Wassily Leontief acts to block the effective implementation of the SDI

by Lyndon H. LaRouche, Jr.

Among all my more prominent adversaries in the so-called "economics profession," Bolshevik-educated Professor Wassily Leontief is the only one who exhibits a streak of sanity. He is not entirely sane, of course; his connections to the theosophical mysticism of Bolshevik Professor Kondratieff's "long-wave ["Great Wheel"] cycles" dogma, are a case in point. Whenever Leontief shifts his attention from the industrial engineer's standpoint in production cost-accounting practices, to the subject of money, his economic theories take on the fascist hues of the notorious Lausanne school of Walras and Say.

However, he is not completely insane, like the "ivory tower" positivists of the Operations Research Society. He is not a mere hoaxster, like that ex-communist professor who runs Wharton econometrics. Nor, is he by any means a silly babbler, like the choleric Professor Milton Friedman, or the Fabian Society's Hayek. He is one of the rare few living economists worth criticizing; even when he is terribly wrong, one is obliged to recognize that there is some important work involved, of practical merit, in the construction of his fallacies.

Harvard's Leontief is famous as the leading figure associated with the design of the United States' present system of National Income Accounting, and thus also more or less the father of the "Gross Domestic Product" method of accounting used by foreign nations generally. At his best, he is a knowledgeable and skillful industrial cost-accountant; his input-output charts of accounts have served the useful purpose of prompting governments and supranational agencies to collect statistics in a sensible form. Until it comes to the subject of price-theory, Professor Leontief is a down-to-earth, sensible fellow. As a cost-accountant, he earns his fees; it is when he pretends also to be an economist, that he falls off the deep end.

Leontief presents himself at his best, and his worst, in a recent report, "The Choice of Technology," as the featured item of the June 1985 (Vol. 252, No. 6) issue of *Scientific American*. Although Leontief appears, on the surface of his argument there, to be recommending increased rates of investment in new technologies, his argument is aimed specifically against the "economic spill-overs" feature of the Strategic Defense Initiative.

The subject of "economic spill-over" benefits of the SDI was introduced by this writer and his associates during 1982, many months before the President's famous announcement of March 23, 1983. The writer's proposals on "spill-overs" were publicly adopted by administration spokesmen during the spring of 1983, and were briefly echoed by Britain's Prime Minister Margaret Thatcher, during her 1983 election-campaign. Not only does Leontief date his present attack against "economic spill-overs" to approximately two years ago, but there are other special features of his piece which more than strongly suggest that it is my own thesis which he has been working to refute during the recent two years. In any case, it is certain, that if his arguments were influential in Defense Department policy, SDI would be as effectively sabotaged as if it were never adopted at all.

I reply to this now, not to waste the precious pages of *EIR* with a mere rebuttal of Professor Leontief's blunders. There are very far-reaching issues of U.S. economic and defense policies, posed, and *Scientific American*, unfortunately, is regarded by the credulous as a most respectable publication, with significant circulation.

Did Leontief attempt to refute LaRouche?

Leontief's piece was referred to my attention by a friend whose judgment was that this was an attempted counter to my own theses on "economic spill-overs." On the basis of the item's content, the most probable inference is that it is exactly that. Leontief explains:

> Two years ago Faye Duchin and I, together with seven of our colleagues at the Institute for Economic Analysis of New York University, assembled the data needed in order to apply input-output analysis to the current prospects for technological change.

The dating itself is indicative. Not only were *EIR*'s studies of this matter publicized during 1982, but it was the common knowledge around government and among private forecasting services, that *EIR*'s LaRouche-Riemann Method of forecasting had provided the only competent forecasts since the October 1979 introduction of what Paul Volcker himself had identified as "controlled disintegration of the economy." During 1982, there was a scramble among economists, to attempt to head off *EIR*'s growing authority around government and industry. New York University is among the locations which closely follow *EIR*'s work, and has been the nesting-place of my avowed adversary, McGeorge Bundy, since Bundy left the Ford Foundation.

