Richard Freeman

The collapse of the machine-tool design principle

The battered world physical economy, if it is to survive and ever undergo reconstruction, must draw from and be energized by the machine-tool design sector. However, the machine-tool industry's capability is being destroyed. This year, orders and/or consumption of the machine-tool industries of Japan, Germany, and the United States have fallen in the range of between 13 and 41%. These three nations combined produce one-half of the world's machine tools.

This indicates a desperate situation for the world economy. It signals the deepening economic collapse in Japan, Germany, and the United States. *But, it also indicates the permanent abandonment of any future*. The machine-tool design principle is the well-spring of economic growth. Economics starts with man in the image of God, and the capacity of the sovereign individual mind to make revolutionary validatable discoveries in fundamental science, as well as in Classical art and music. In the scientific realm, these ideas are incorporated as designs for machine tools and other advanced machinery. Through this process, they are directly transmitted into the physical economy and the productive process, directly imbuing that process with a power that permits man to transform and greatly increase his mastery over nature, advancing civilization.

The loss of the machine-tool industry is due to the process that Lyndon LaRouche has scientifically represented as the Triple Curve collapse function, displayed in **Figure 1.** The financial aggregates, or the speculative bubble, which is represented by the top curve, and the monetary aggregates, which are attempting to hold up the bubble, as represented by the middle curve, suck the life from the physical economy, which is the bottom curve, causing it to collapse. These are three curves, but one simultaneous function. But, what the loss of the machine-tool design principle consists of is something special: If mankind losses the machine-tool design principle, *it will never have the chance to advance*. Man will be thrust back into ruin and destruction, a world of half a billion semi-literate human beings roaming the Earth—which is the explicit goal of Britain's Prince Philip. In fact, this is why the machine-tool industry has been *deliberately targetted for destruction,* which will documented here in the case of the United States.

The machine-tool industry is collapsing at a dramatic rate.

Figure 2 shows the consumption of machine tools in the United States. For the first half of 1998, the consumption of machine tools was $3.274 billion; for the first half of 1999, the consumption of machine tools was $1.944 billion, a staggering fall of 41%. If one saw this level of fall and did not

FIGURE 1
A typical collapse function

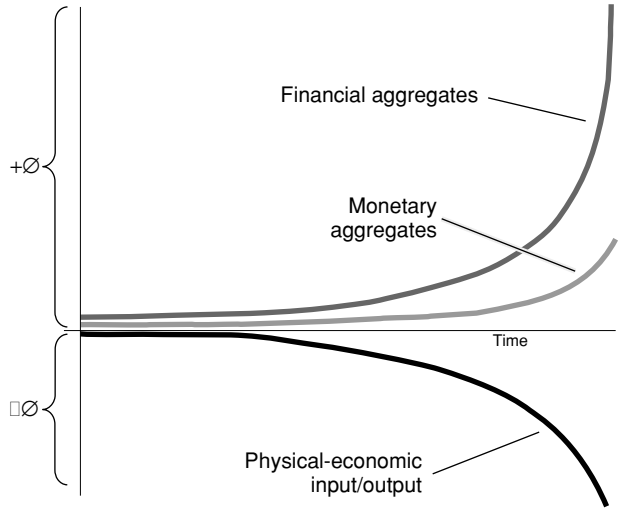
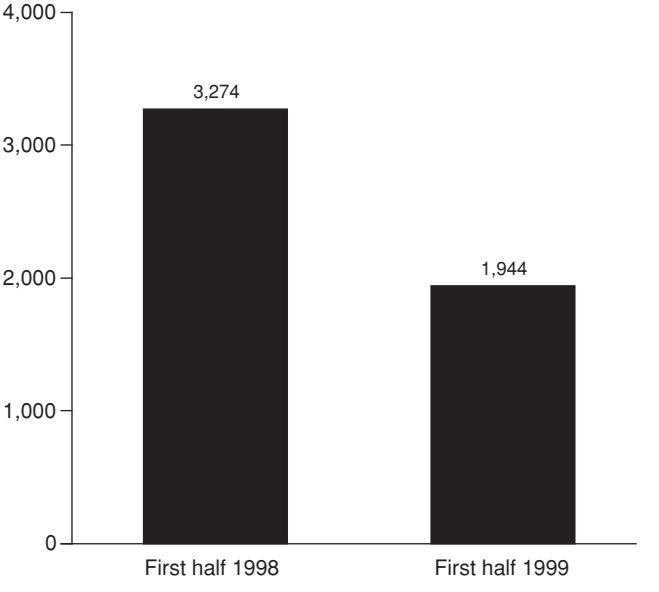


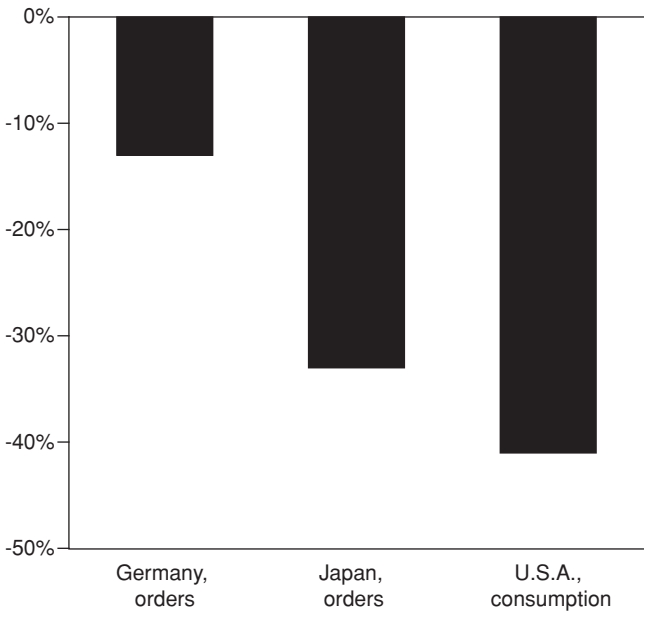
FIGURE 2
U.S. machine-tool consumption collapse of 41%

($ millions)



Source: Association for Manufacturing Technology.

FIGURE 3
Fall in big three world machine tool production
(percent)



Sources: Association for Machine Tool Manufacture; VDMA, German Association of Machine Tool Builders; Japan Machine-Tool Builders' Association.

TABLE 1
The largest machine-tool-producing nations
(1998 = $36.8 billion)

1. Japan
2. Germany
3. United States

4. Italy
5. Switzerland
6. China
7. Taiwan
8. United Kingdom
9. France
10. Spain
11. South Korea
12. Brazil

Source: *Metalworking Insiders Report,* "World Machine Tool Output and Consumption Report, 1999."

know which country it occurred in, one might say, "Oh, this is Russia," or, "This is occurring in a country in Africa." But no, this occurred in the United States, which, we're told, is in its ninth year of economic expansion.

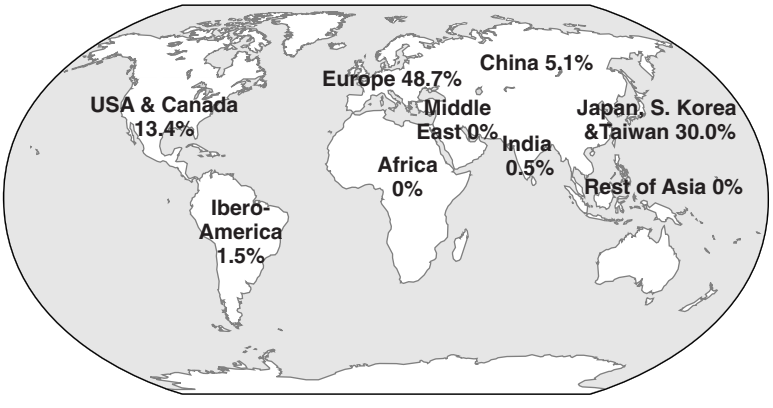
Figure 3 shows the situation for the other two members of the big three machine-tool producers, Germany and Japan. Unlike with the United States, the figures do not show consumption, but rather new orders. But whether one is dealing with consumption or new orders, if they are falling, it all leads back to one thing: a fall in production. For Germany, for the period of May through July of this year compared to May through July of last year, new orders fell by 13%. For Japan, we have a longer span: Comparing the first six months of 1999 to the first six months of 1998, new orders dropped by 33%.

