As LaRouche notes, the U.S. Federal Reserve, from its March 23 weekly report on, suddenly suppressed public release of information on its broadest money-supply measure, known as M3, although acknowledging that the Fed is, of course, still gathering and computing this information.

The rate of expansion of M3 has accelerated, even as the financial press abounds with talk of "tightening" by the central bank. For the 13 weeks ended Feb. 27, M3 had grown at a very high 8.7% annual rate. Since then, the data is "classified."—*Paul Gallagher*

## What Are M1, M2, M3?

Until March 23, 2006, the U.S. Federal Reserve published weekly and monthly data on the three measures of the U.S. money supply, M1, M2, and M3. As LaRouche noted, the Fed on that day suddenly dropped its official statement of M3 (the widest definition of money supply), because it showed the hyperinflationary bubble now underway.

The different measures reflect the different degrees of liquidity—or spendability—of different kinds of money. The narrowest measure, M1, refers to the most liquid forms of money, including currency in the hands of the public; travelers cheques; demand deposits (normal chequing accounts), and other deposits against which cheques can be written. M2 includes M1, plus savings accounts, time deposits of under $100,000, and balances in retail money market mutual funds. M3 includes M2 plus large-denomination ($100,000 or more) time deposits, balances in institutional money funds, repurchase liabilities, and Eurodollars, i.e. U.S. dollars on deposit in banks outside the U.S. A typical repurchase liability ("repo") is when the Federal Reserve buys a security (usually a U.S. government bond) with an agreement to sell the security back to the seller at the same price within a short period, usually no more than 15 days. "Repos" allow the Federal Reserve to inject huge amounts of short-term liquidity into the system, to keep the bubble from popping.

## LaRouche: Reorganise U.S. Auto Industry as Key to Global Recovery

*from Page 1*

the CEC), while millions of pamphlets containing "Emergency Legislation, Now!" and a survey of the extent of the collapse of the auto industry along with related material, will hit the streets of the U.S. in the weeks ahead.

**The Youth Lead the Charge**

The present governments of the U.S., the U.K., France, and Italy—to name just a few—are incapable of dealing with the ongoing hyperinflationary blowout, and are therefore disintegrating. In recent polls, Bush's approval rating has plunged to 29%, just barely ahead of his I.Q., while his chief political advisor, Karl Rove, will likely soon be indicted for lying and obstruction of justice related to the Iraq war. However, a desperate, Cheney-dominated Bush administration could well launch a war on Iran to "change the subject."

The choice for the U.S., therefore (and for the world), could not be clearer: economic reorganisation with LaRouche, or war, genocide and a New Dark Age with Cheney, Bush and their controllers in the financial oligarchy. A national credit-fueled reorganisation of the U.S. auto industry is the vital next step in that fight. For this, no one is playing a more crucial role than the LaRouche Youth Movement (LYM).

As LaRouche said to his youth movement on May 13, "If the rest of the society sees the young adults coming up now, as being part of a process which means that the future is going to be better than the present, then people will react to young adults by saying, *They are our future.* The fact that the young adults are moving in a conservative direction, means that the rest of society says, 'Our society has a future, and these young people are the demonstration of that.' "

Leaders of the LYM are prominent elected officials of the Democratic Party, particularly in California; have been omnipresent as a lobbying force in the U.S. Congress over the past several years; and maintain a high-profile street presence throughout the U.S. auto and steel heartland in the midwest and in other key urban centres. Their knowledge and enthusiasm are sparking broader layers to take up the battle.

# Zepp-LaRouche Re-Issues Call for New Bretton Woods

In 1997 and again in 2000, Helga Zepp-LaRouche, chairwoman of the international Schiller Institute and wife of Lyndon H. LaRouche, Jr., issued calls for a "New Bretton Woods" reorganisation of the international monetary system. These calls were endorsed by thousands of notable personalities worldwide, including former heads of state, parliamentarians, church leaders, members of the military, trade union leaders, etc., among them a number of prominent Australians. Reflecting that ferment, and the reality that the "globalist" system was an increasing disaster, the Parliament of Italy formally passed a resolution for a New Bretton Woods, which mandated the Italian government "to convene an international conference at the level of Heads of State and Government, to globally define a new and more just monetary and financial system."

Now, with the globalist system entering the final phase of a hyperinflationary blowout, Zepp-LaRouche on May 10 issued an updated call for a New Bretton Woods.