Leontief's next point pins the matter down:

> They [the data] are based on the input needs of technology that can be expected to replace the present methods of production in the next 15 years. Our method did not require us to make any projections about *unknown, future technology*. On the contrary, the technology we considered is already well understood, but it has not yet been widely introduced. [emphasis added]

Later, he qualifies this. His study limited itself to projection of effects of automation: "technological changes related to the introduction of computerized automation."

> We made no effort to assess the economic effects of the technological changes that can be expected in agriculture from the genetic engineering of crops, in mining . . . or in various industries from substitution of materials. . . .

Thus, he excludes most of the primary categories in which technological progress is occurring, or might occur, and limits himself to the "technetronic."

Even had the professor taken a broader spectrum of technologies into account, his approach would still have the same terrible defect central to the article in question. If his method were employed in devising either the federal defense budget for SDI, or employed as policy for SDI implementation within the Department of Defense itself, it would be next to impossible to get the SDI off the ground. The unfortunate fact is, that Professor Leontief's flaws are deeply embedded in Mr. Stockman's computerized Office of Management and Budget (OMB), and have been embedded in the civilian, "systems analysis" staff of the Pentagon for nigh on 25 years.

At this point in our introductory remarks, the purpose of publishing this criticism of the *Scientific American* piece can now be fairly stated. The practical importance of this piece, from an economist of such legendary respectability as the professor, is that it helps to tilt the balance of U.S. SDI-implementation policy, in favor of "systems analysis," and against revival of those "crash program" methods which served us so well in the Manhattan Project and the pre-1967 phases of the postwar aerospace program. The point is to save this republic, this civilization of ours: And we can not expect our nation to survive much beyond 1988, unless the SDI is effectively implemented.

On this account, there are only two "econometricians" whose work itself requires any depth of criticism: Professor Leontief's, and the sly Ilya Prigogine. Everything else in present-day economics was thoroughly refuted by leading scientists during the 18th and 19th centuries. By contrast with Leontief, von Neumann, the putative founder of "Operations Research" varieties of "econometrics," is an ignorant simpleton in economics, and the von Neumann-Morgenstern *Theory of Games & Economic Behavior* a hoax. Prof. Milton Friedman is merely a carnival pitchman, the Wharton Institute merely fakers, and the rest generally a cast of characters from the play *Marat-Sade*. Prigogine is important, only because he has duped many credulous people into the delusion that he has provided a method for dealing with "non-linear" network-problems; refuting Prigogine belongs more to the domain of mathematical-physics formalities as such, than to economics. Flawed as his work is, Leontief is the best among the outstanding figures of the academic economists as a lot.

I have been familiar with Leontief's work for three decades. I have missed more than one or two of his pieces over this period, but have followed a large enough sampling to warrant firm general conclusions. There are, without doubt, three major incompetencies permeating his work as a whole:

> 1) He has no comprehension of "technology," not in the sense the term was defined by Gottfried Leibniz.

Leontief's relative merit, is the degree of emphasis he places upon examining the physical magnitudes of inputs and outputs of production. What lies between these inputs and outputs, the process of production itself, eludes him entirely. He appears never to recognize the existence of the question: "What is it that occurs in the productive process, between the inputting of inputs and the outputting of outputs, which accounts for economic growth?" This flaw is the central feature of the piece in the *Scientific American*.

> 2) His work ignores the question: "How is it possible to show that the relative prices prevailing in an economy are wrong prices?"

Let us suppose the extreme case, that relatively favorable cost-price ratios in financial usury, prostitution, drug-trafficking, and operation of gambling casinos, compared to very poor cost-price ratios in agriculture and basic industry, cause capital to flow out of the latter into the former, collapsing agriculture and industry, and thus collapsing the society. Obviously, the cost-price ratios are wickedly wrong. Since such anomalies are commonplace, it is clear that price-mechanisms are not to be relied upon as determinants of relative economic value. It should also be obvious, that the only remedy for the unreliability of price-mechanisms is the adoption of some other yardstick; the only yardstick available for such purposes is the physical relations of production, physical relations defined without yet introducing the measure of price.

This problem Leontief sidesteps. Like Karl Marx, he assigns a price to "average labor," and makes the "market basket" of wage-commodities the means for turning price into the common denominator of economic relations. There is no indication that he, any more than Marx, recognizes what is terribly, terribly wrong, in such tricks.