What makes this a catastrophe for the world, is the fact that the machine-tool industry is a small industry, but a highly skilled, highly technologically developed industry. It should have been much larger throughout its history—but it's not a gigantic industry. Most machine tool shops are what are called in Germany *Mittlestand* shops, shops of between 10 and 200 employees, which, in the past, were dedicated to technological progress. For purposes of comparison, in 1998, total world production of machine tools was only $36.8 billion, out of a total world Gross Domestic Product of $41 trillion.

Let us look at just how concentrated world machine-tool production is. **Table 1** lists countries in order of size of machine-tool production. Japan, Germany, and the United States are grouped together, because these three countries have averaged, for the last three years, production of 53% of the world's machine tools. If one adds the next four largest machine-tool builders, in order of rank—Italy, Switzerland, China and, Taiwan—then these seven countries produce 79% of the world's machine tools. So, seven countries produce four-fifths of the world's machine-tool output.

Next, **Figure 4** shows a map of world distribution of machine-tool production. There are three main centers: first, Ja-

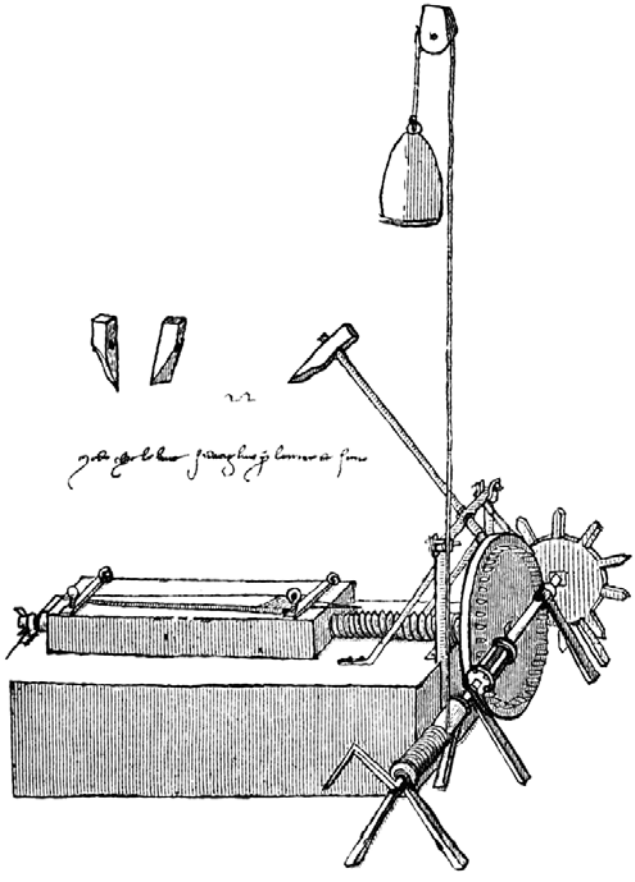
FIGURE 4
Where world's machine tools are produced
(1998 production = $36.8 billion)



pan, Taiwan, and South Korea, which have 30%—and remember, Japan and Taiwan are among the world's top seven producers; Europe, which has 48.7%, in which Germany, Italy, and Switzerland make up the lion's share; and the United States and Canada, which have 13.4%, which is almost exclusively from the United States. There's also China, with 5.1% of world production, and India with 0.5%. Now, look at the rest of the world. Ibero-America has 1.5%; that's largely Brazil. Africa, the rest of Asia, and the Middle East have *zero percent of the world's machine-tools production*. We have to build up machine-tool production in these other areas, and that is a key feature of the Eurasian Land-Bridge. But now, you can realize what a disaster it is when machine-tool performance is plunging in the range of 13-41% in Japan, Germany, and the United States, which produce by themselves more than half the world's machine tools. The world is starved for machine tools.

But the critical point is, that most of the population would not even appreciate what has just been proven about the devastation of the machine-tool design principle. They're focussed on the stock market, on the Internet, on McDonald's. You say to most people, "What do you think of the fall of something upon which human life depends, machine tools?" The reply: "I don't know much about it, and I don't really care." And that's probably the biggest problem, because leaders of state, people who are running for the Presidency, *do not even understand, that this is one of the most fundamental question facing the human race, at least in terms of the economic principles involved*.

FIGURE 5
Drawing by Leonardo of a file-cutting machine



The machine-tool design principle is an expression of the fundamental discovery in epistemology that Lyndon LaRouche made in the period 1948-52, arising from his study of Bernard Riemann and Georg Cantor, as will be seen.

What are machine tools?

Before delving further into the machine-tool principle, let us look at what a machine tool is—because most people haven't seen them, and since some of them are going the way of the dodo bird. We'll look at machine tools; then, we'll look at the higher concept of the machine-tool design principle, which is *not the same thing as machine tools*—machine tools are a *function* of that higher principle. Then, we'll look at the deliberate destruction of the machine-tool industry, and finally the relation of the machine-tool principle to the Eurasian Land-Bridge.

FIGURE 6

Characteristic action of major metal-cutting machine tools

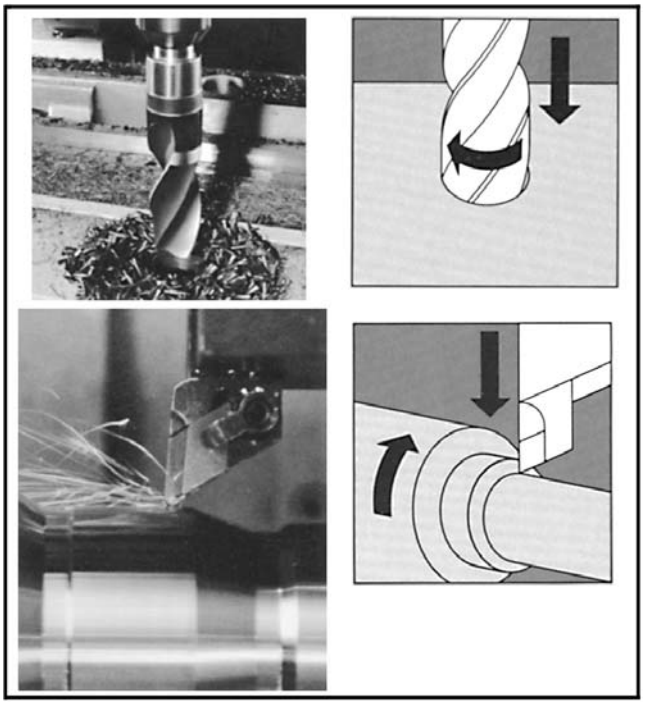
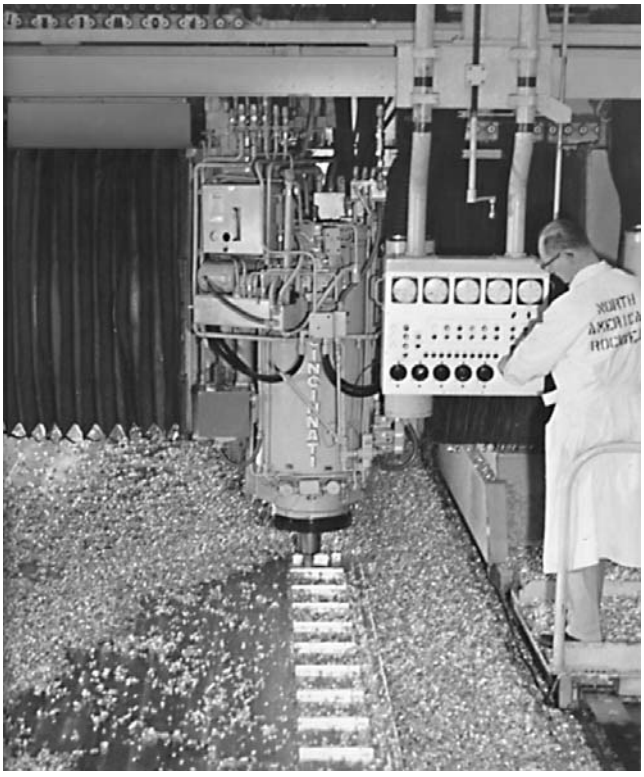