After recounting the depth of the present global crisis, the call concludes with the following six points of action:

1. A system of fixed exchange rates must be agreed upon immediately.
2. Derivatives speculation must be prohibited through an agreement among governments.
3. There must be put into effect a comprehensive reorganisation, or rather a stretching-out of debts.
4. There must be put in place new credit lines, through state credit creation, in the tradition of Alexander Hamilton and the American System, which will make possible productive full employment, through investments in basic infrastructure and technological revival.
5. The completion of the Eurasian Land-Bridge, as the kernel of the reconstruction of the world economy, is thus the vision which will not only bring about an economic miracle, but also can become a system of peace for the 21st Century.
6. A new "Treaty of Westphalia" must guarantee the opening up and development of raw materials for all nations on this Earth, for at least the next 50 years.

Helga Zepp-LaRouche, Chairwoman of the international Schiller Institute.

The full call may be seen at http://www.schillerinstitute.org/lar_related/2006/Hegla_New_BW.html. The full background to the New Bretton Woods concept, along with the signatures of many hundreds of the signers of previous calls may be found in the CEC's book, *What Australia Must Do to Survive the Depression*, now in its third printing.



## The Beauty of Completing The Nuclear Fuel Cycle (cont. from p.4)

*Cont. from Page 4*

a year, the total radioactivity level is only about 12% of what it was when the fuel rod came out of the reactor.

At present, the United States does not reprocess spent fuel, and so the spent fuel rods sit in cooling pools at the reactor. After the spent fuel has cooled, it is stored in dry casks, waiting for "burial" or reprocessing.

But the spent fuel is not "waste"! It contains between 90 and 95% of usable uranium, that can be separated out and recycled into new fuel, and it also contains a smaller amount—about 1%—of plutonium, a fuel for breeder reactors.

### Reprocessing

7. Now for the remarkable renewability of nuclear fuel. The spent fuel from a single 1,000-megawatt nuclear plant, operated over 40 years, is equal to the energy in 130 million barrels of oil, or 37 million tons of coal. Why bury it? Extract it and process it into new fuel. Short-sighted policymakers (discussed below) decided in the 1970s, for no good reasons, that it was preferable to prevent the full use of this potential by burying the spent fuel in a once-through cycle.

The reprocessing method that was successfully used in the United States at the Savannah River facility in South Carolina for military purposes, is just as efficient for civilian spent fuel. Spent fuel rods are processed to remove the highly radioactive fission products, and separate out (partition) the fissionable U-235 and plutonium.

This plutonium could be directly used as fuel for breeder reactors, which was the intention of the completed fuel cycle. It can also be used to make mixed-oxide fuel, or MOX, which some of today's reactors are being converted to burn as fuel. (Thirty-five reactors in Europe now use MOX fuel.)

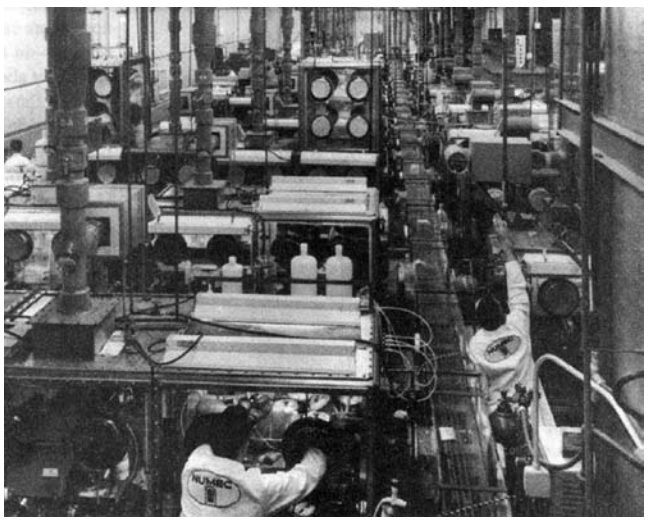
The reprocessing facilities at Savannah River were called "canyons" because they were tall, narrow buildings. The spent nuclear fuel was handled remotely by technicians who were behind protective walls. This was large-scale industrial processing, which was entirely successful, safe, and safe-guarded.

Once the uranium was separated out, it was sent to another building at Savannah River to be fabricated for weapons use. The remaining amount of highly radioactive fission products—a tiny fraction of the spent fuel—was set aside for vitrification and storage. Today, the technologies exist, or could be developed, to extract valuable medical and other isotopes from this 3% of high-level waste. Virtually all of the spent fuel could be made usable.