> 3) Like Karl Marx, and like all modern academic economists, Leontief fails to recognize the fact that economic processes are intrinsically "non-linear."

Since John von Neumann laid down his dogma on the subject, modern econometricians and operations researchers, have assumed that economic processes can be reduced to a mathematical system of "linear inequalities"; and that solutions to such systems are more or less adequate analysis of real economic processes. Worse, von Neumann assumed that these systems could be reduced to relative utilities, as measured in relative price. Since von Neumann was a very famous mathematician, who had been a child prodigy in arithmetic, who could dare to challenge the oracular utterances of the "Great von Neumann"?

It happens, that von Neumann's dogma was absurd. All economic processes are intrinsically "non-linear."

Let us review, as briefly as possible, the matters of which Professor Leontief is ignorant.

'Technology'

"Economic science," in the strict sense of the term, was established by Gottfried Leibniz, beginning with his short paper on *Society and Economy,* of 1672. The central feature of Leibniz's work on economy, the key to the founding of economic science strictly defined, is his concentration on the subject of the heat-powered machine. Leibniz created the notion of "technology," as a leading included feature of his principles of heat-powered machines.

The principles of machine-design were essentially completed by Leonardo da Vinci. After Leibniz, the principles of machine-design were brought to near-perfection by the 1794-1814 Ecole Polytechnique of France, under the leadership of Lazare Carnot and Gaspard Monge. Beginning the work of the 1794-1814 Ecole, the center of work was shifted, from machine-design, toward development of a general theory of electro(hydro)dynamics, an effort centered around the work of Gauss, Weber, and Riemann, at Göttingen in Germany.

Although Leonardo already mastered the principles of animal-powered machines, and perfected the hydrodynamics of wind-powered and water-powered machines to a high degree, Leonardo merely began exploration of steam-powered machinery. After Leonardo, circles around Gilbert in Tudor England, pressed for development of coal as a replacement for charcoal. Until after the Peace of Westphalia, and the 1653 defeat of the Hapsburgs, technological progress was generally suspended by the catastrophic conditions of the early 17th century. Work toward a doctrine of heat-powered machinery waited until Leonardo's approach was resumed by Huyghens and Leibniz, later in the 17th century. It was Leibniz who established the foundations of a general solution.

Given, a coal-fired source of power for a machine, and given a standard quality of unit-output of an operative, what is the relationship between increasing the heat supplied to drive the machine and the number of units of output of the operative?

Immediately, several variables must be considered:

1) The amount of coal-equivalent consumed per day;

2) The temperature at which the coal is burned;

3) The average cost of each unit of output, after adding the cost of producing and processing the coal and producing the machine, to the cost of the operative: capital-intensity costs;

4) Technology.

Note the special case: Given two machines, each consuming the same coal-equivalent, but different in the respect, that the same operative employing one produces greater unit-output than employing the other. The difference in performance lies in some internal features of the machine's organization. The ordering-principle, which defines increasing "efficiency" of machine-designs in such terms of reference, is the barebones definition of "technology."

Actually, "technology" is an ordering-principle which subsumes all four of the conditions listed above:

1) Quantity of usable energy per operative;

2) Energy-intensity (energy-flux density) of the usable energy supplied;

3) Capital-intensity;

4) Internal organization of the machine (or process).

All of these, combined coherently under a single ordering-principle, determine the relative physical productivity of operatives.

What is that ordering-principle? Start with bare beginnings, and proceed until a single principle is sufficiently elaborated to subsume all of that for which we must account.

Leibniz began to define the solution, by adopting a principle discovered by Cardinal Nicolaus of Cusa: that in Euclidean physical space-time, only circular action has self-evident existence. Cusa named this "The Maximum Minimum Principle" (*De Docta Ignorantia,* 1440); it is familiar to modern mathematicians as the isoperimetric principle of topology.

Leibniz divided the action of machines into two aspects, simple action and work. Action is measured as displacement of a closed cycle of action, as the displacement of action along the perimeter of a closed line of motion. Work is measured, in first approximation, as the area subtended by that perimetric action. Thus, action is expressed as = mv, where m is mass and v is perimetric displacement; while work is expressed as proportional to mv^2.