FIGURE 7

A numerically controlled machine tool machining fuel tank panels



A machine tool is a machine that makes other machines. The design of machine tools has been developed for hundreds of years. This sketch (**Figure 5**), from either the late fifteenth or early sixteenth century, is from Leonardo da Vinci's notebooks. It is a file-cutting machine. Leonardo made hundreds of sketches of every variety of machine tool, absolutely every variety you can imagine, although it is not known how many of these were made into working models; the implementation of some of his inventions would have to await the development of the heat-powered machine.

The development of the machine tool, and the machine-tool design principle, was greatly advanced by Lazare Carnot and Gaspard Monge at the Ecole Polytechnique in Paris in the first part of the nineteenth century. Thus, the machine-tool design represents *a process of centuries of ongoing perfecting*.

There are two main types of machine tools: the metal-cutting machine tool and the metal-forming machine tool. The distinction is based on their characteristic of action. The metal-cutting machine tool cuts metals, ceramics, or other materials; this can be cone by boring, gear-cutting, turning, grinding, and so forth. Metal-forming machine tools stamp or form a metal or other material; their operations include stamping, forging, etc.

We are going to look at two varieties of the metal-cutting type. Importantly, all of these work through rotational action. In **Figure 6,** we see a drilling machine on the top. The drilling machine tool's rotating bit bores or enlarges holes in the material that one is being worked on; what one is working on, is usually called the work-piece material. Below that, is a turning machine, also called a lathe. In a turning machine tool, it is the work-piece that is rotated along a common center line, and the blade is brought into contact with the rotating work-piece material.

In the operation of metal-cutting machine tools, the force of the instrument is normally built up or concentrated in the tool bit or blade. Dozens of parameters determine a machine tool's functioning. One important parameter is the spindle speed of the tool bit. During the nineteenth century, spindle speeds of 100 to 750 revolutions per minute (rpms) were common. Today, spindles can rotate at 8-15,000 rpms. Speeds of 30-40,000 rpms may soon be common.

We have examined machine-tool blades and tool bits, and their characteristic actions; let us move upward to examine an entire machine. The picture in **Figure 7** was taken 30 years ago. It shows a numerically controlled machine tool that is 270 feet (82 meters) long. It is machining, in an advanced way, the fuel tank panels for the Saturn V rocket, which is the rocket that took the Apollo 8 spacecraft on man's first voyage

to the Moon in 1969.

I want to plant an idea into your head, to stimulate a mental concatenation of ideas. Scientists, such as Wernher von Braun and others, originate the concept of space travel totally in their minds, involving new physical principles. There is nothing *physical* that exists yet. So, the scientist conceives of a spacecraft, with specifications, and much work goes into that. But to make that spacecraft, he has to have hundreds of specially built or modified machine tools to machine the specific functions without which the spacecraft could not be built.

Moreover, the engineers building the spacecraft will work with master mechanics, who have decades of experience, and will know what type of machine tool needs to be constructed to, in turn, build the spacecraft. So, the scientists, the engineers, and the master machinists, through discussions, traverse back and forth in their heads *the product designs, both of the spacecraft and of the machine tools that will build the spacecraft*. Then they incorporate these advanced designs into the machines. In this way, the advanced designs increase man's power over nature.

Now, we've seen a single machine tool. Some single machine tools are very powerful, such as the five-axis machine tool, which can perform multiple functions of drilling, milling, etc., and can work on a work-piece material not from only three axes, but from five axes, and as well as tilt the work-piece. As part of the advances, there are machine tools based on new physical principles, such as lasers, particle beams, and plasmas to do milling and other jobs.

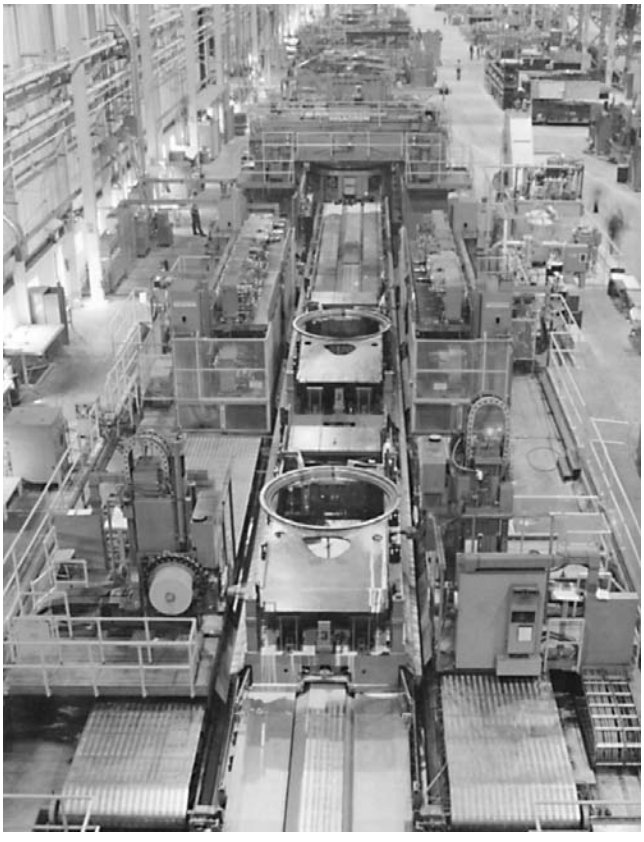
But now, look at **Figure 8.** This is a manufacturing plant, making a hull for an Army tank. The hull can be seen in the center, the round shape, floating down the center on a cushion of liquid. On either side of the hulls are many machine tools. Each one or two machines is performing a different function. This gets us to the next level. The machining work is not done by a single machine tool, but an organized series of them, dozens, or perhaps hundreds. Thus, one increases the power of the machining process, by organizing the machines into an ordered configuration. The power of the configuration is greater than the sum of the powers of the individual machines.

This point is exemplified by the Mack Truck assembly and manufacturing plant in Frederick, Maryland, which can be visited. Inside, it has 1,450 machine tools. The production process is nothing other than an organized configuration of machine tools, which is how real manufacturing is done.

The introduction and advancement of machine tools, especially since the introduction of the heat-powered machine, has created an increase of power and efficiency by man by as much as 100-fold.

An important feature of machine tools is that they build, not just individual products, but other machines. **Figure 9** shows that proceeding from creative human discovery, machine tools build construction equipment, mining equipment, oil and gas drilling equipment, etc. The construction equipment, built with machine tools, in turn, is used to build dams, bridges, water mains. So, the machine tool builds the construction equipment, which is utilized to build the dams and other edifices. By this process, physically, the machine-tool design radiates out everywhere, throughout the economy.