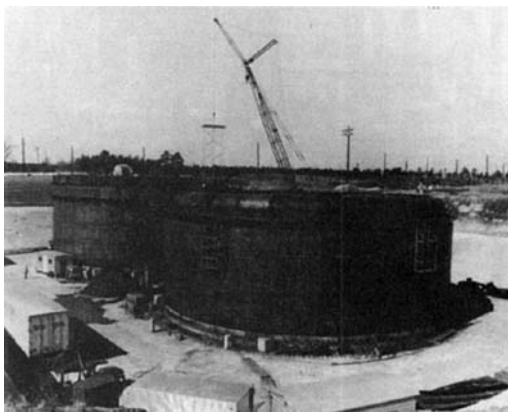
U.S. civilian spent fuel could be reprocessed in a similar fashion using the Savannah River model—or by new technologies still to be developed. Right now, Britain, France, Russia, and India reprocess civilian spent fuel, using the Purex method (which stands for Plutonium Uranium Extraction), and Japan has a commercial reprocessing plant now in a testing start-up phase. Other nuclear nations send their spent fuel to Britain or France for reprocessing, or they store it. China reprocesses military spent fuel.

### Who Opposes Reprocessing?

Reprocessing makes the antipopulation faction very nervous, because it implies that nuclear power will continue to develop as a source of electricity, and with a cheap and clean source of power, there are no limits to growth. Malthusians and other alarmists rant about the "dangers of proliferation," but if you poke them, what they are really concerned about is the potential for nuclear energy to expand, and population and industrial development to grow.



In this 1964 photo, laboratory technicians work in glove-boxes to remotely fabricate plutonium fuel elements.



A 1972 photo of high-level waste storage tanks in construction at DOE's Savannah River Plant in South Carolina. The tanks are built of carbon steel, surrounded by concrete encasements 2 to 3 feet thick, set about 40 feet in the ground and then covered with dirt. Shown are the steel tanks before concrete encasement. Each tank has a capacity of from 750,000 to 1,300,000 gallons.

The overt arguments against reprocessing are mostly scare tactics: Permitting U.S. reprocessing will make it easier, they say, for "bad guys" to build bombs—or dirty bombs. This is the gist of the objection, although it may be posed at length in more academic (and tedious) language.

But this argument is one based on fear—fear that an advanced technology can never be managed properly, and fear that we will never have a world where there aren't "bad guys" who want to bomb us. It is the opposite of the Atoms for Peace philosophy.

In fact, if one is truly worried about diversion of plutonium, why not burn it to produce electricity, instead of letting it accumulate in storage? And as Savannah River manager William P. Bebbington, a veteran of the Manhattan Project, wrote in a landmark 1976 article on reprocessing, "Perhaps our best hope is that someday plutonium will be more valuable for power-reactor fuel than for weapons, and that the nations will then beat their bombs into fuel rods."

A second objection is that reprocessing is not "economical"; it is cheaper to have a "once through cycle" and discard the spent fuel. But the cost/benefit basis on which such economics are calculated is a sham. What is the cost of not reprocessing—in terms of lives lost and society not advancing? And what about the cost of the storage of spent fuel—not to mention the still unused U.S. storage facility at Yucca Mountain, Nevada, which has become a costly political and emotional football?

The "proliferation" argument was key in 1976 in stopping U.S. reprocessing. Fear was fed by the idea that reprocessing would make more plutonium available, which could be diverted by "rogue" nations or groups to make clandestine nuclear weapons. President Ford, the incumbent, carried out a secret study, and issued a nuclear policy statement on Oct. 28, 1976, just five days before the election, which advocated an end to reprocessing.

Jimmy Carter, who won that election, then carried out the policy to stop U.S. reprocessing; and the next President, Ronald Reagan, sealed the lid on the fuel-cycle coffin with the idea of "privatizing" both reprocessing and breeder reactors.

The full story of how reprocessing was stopped still has to be told. But the ending of the story is clear: The United States shot itself in the foot—twice: 1) The United States stopped an important technology, which this country had pioneered, and 2) the U.S. anti-reprocessing policy did absolutely nothing in the rest of the world to stop other countries from developing the full nuclear fuel cycle, or desiring to.