The isoperimetric principle shows, that the least action required to generate an area of closed action is circular action. Therefore, the amount of action required to generate a defined amount of work (least action) is the amount of circular action needed to do so. No action in physical space-time is greater in magnitude than the least action: the Principle of Least Action.

Therefore, the constant increase of the energy-flux density of action, and work, is represented by a self-similar conical spiral. If the amount of action associated with increase of energy-flux density is constant, the action is converging self-similarly upon the apex of the cone. If the radian-measure of perimetric action is constant, and the energy-flux density is increasing per unit of radian-measure, the result is described by an expanding cone. So:

1) The relative energy is the rate of helical action with respect to time;

2) The relative energy-flux density, is the area of work subtended by each interval of helical perimetric displacement;

3) The relative capital-intensity is expressed by work supplied per operative;

4) The internal organization of the process is expressed by a conic function.

This is the case in first-approximation. A function subsuming increases of these relative values, coherently, to the effect of increasing the productive powers of the average operative, is the definition of "technology."

These first-approximation relations are readily shown by comparative statistics for capital-intensity, energy-throughput per-capita unit of potential relative population-density, and per-capita output-rates, for assorted economies in the world today. Such data, compiled in the manner Leontief's input-output designs variously specify or imply, show these to be the proper first-approximation criteria.

Economies as processes

The gross characteristics of economic processes, are indicated simply, by comparing the potential population-levels of mankind for "primitive hunting-and-gathering society," about 10 million maximum, with nearly 5 billion today. It is also possible to construct estimates for population-levels since Roman times, with increasing accuracy as we approach the present. By such means, we are able to construct arbitrary mathematical functions which incorporate the most visible characteristics of successful population-growth, and of economic growth.

The first modern effort to construct such a function, is the work of Leonardo of Pisa, the so-called Fibonacci series. Toward the close of the 15th century, a more accurate function was discovered, by the collaborators Luca Pacioli and Leonardo da Vinci. The latter, working on the basis of Nicolaus of Cusa's specifications for scientific method, showed that all living processes exhibited distinctive harmonic patterns, both as patterns of growth, and determined morphologies of bodily functioning. These harmonic patterns were congruent with the Golden Section of geometry. Today, we know that this distinction of living processes applies to all ranges of phenomena between the extremes of astrophysical and microphysical scale. From Pacioli and Leonardo, through Louis Pasteur, there is a continuity running into modern optical biophysics. Within the ranges indicated, all processes which are harmonically congruent with the Golden Section, are either living processes, or are artifacts produced by living processes.

Economic growth is harmonically congruent with the Golden Section.

Since the work of Gauss, Dirichlet, Weierstrass, and Riemann, we know that the images which appear to us because of the organization of our brain, as primarily Euclidean images, are a kind of distorted-mirror image of the real universe. We know that the real universe is of the form of a Riemannian hyperspherical function, generated by three degrees of self-reflexive conical self-similar-spiral action in physical space-time. Through study of stereographic projection, we also know that we must not assume that our brain-images are literal pictures of the real universe, but we have the comforting certainty that certain features of those images, called "projective invariances" or "topological invariances," are in agreement with the physical space-time experienced.

In this context, we also know, that the existence of Golden Section harmonics among the brain's images of Euclidean space-time, conforms to conic self-similar spiral action in the Gaussian manifold of real physical space-time. Looking at Kepler's astrophysics retrospectively, from the vantage-point of Gauss, et al., we know that the universe as a whole is ruled by laws which are invariant with respect to the Golden Section.

Inasmuch as the notion of "negentropy" is associated with the phenomena of living processes, we are obliged to discard the definitions of "negentropy" and "entropy" supplied by statistical thermodynamics. We define "negentropy," properly, as the characteristic of processes which are either living processes, or are like living processes.

A healthy economy, like a healthy living organism, is "negentropic." Once the living process ceases generating "negentropy" at a sufficient rate, it is sick, possibly dying. Similarly, an economy.

Therefore, what we must measure, to determine the performance of economies, is the relative rate of negentropy generated per-capita. "Economic value" is properly measured only as per-capita negentropy. Therefore, to measure "economic value," we must define a mathematical function in which the content of "work" measured is measured in "units of negentropy."