FIGURE 8
Configuration of machine tools machining a tank hull



All economic mobilizations require machine tools, including the Land-Bridge. For example, the biggest bottleneck in the economic mobilization of the United States during 1939-44 for war production, was machine tools. Since machine tools build other machines, the United States couldn't build anything without having machine tools first. Leading his Hamiltonian-style mobilization of industry, President Franklin Roosevelt ordered the construction of new machine-tool plants, and their operation on 24-hour-per-day shifts. **Figure 10** shows that the United States went from the production of 34,000 machine tools in 1938 to 307,000 in 1942. We can build machine tools when we decide to.

The higher machine-tool design principle

Considering the development and power of the machine tool, we've moved in the direction of, but have not yet reached, the machine-tool design principle. It is to be empha-

FIGURE 9

The central role of the machine tool in the economy

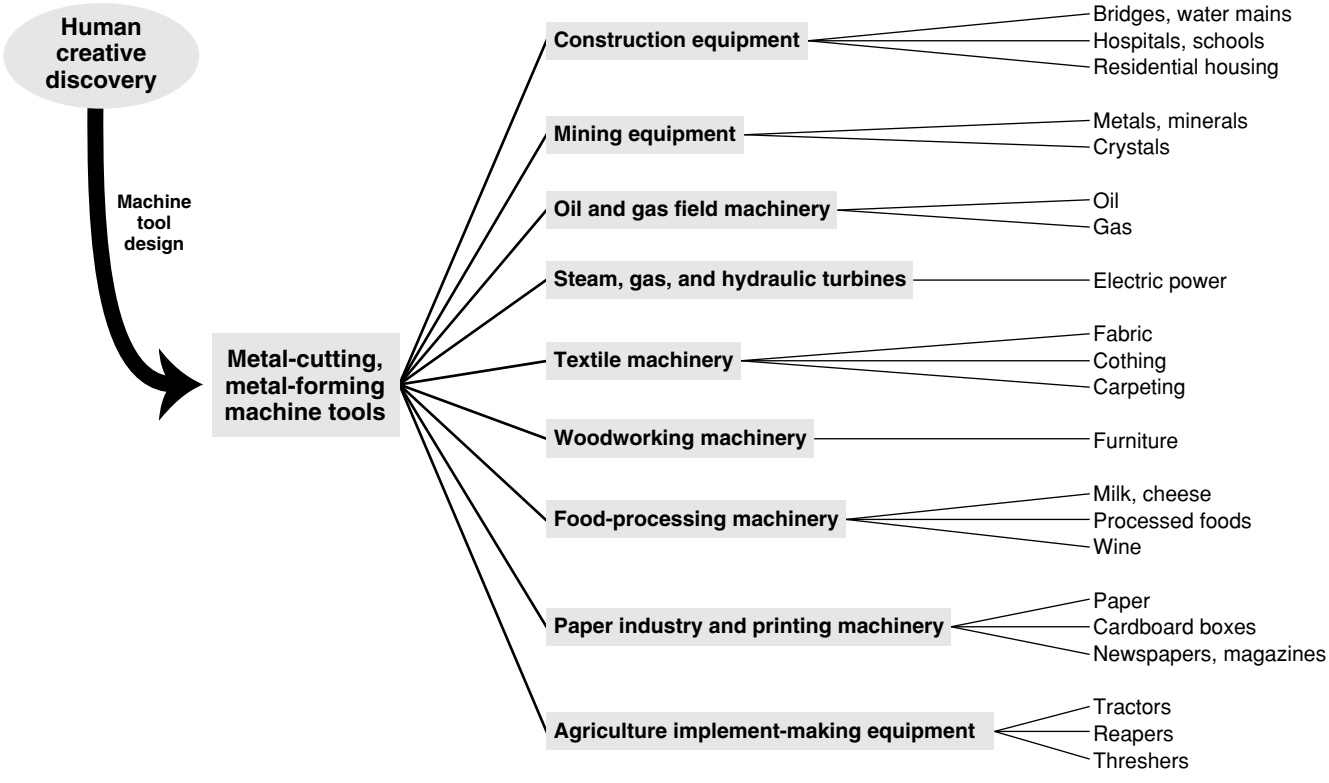
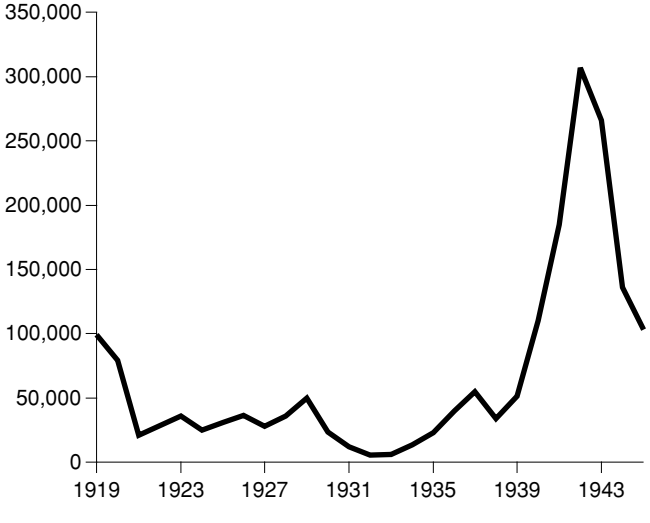


FIGURE 10

U.S. machine-tool production surges under Roosevelt 1939-43 mobilization

(units produced)



Source: "A Study of the Machine Tool with Emphasis on the Problem of Stability," 1962 Doctoral Thesis at American University by Robert Stanley Himes.

sized, again, that the machine tool, as powerful or remarkable as it is, *qua* machine tool, is not the machine-tool design principle. It is a function of the principle.

The machine-tool design principle exists as a higher concept, which involves the creative mind, the mind's creation and improvement of the machine-tool design, its improvement of the productive labor force, and the relation of all of this to transforming the economy.