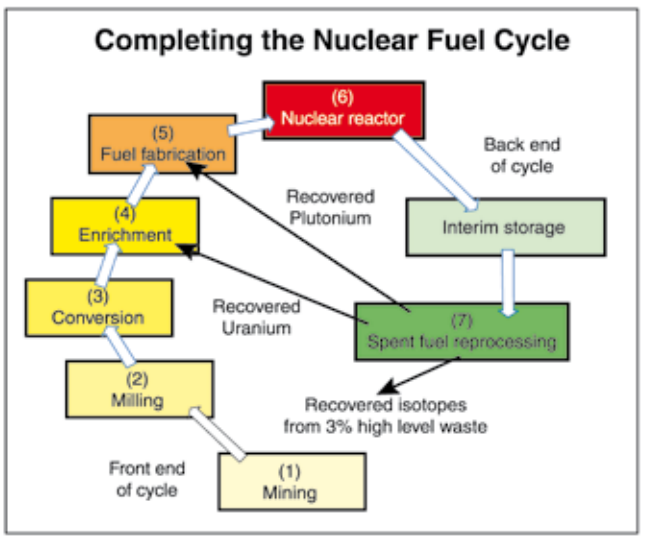
Interestingly, the Ford Administration's policy in 1976, which advocated killing U.S. reprocessing for the same fallacious reasons that President Carter later elaborated, was written under the direction of Ford's chief of staff—Dick Cheney. And one of the key reports supporting Carter's ban on reprocessing was written by the mentor of the leading neo-cons in the Bush Administration, Albert Wohlstetter, then a consultant to the Department of Defense.

Once the political decision is taken to begin an ambitious nuclear construction program, reprocessing—both Purex and new technologies—will follow.

1. The energy density of nuclear can be seen by comparing fission fuel to other sources. In terms of volume of fuel necessary to do the same amount of work, a tiny pellet (1.86 grams) of uranium fuel equals 1,260 gallons of oil, or 6.15 tons of coal, or 23.5 tons of dry wood. This means that nuclear is 2.2 million times more energy dense than oil, and 3 million times more energy dense than coal. Thermonuclear fusion will be even orders of magnitude more energy dense. These calculations were based on the work of Dr. Robert J. Moon in 1985.

# The Beauty of Completing The Nuclear Fuel Cycle

***The U.S. pioneered the full nuclear fuel cycle, but gave it up in the 1970s, following a Ford Administration policy written under the direction of Dick Cheney. Marjorie Mazel Hecht reports.***




The full nuclear fuel cycle shows that nuclear is a renewable energy source, because the spent fuel can be reprocessed to recover unburned uranium and plutonium that can be fabricated into new reactor fuel. At present, the U.S. nuclear cycle is "once through", going from spent fuel to interim storage and then longer-term storage.

A cylinder of uranium hexafluoride enriched in U-235 is readied for shipment to a conversion facility, where it will be converted to uranium dioxide for use in fuel rods. The cylinder weighs 2.5 tons.

A nuclear fuel assembly. A fuel assembly consists of a square array of 179 to 264 fuel rods, and 121 to 193 fuel assemblies are loaded into an individual reactor. After the nuclear fuel is used at nuclear power plants, it can be reused as recycled fuel through chemical processing at a reprocessing plant.

It would take 2 million grams of oil or 3 million grams of coal to equal the power contained in 1 gram of uranium fuel.[1] Unlike oil and coal, nuclear fuel is recyclable and, in a breeder reactor, can actually produce more fuel than is used up! For these reasons, nuclear energy is by far the best means now available to power a modern industrial economy.

Nuclear power is a gift to humanity, and only the propaganda of Malthusian extremists, dedicated to stopping human progress and reducing the world's population, has created public fear and skepticism.

The best way to overcome irrational fear is through knowledge. To this end, reviewed here is the process by which natural uranium ore is turned into fuel for a nuclear reactor, how it is used, and how it can be recycled, such that the reader will come to understand that there is really no such thing as nuclear "waste."

**The Nuclear Fuel Cycle**

To understand the "renewability" of nuclear fission fuel, we have to look at the complete fuel cycle. At the beginning of the nuclear age, it was assumed that nations would complete the fuel cycle—including the reprocessing of spent nuclear fuel from reactors, to get as near to 100% use of the uranium fuel as possible. Here we very briefly review the seven steps of this cycle. Keep in mind that the brevity of description leaves out details of the complex chemical processes, which were initiated during the Manhattan Project and are still being improved on.

1. First, natural uranium is mined. There are enough sources of uranium worldwide for today's immediate needs, but once we begin an ambitious nuclear development program (to build 6,000 nuclear reactors in order to provide enough electricity to bring the entire world population up to a decent living standard), we would have to accelerate the development of fast breeder nuclear reactors, which produce more fuel than they consume in operation.