In other words, if you do not assist in some necessary way, in transmitting negentropy to the economic process as a whole, you are economically useless. Any product produced and consumed, which does not satisfy this requirement, is economically valueless.

The paradigm for the transmission of negentropy to an economic process, is technological progress.

To the degree, an economic process is doing the same thing over and over again, it is, to that degree, entropic, and is dying. In that sense, its output is worthless. It is only as output contributes to the production of negentropy, technological progress, that output has economic value. It is technological progress which has enabled mankind to rise from the status of primitive man desperately gorging himself on the raw fish left as jetsam on the beach.

Simple thermodynamics of economy

In the simplest thermodynamics, we subdivide the total usable form of energy-throughput in a closed cycle, into two general categories. The first category is the amount of such throughput which must be consumed or wasted, merely to maintain the process at a constant level of potential. This portion, we call the "energy of the system." If there is any remaining energy-throughput, after deducting the "energy of the system" requirement, we call this the "free energy."

Thereafter, all interesting questions are posed in terms of the ratio of the "free energy" to the "energy of the system," and the correlation of changes in this ratio, to the total energy-throughput. For the condition in which the ratio rises in correlation with an increase of the energy-throughput, we describe the process, roughly but fairly, as "negentropic." If this condition is not satisfied, we estimate the process to be "entropic."

In analysis of economic processes, we must reduce all physical economy (inputs, outputs, etc.) to common thermodynamical units of measurement. We approximate this, by measuring the usable energy-throughput in per-square-kilometer and per-capita terms, and by correlating these two measurements in terms of rates of increase of the productivity of labor. We measure increase of the productivity of labor, as increase of potential relative population-density. This enables us to analyze economic processes independently of price-mechanisms. Although the studies require guidance by rigorous mathematical procedures, the results of such studies are readily accessible to intelligent "common sense."

The interesting aspect of thermodynamic negentropy, as we confront it in economic processes, centers around the variable effects of converting the "free energy" of the economic process-cycle into augmented "energy of the system." Typically, this signifies increasing the energy-intensity and capital-intensity of the economy, per-capita. In other words, the energy-cost of maintaining the average person and operative is increased—by increasing the energy-intensity and capital-intensity per-capita.

Karl Marx foolishly imagined, that such "reinvestment" of profit in production, caused a "falling rate of profit." In thermodynamics language, this means, that if the "free energy" produced is generated only by labor of operatives, and the capital-intensity of production is increasing, then the ratio of "free energy" to "energy of the system" must tend to fall. Leontief's system is implicitly Marxist, on this and other counts.

It should be noted and stressed, that once we convert physical inputs and outputs into prices, and then attempt to explore economic processes in terms of price-mechanisms, Marx's folly of "the tendency of the rate of profit to fall," appears a certainty. It should be obvious, on such and analogous grounds, that once we price-out physical relations of production, as a precondition for economic analysis, we have excluded from consideration the essential principle of economic processes, the function of technology, just as Leontief does, in his "The Choice of Technology."

So, Leontief hunts for technology everywhere, unsuspecting that that for which he searches, he has just banished from his priced-out data: "Data, data, everywhere, but not a drop to drink."

Marx's error, like Leontief's quasi-Marxist constructions, is that in plagiarizing the notion of "labor-power" from Friedrich List and Henry C. Carey, Marx was like a baboon who stole a watch: he didn't know the use of what he had stolen. "Socially necessary average labor," is not Alexander Hamilton's meaning of "productive powers of labor." True, only the labor of goods-producing operatives actually produces wealth. The increase of the productive power of labor is the advancement in technology brought to the point of production: the increase in energy-intensity, the increase in capital-intensity, and the advancement in the internal organization of the productive process under such conditions. This depends upon the power of the operative's mind, to assimilate advances in technology for efficient use. The relations of production are defined in per-capita-operative terms, but the relations are essentially the technology of production per-capita.

It is that relationship, which exists only in the physical economy, not the prices of commodities, which vanishes with the introduction of the price-mechanism.