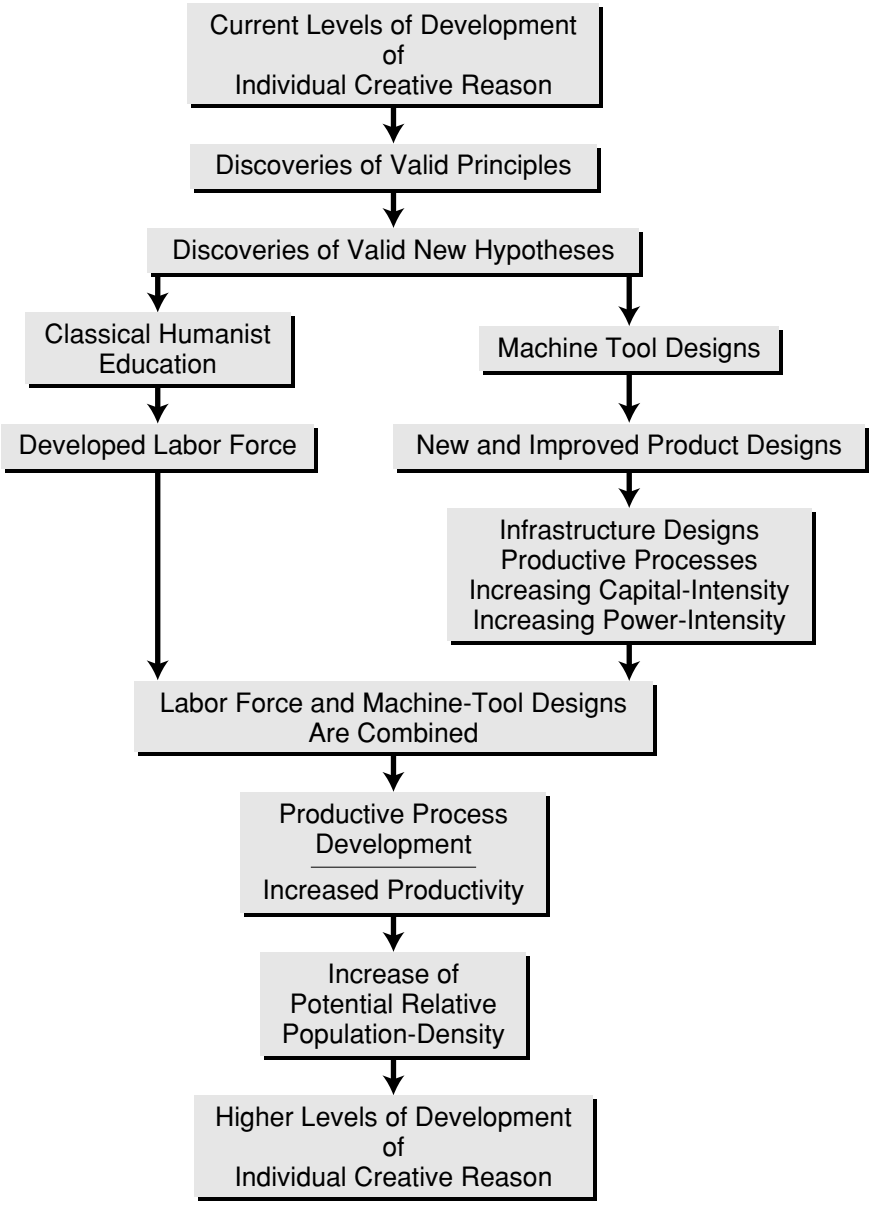
Figure 11 is a graphic from Lyndon H. LaRouche's article, "Return to the Machine-Tool Principle," which appeared in the Feb. 7, 1997 *EIR*. It is recommended that you read this in full. I could not do full justice to elaborating this valuable work, so I just want to make a few points.

Start with man in the image of God. Man makes a revolutionary discovery of physical principle. It is usually individuals who care very much about mankind, who make such discoveries. This new discovery is effected at first as an hypothesis, and then as a validated solution to an otherwise perplexing paradox in existing knowledge. Mr. LaRouche has represented that, as the column splits off to the right side in Figure 11.

This discovery occurs in the cognitive mind, in the same manner that it does in art and music—that is, as a metaphorical idea. However, the metaphorical idea is not painted onto a canvas, or sculpted into stone. Rather, it is put into a machine.

FIGURE 11

How the Machine-Tool Principle is situated



If you want, *the idea as a design concept, is painted or transferred to the machine*.

So, we have man generating a succession of revolutionary scientific discoveries, which generates a succession of machine-tool designs. These designs are incorporated into a succession of machines, each with greater efficiency. So, the machine-tool design principle is not a single machine, nor is it a single machine-tool design; rather, it's an ordering process, starting with scientific discoveries, of a *succession* of machine-tool designs, each with more power, incorporated into the machines.

Here, we are talking about machines, not just restricted to machine tools in the narrowest sense, but to all advanced machines, including laser systems, power systems, rail systems, that incorporate this latest machine-tool design.

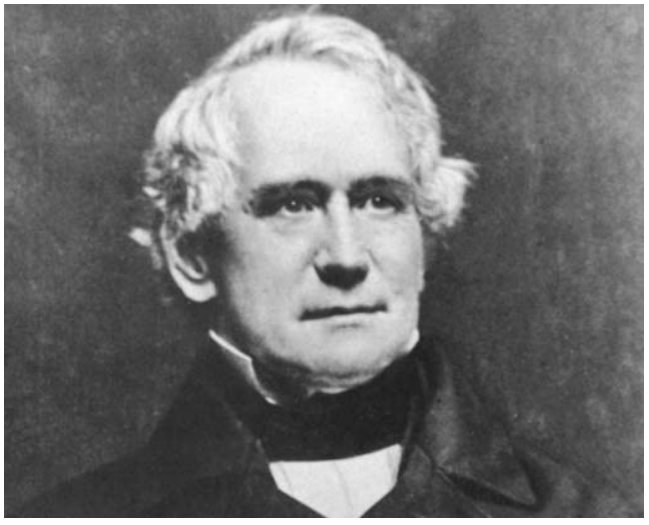
In this way, each machine-tool design represents a transmission from the past of all the advanced ideas, from Leonardo da Vinci, from Lazare Carnot, and so on. It represents the transmission of all the important ideas of civilization, which are still alive, but now improved upon.

Simultaneously, and this is the left side of that chart, this process of generation of revolutionary ideas must shape the minds of members of the labor force, so that their cognitive ability, and associated skill level, are constantly rising. The labor force must have more powerful minds to master the machine-tool principle.

Bring the two processes together, and now you have the advanced mind working with the advanced machine-tool principle. *This is the source of productivity*. This is the point that LaRouche was concentrating on in his 1948-52 studies, which led to his breakthrough in economic science. How do you go from the invisible world of the mind, into modifying the material and physical world? Where is that transmission point? This is it.

This is the source of technological progress. Technological progress is *not* computers. It is not the Internet. It's not the Information Age. That's all nonsense! That high-tech stuff is not really high tech. *This* is the source of technology, the *real* source of technology. It's the *only* source of technology, this entire conceptualized process. This results in the increase in non-entropic activity in the whole economy. Man enhances the rate of growth of potential relative population density.

The society that's committed to this principle, that's organized by this principle, is a society that moves and can move with the most advanced ideas, as LaRouche has discussed in terms of the Riemannian manifold, from an *n*



Henry Carey (1793-1879), the great anti-free-trade economist of the American System.

domain to an *n*+1 domain. Think of being able to transmit that into machines, which can then move the whole society that way.

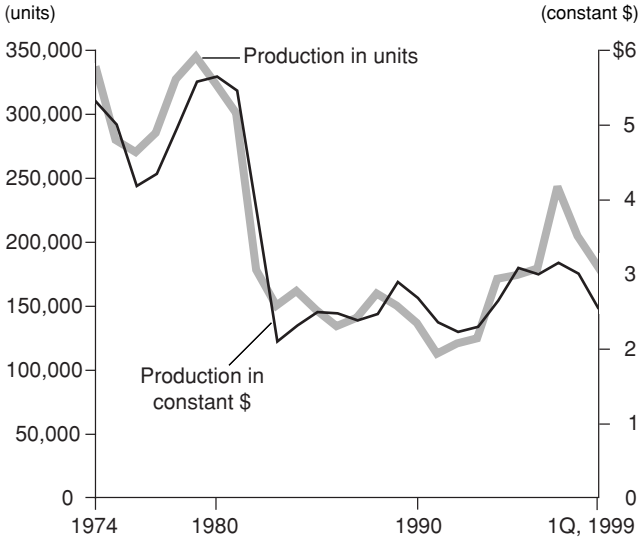
A society that has machine tools, and this whole machine-tool design principle, and a skilled labor force, can think of these ideas and almost immediately transmit them. But an underdeveloped country in Africa, right now, can't. *Therefore, such a country is denied the very principle required to develop*. And the deliberate collapse of the machine-tool industry, therefore, represents not just the collapse of orders, or of consumption, it represents the collapse of the very principle itself. Because, if you abandon the machine tools, then you can't have the larger, higher machine-tool principle operate.