2. Next, the uranium is processed and milled into uranium oxide (U308), called yellowcake, which is the raw material for fission fuel. Yellowcake became infamous in the political fabrication that Saddam Hussein's Iraq was trying to import yellowcake from Niger, in order to use it for bomb-making.

It is basically natural uranium ore, which is crushed and processed by leaching (with acid or carbonate) to dissolve the uranium, which can then be extracted and concentrated to 75% uranium, in combination with ammonium or sodium-magnesium.

3. The concentrated uranium is then converted into uranium hexafluoride ($UF_6$), which is heated into a gas form suitable for enrichment.

4. Natural uranium has one primary isotope, U-238, which is not fissionable, and a much smaller amount of U-235, which fissions. Because most uranium (99.276%) is U-238, the uranium fuel must go through a process of enrichment, to increase the ratio of fissionable U-235 to the non-fissionable U-238 from about 0.7% to 3 to 4%. (Weapons uranium is enriched to about 93% U-235.)

The technology of enrichment was developed during the World War II Manhattan Project, when the object was to create highly enriched uranium (HEU) to be used in the atomic bomb. Civilian power reactors use mostly low-enriched uranium (LEU). (Canada has developed a type of reactor, the CANDU, which uses unenriched, natural uranium in combination with a heavy water moderator to produce fission.)

The gaseous diffusion method of enrichment, which is still used by the United States, was developed under the Manhattan Project. Uranium hexafluoride gas is pumped through a vast series of porous membranes—thousands of miles of them. The molecules of the lighter isotope (U-235) pass through the membrane walls slightly faster than do the heavier isotope (U-238). When extracted, the gas has an increased content of U-235, which is fed into the next membrane-sieve, and the process is repeated until the desired enrichment is reached. Because the molecular speeds of the two uranium isotopes differ by only about 0.4%, each diffusion operation must be repeated 1,200 times.

The Manhattan Project devised this method of gaseous diffusion with incredible speed and secrecy. It was not finished in time to produce all the uranium for the uranium bomb dropped on Japan, but it produced most of the enriched uranium for the civilian and military programs in subsequent years. Although a successful method, it required a tremendous amount of energy and a huge physical structure to house the "cascades" of separate membranes. Four power plants were built in Oak Ridge, Tenn., to power the process, producing as much electric power as the consumption of the entire Soviet Union in 1939! Almost all the power consumed in the diffusion process is used to circulate and compress the uranium gas.

Technological pessimists take note: At the time the gaseous diffusion plant was being built, scientists had not yet figured out how to make a membrane to be used in the process—but they did it in time to make it work!

The centrifuge system, used in Europe and Japan, is 10 times as energy efficient. The strong centrifugal field of a rotating cylinder sends the heavier isotope in uranium hexafluoride to the outside of the cylinder, where it can be drawn off, while the U-235 diffuses to the inside of the cylinder. Because of the limitations of size of the centrifuge, many thousands of identical centrifuges, connected in a series called a cascade, are necessary to produce the required amounts of enriched uranium.

A centrifuge plant requires only about 4% of the power needed for a gaseous diffusion plant, and less water is needed for cooling.

Other methods of enrichment are possible—electromagnetic separation, laser isotope separation, and biological methods.

**Fabrication Into Fuel Rods**

5. Once the enriched uranium is separated from the depleted uranium, it is converted from $UF_6$, into uranium dioxide and fabricated into uniform pellets. The pellets are loaded into long tubes made out of a zirconium alloy, which captures very few neutrons. This cladding prevents the release of fission products and also transfers the heat produced by the nuclear fission process in the fuel. The fuel is then transported to the reactor site.

Different types of reactors require different designs of fuel rods and fuel bundles. In a light water reactor, the fuel rods are inserted into the reactor to produce fission, which creates steam, which turns a turbine that creates electricity.

The fuel for the next-generation hightemperature gas-cooled reactors is different: The enriched uranium is formed into tiny "pebbles" which are coated with graphite and special ceramics that serve as individual "containment buildings" for the fuel pebbles.

6. Fuel rods are used for about four and a half years before replacement, and usually a reactor replaces about a third of its fuel at one time. The fuel is considered spent when the concentration of fissile uranium-235 becomes less than 1%. When removed from the reactor, the spent fuel is put into cooling pools, which shield it as its short-lived nuclides decay. Within

*Continued Page 3*

An overhead view of rows of centrifuge units used for the enrichment of Uranium.



## You Can Help!

**In coordination with LaRouche's efforts in the U.S., we have to force the policy makers in this country to dump globalisation, and go with a national banking-financed, infrastructure-centred recovery policy. You can help by:**

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