The geometrical approach

In the mathematics which I employ for economic science, algebraic expressions appear only as descriptions of geometrical constructions. None of the axiomatic assumptions, or deductive methods of the ptolemaic "Euclid's" geometry are allowed, and no axiomatic arithmetic. The only self-evident form existing in mathematics, is circular action; from circular action alone, all constructions must be derived and constructed. In other words, a "synthetic geometry," or what some might wish to describe as a "radically constructive" geometry.

I have described my methods in other published locations, so I shall merely summarize the most relevant points.

1) To construct all forms which are commensurable in Euclidean physical space-time, construction must begin with circular action, straight lines, and points. Therefore, straight lines and points must first be created by circular action upon circular action.

2) This requires triply-self-reflexive circular action: For every small interval of Circular Action A, Circular Action B must be acting, as if perpendicular to Circular Action A; for every small interval of Circular Action B, Circular Action C must be acting, as if perpendicular to both Circular Action A and B. This is sufficient to generate a straight line, a point, measure by a factor and powers of 2, and a sphere and a hypersphere. These are the minimal preconditions for Euclidean physical space-time.

3) However, since perception occurs in never less than a finite interval of physical space-time, circular action appears as helical action. Triply-self-reflexive helical action is the minimal precondition for gener-

alized physical space-time. The required form is triply-self-reflexive, conical, self-similar-spiral action.

The minimal ideal model for technological progress in an energy-intensive, capital-intensive mode, is doubly-self-reflexive self-similar-spiral action. This generates an hyperboloid, whose central axis is the time-axis. This is to be constructed on the surface of a Riemannian sphere, rather than in Cartesian coordinates.

The flaring of the hyperboloid, through the vanishing-point, apparently defines a mathematical discontinuity. Yet, the economic process is not halted; there is no discontinuity in the physical process, but therefore some inadequacy in the mathematics.

Let perimetric action be defined as the area swept on the surface of the sphere, and work, therefore, as the subtended volume of the sphere. So, the topological singularity (the apparent discontinuity) defines a "jump" of the continuing action to the larger, concentric sphere, whose image we can project downward onto the first sphere's surface. The action continues, thus. The rate at which the next hyperbolic flaring is generated is more rapid. And, so on and so forth, in the idealized case. The relative density of singularities is increased, harmonically: the nested spheres form an harmonic series. This hyperspherical function corresponds to triply-self-reflexive self-similar-spiral action.

The significance of the increased volume of action, as a jump to a larger concentric sphere occurs, is an increase of the "energy of the system." In this schema, increase of the energy of the system is measured as increasing density of singularities.

This increasing density of singularities correlates with the increasing complexity of the production of the unit marketbaskets of households' and producers' goods, per-capita, the increasing complexity of the division of productive labor.

This process proceeds, both mathematically and in real economic experience, as periodic "jumps." That is, the gradual technological progress of the economy does not alter the economy simply, but in periodic jumps, like shock-fronts.

These "jumps" correlate with the process of dispersion of technological advances, from points of initial impact, radiating effects into the economy more broadly. Think of this dispersion as "technology waves." As the division of labor in the economy is upshifted by these waves, the energy of the system for every local action in the economy is upshifted accordingly. This corresponds to the flaring of the hyperboloid. Thinking of this radiation of "technology waves" in hydrodynamic imageries, think of resonance of the economy with respect to this radiation of technology-waves: that is what the historical data show us. As "structural changes" in the economy are so induced, the entire economic process upshifts to a new phase-state, new resonant characteristics: the jump occurs.

A similar pattern appears in economic devolution, technological down-shifts. The U.S. economy has been downshifting since 1967-71. In physical, technological parameters, the productivity of labor has been falling since approximately 1971. The rate of fall was accelerated by the 1973-75 impact of the induced energy crisis and the Rambouillet monetary resolutions' implementation. Since Volcker's introduction of the "controlled disintegration of the economy," beginning October 1979, the economy has been passing through accelerating, successive downshifts.

The post-1979 downshifting of the U.S. economy, has proceeded like the down-side of a roller-coaster ride. Down, then up, then down, then up, with the up never reaching the height of the point before the preceding down. Beginning February 1980, down. A slight up, later that year. A deep down-plunge, from early 1981, into October 1982. A slowing of the rate of collapse during 1983 and most of 1984, followed by a new down, starting September-October 1984, and a plunge into a deep down-slope by March 1985.