The destruction of machine-tool design

When America was founded, it was directed by the machine-tool design principle. During the period of 1861-76, America advanced the machine-tool principle around the world, under the leadership of Henry Carey (see photo). America helped construct railroads in an earlier version of the Land-Bridge and machine-tool shops and other manufacturing industries in other nations.

But the British oligarchy specifically targetted the American machine-tool industry for destruction. In the 1960s, it introduced the post-industrial society. In 1971, it manipulated President Richard Nixon into taking the United States off the gold-reserve standard, and into adopting the floating exchange-rate system. The oligarchy started building up the speculative bubble that sucked the physical economy dry. In 1979, British asset Paul Volcker was made Federal Reserve Board chairman, and applied a policy which he called "controlled disintegration," which he and some others had developed at the New York Council on Foreign Relations, as part of a project, called *Project 1980s*. This produced in the 1970s, a series of 33 books. The *Project 1980s* book on monetary disorder, written in the 1970s, asserted that the economy would be put through oil shocks, energy cutoffs, interest rate hikes, and would plunge the economy into negative growth and disintegration, which the oligarchy hoped it could control—hence the term, "controlled disintegration."

FIGURE 12
U.S. machine-tool production, in units and 1982 constant dollars



Sources: Association for Manufacturing Technology; U.S. Department of Commerce, Bureau of the Census; *EIR*.

In November 1978, speaking in Leeds, England, Volcker affirmed the policy, saying, "Controlled disintegration is a legitimate objective of the 1980s." During the second week of October 1979, now installed as Fed chairman, Volcker raised interest rates into the stratosphere. By February 1980, the prime lending rate was 21.5%. The real physical economy, led by the machine-tool industry, buckled at the knees.

Figure 12 depicts machine-tool industry production level in units produced, which is the upper curve, and in 1982 constant dollars, which is the lower curve. The horizontal line represents 1979. You'll see the effect of Volcker's action, with a delay of about 18 months. Machine-tool production went straight down. Although there has been some bouncing around near the bottom since, and sometimes a slight rise, it is far below where it was in 1979.

Figure 13 shows machine-tool production per capita. The index is based on 1967. On this basis, America's machine-tool production today is 58% below where it was in 1979.

FIGURE 13

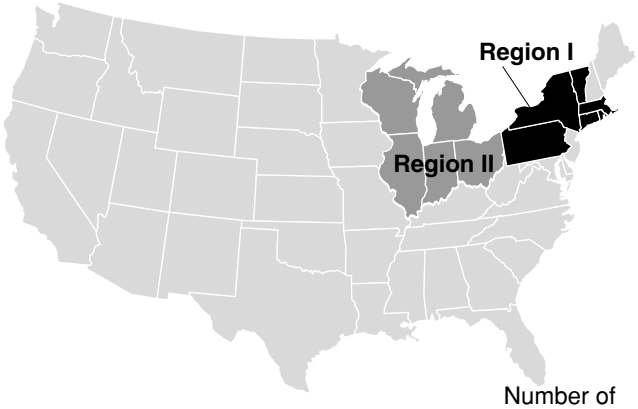
U.S. machine-tool output per capita collapses

(1967=1)

Sources: Association for Manufacturing Technology; U.S. Department of Commerce, Bureau of the Census; *EIR*.

FIGURE 14

Collapse of U.S. machine-tool establishments and employment, 1977 to 1992



	Establishments	Number of employees
1977		
Region I	275	23,500
Region II	567	48,200
1992		
Region I	115	7,700
Region II	317	22,700

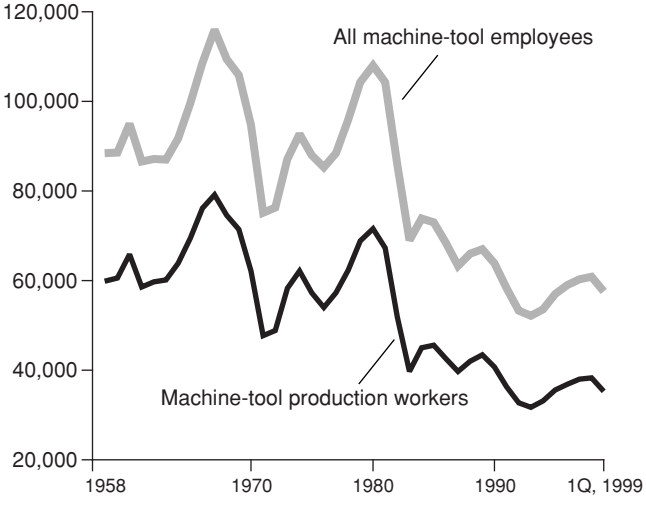
Volcker's action was a scorched-earth policy. The United States permanently lost capacity. **Figure 14** is based on the Commerce Department's census of the machine-tool industry for 1977, just before the Volcker actions, and for 1992, which is the latest year available. These are the two regions where most of America's machine tools are made: Region I is New England, and Region II is the Midwest. Between 1977 and 1992, in the Midwest, the number of machine-tool establishments went from 567 to 317, the number of machine-tool workers went from 48,200 to 22,700. In New England, the number of machine-tool establishments went from 275 to 115, and the number of machine-tool workers went from 23,500 to only 7,700. The machine-tool plants permanently closed their doors, and the workers scattered to the four winds.

Figure 15 documents the number of machine-tool workers. The top curve is all employees, including white collar workers. The bottom curve is just production workers, the workers who physically build the machine tools. The number of machine-tool production workers has fallen in half since 1967, to 35,300. That's the total number of workers in the entire United States that make machine tools today. Many workers who used to make machine tools, are either retired or are now driving taxicabs.

It should be considered that the average age of machine-tool workers is now 50-55 years. The industry is not getting the necessary influx of new workers, and the older workers

FIGURE 15

Number of U.S. machine-tool employees and production workers halved since 1967

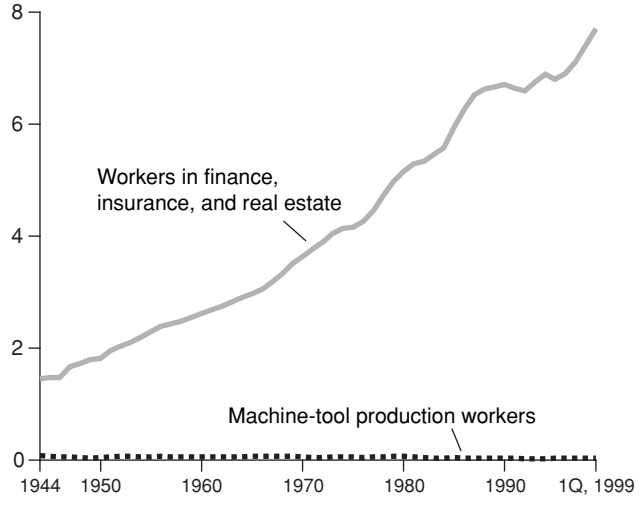


Sources: U.S. Department of Labor, Bureau of Labor Statistics, "Employment and Earnings," various years; *EIR*.

FIGURE 16

Machine-tool production workers vs. workers in finance, insurance, and real estate (FIRE)

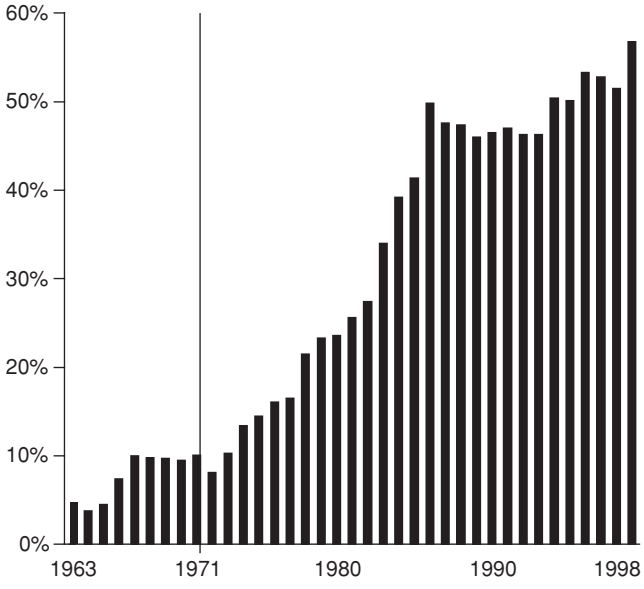
(millions of workers)



Source: U.S. Department of Labor, Bureau of Labor Statistics, "Employment and Earnings," various years; *EIR.*

FIGURE 17

Imports as a percentage of U.S. machine-tool consumption



Sources: Association for Manufacturing Technology; U.S. Department of Commerce, Bureau of the Census; *EIR.*

are nearing retirement age.

The machine-tool workforce has always been a relatively small work force, although in its heyday it should have been much larger than it was, given the needs of an expanding economy. I took the number of machine-tool production workers from the last graph, and put them in **Figure 16.** They are at the bottom; they look like a smudge on the bottom. This is the tiny force of highly skilled people, among the most skilled workers in America. Let us compare the number of machine-tool production workers to some other type of employment—say, the number of workers in the expanding "industry" of finance, insurance, and real estate, which goes by the acronym of FIRE. The acronym is quite apt, as this is the industry of financial speculation, which is burning down America. In 1999, there were 7.7 million workers in the FIRE sector, only 35,300 in physical production of machine tools. There are 220 workers in finance, insurance, and real estate in America for every worker making machine tools.

Finally, one hears a lot about imports. America imports more than half the machine tools that it uses each year, a strategic threat. This is the result of bad policy decisions. **Figure 17** shows imports as a percent of all machine-tool consumption in the United States. The year 1971, marked on the graph with a vertical line, is the year that Nixon took the dollar off the gold-reserve standard. Machine-tool imports, which had always been 10% of total consumption before 1971, now went up to 20%. It may be shocking, but up until 1976, the United States still exported more machine tools than it imported. In 1979, Paul Volcker began applying controlled disintegration to America, and as a result, within a few years, machine-tool imports went up to 50% of all machine-tool consumption, and have basically held at that level most of the time, until now, when imports are 56% of consumption. So, in assessing responsibility for this, America should look toward itself, rather than blaming other nations.

So, the collapse of machine-tool consumption we saw for the first half of this year (Figure 2), is occurring within the shrunken, or shrinking, industry. *It's a phase-point within the larger span of collapse.*

The collapse of the machine-tool sector is not occurring in isolation. Let us look at just three critical industries.

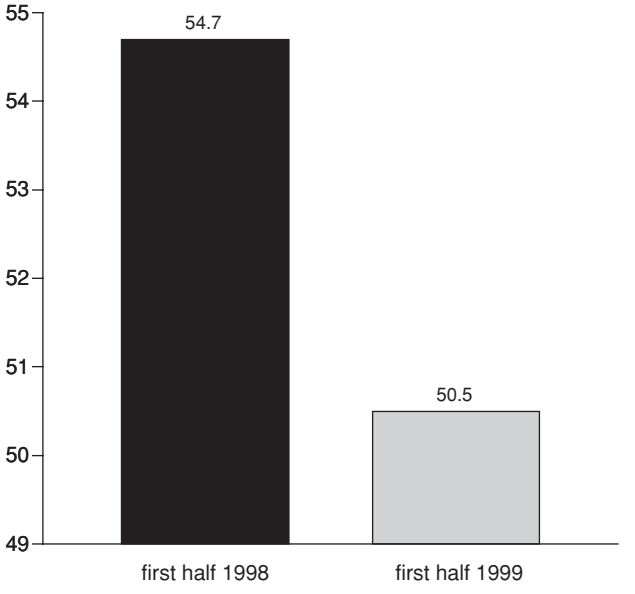
Figure 18 shows that finished steel production in the United States, for the first half of this year, compared to the first of last year, is down 7.7%.

Figure 19 documents the production of farm equipment. America produces one-third of the world's farm equipment and exports one-quarter of what it produces. This is vital for the whole world. For the first seven months of this year, compared to the first seven months of last year, shipments of two-wheel-drive tractors above 100 horsepower, which

FIGURE 18

U.S. finished steel shipments fall 7.7%

(millions of net tons)



Source: American Iron and Steel Institute.

FIGURE 19

Percentage fall in U.S. farm equipment shipments

(first seven months 1998 compared to first seven months 1999)

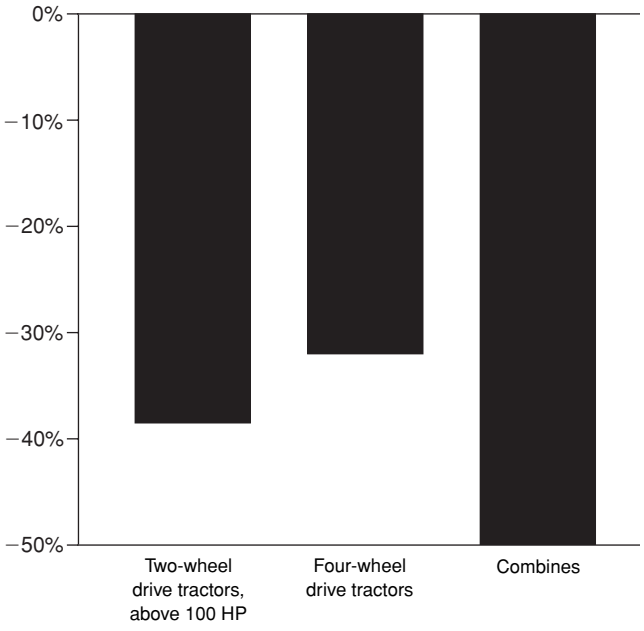


FIGURE 20

Shipments of four-wheel-drive tractors and combines, 1980 to 1997

(number of units shipped)

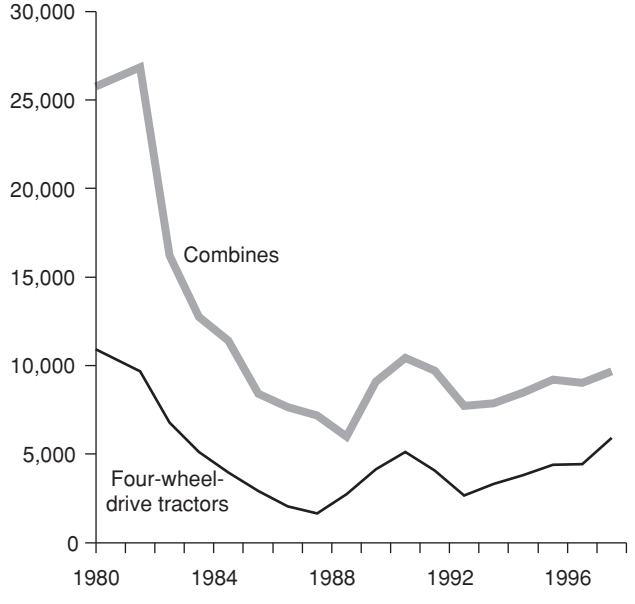
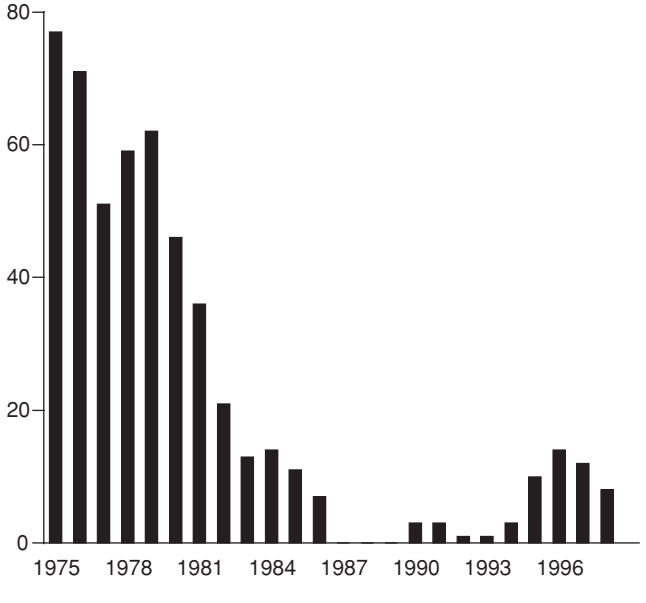


FIGURE 21

U.S. commercial shipbuilding orderbook, 1975-98

(number of ships)



Sources: U.S. Department of Commerce and McGraw-Hill Companies, "U.S. Industry & Trade Outlook '99"; *EIR.*

FIGURE 22

Eurasia: future main routes of the Eurasian Land-Bridge

are standard equipment on farms, were down 38.5%; four-wheel-drive tractor shipments were down 32%; and shipments of combines were down 50.2%. We've shown similar statistics before, but every time we update the picture, it just keeps sinking lower and lower. Farm equipment embodies the most advanced technology for man to alter nature on the farm, and it is disappearing. **Figure 20** depicts the historical trend, since 1980, of combines and four-wheel-drive tractors.

Figure 21 shows the third industry, shipbuilding. America went from building 77 commercial ships in 1975, to building none in certain years, and now we're building eight. Shipbuilding has the capability of building not only ships, but many other things—and now it's nearly gone.

So, the collapse of the machine-tool industry is the harbinger of, and accompanied by, the collapse of other critical industries, such as tractor production and the shipbuilding capability, which are leading features of the machine-tool design sector.

Can the machine-tool design principle be saved, not only for America, but for the world? What does it mean if it's not saved?

If it is not saved, we don't survive.

The most important feature that can be introduced in the world today, is a New Bretton Woods monetary system, pivoted around the Eurasian Land-Bridge. Helga Zepp-LaRouche developed this powerfully in her presentation [see last week's *EIR*]. The Land-Bridge cannot be built without machine tools.

Figure 22 shows the Land-Bridge rail map. Consider all the machine tools needed to build that. But also think of these rail corridors and development corridors as extensions, physical extensions, or tentacles of the machine-tool principle into all these other places in the world, such as Kyrgyzstan and Kazakstan, and so forth.

Figure 23 shows a span under construction along the northernmost route of the Land-Bridge, the bridge network that connects mainland Europe, at Denmark, to Sweden, and then connects up the important islands of Sweden. It's quite beautiful. This requires, of course, machine-tool design.

Figure 24 is an artist's rendition of a nuplex, a complex of nuclear plants, preferably pebble-bed high-temperature gas-cooled reactors, and the nuclear plants that generate electricity and other power to the other industries that are

FIGURE 23

The West Bridge, part of the 'Øresund Connection,' linking Sweden and Denmark

FIGURE 24

An artist's rendition of a nuplex

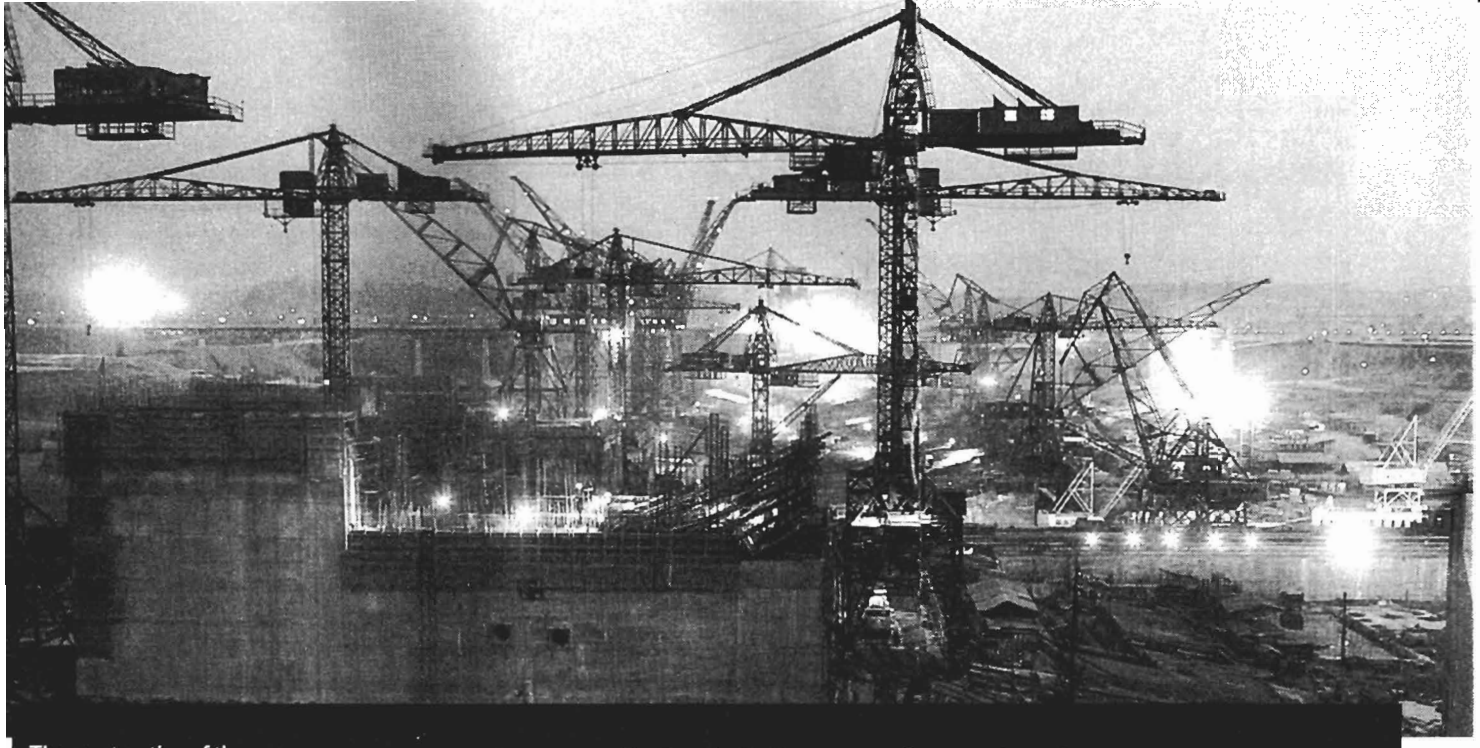
set up there. This requires a tremendous number of specialty machine tools; it's also part of the machine-tool design principle.

Figure 25 is an artist's drawing of the Three Gorges Dam project in China. It's a wonderful project, which will transform the face of China; it requires a tremendous number of machine tools, and is part of the machine-tool design principle itself.

There's an irony here. To build the Land-Bridge requires machine tools and the machine-tool design principle, which is being destroyed. But were the Land-Bridge policy to be adopted by the West (as well as by China and other nations of the region, which are already forging ahead with it on their own), through the courage of a few far-sighted leaders, it would be the critical missing ingredient for the revival of the machine-tool design principle. We cannot allow the destruction of the design principle which is the well-spring for the long wave of economic survival.

FIGURE 25

China's Three Gorges Dam Project



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