Each downward-shift is a devolutionary shock-front. The economy reaches a lower plateau, and briefly stabilizes at the new, lower level: the slight up-tick. Then, the erosive process sets off a new down-tick, a collapse to a lower plateau, then a slowing of the rate of decline, prior to a new down-tick. Each speeding-up of the rate of collapse, is a devolutionary shock-front. Instead of "jumping" to the larger concentric sphere, as in technological progress, the economy collapses, in jumps, to smaller spheres.

These "jumps" are what appear to the befuddled "econometricians" as "non-linear anomalies." Whenever one of the jumps appears, their econometric forecasts break down, and they have no means, within the scope of v. Neumann's systems of linear inequalities, to forecast these occurrences.

The folly of the automation myth

The computer, except as potential means for collapsing the percentile of the labor-force employed in clerical occupations, is not truly, in itself, a means for increasing the productive powers of labor. Digital-computer technology may be indispensable auxiliary to implementation of new technologies, but is not the basis for technological leaps purely in and of itself.

The new technologies are essentially three:

1) Controlled thermonuclear fusion, and related applications;

2) Coherently directed energy;

3) Optical biophysics.

Respecting the first two of these three, the impending upward jump centers around the possibility of a four-fold or greater rise in the average effective temperature of heat-driven productive process. A four-fold leap in "average temperature" of productive processes, requires and makes possible new kinds of materials in general use, and redefines radically both the absolute and relative-cost meaning of the term "natural resources." The confinement of hot plasmas as sources of commercial energy, combined with the means to transform such plasma-energy directly into industrial forms of directed-energy applications, suffices to signify the greatest and most rapid leap upward in productivity, in the history of mankind. An increase of the productivity of labor in the U.S.A. by a factor of between two and three, by the year 2000, is not a wild estimate—on condition we get to business quickly, before the present collapse of the U.S. economy goes much further.

Leontief does make passing reference to biotechnology, sometimes called "genetic engineering." This work is important, but it's small-time stuff compared with another dimension opening up in biology today: optical biophysics.

So far, excepting lines of inquiry opened by the work of Louis Pasteur, biochemistry has not treated living processes as living, but as organic-chemicals factories which happen also to be living. That aspect of living processes which distinguishes living from non-living organic-chemical reactions, has not been isolated in itself. Now, that is beginning to change.

The problem has been, that as long as we assume that atoms are composed of elementary, irreducible particles, it is axiomatically impossible to define the conditions in which a chemical process must necessarily "come alive." Yet, Kepler already implicitly demonstrated that the general laws of astrophysics are invariantly negentropic. In the geometry of the Gauss-Riemann manifold, it is necessary that the most elementary of the apparent particles also reflect an invariant negentropy. So, it would appear, that if we combine the approach of Gauss-Weber-Riemann electro(hydro)dynamics, with the approach taken by Leonardo and Pasteur, that scrutiny of the electromagnetic, optical, characteristics of living processes will discover those "anomalous" distinctions of living processes which distinguish living from non-living organic chemistry.

Otherwise, the mere fact that the electrodynamics of living processes are characteristic, overall, of negentropic processes, as inorganic processes on the ordinary macroscale are not, has a very special significance. In optical biophysics, we are not only examining living processes through means made possible by modern instruments; we are examining the most fundamental laws of the universe in a way not otherwise accessible to us in the laboratory.

Let us be cruelly frank with ourselves. Optical biophysics, like controlled thermonuclear fusion and directed-energy systems, are weapons of warfare, as well as tools of the works of peace. After all, a weapon is, by definition, nothing but a tool, a machine, or a scientific instrument, applied to the actions of warfare. Every tool, even a simple pencil or ashtray, is a weapon which can be used very efficiently to kill, with proper practice. The field and forest abound with weapons of biological and chemical warfare, in knowing hands. The greater the productive power of a tool, the greater the firepower and mobility is represents, potentially, as a weapon.

Microwaves are excellent killers. Optical biophysics is also a source of weapons in warfare against insects and pathogens, which are vulnerable in various respects, if we tune our beams rightly. We do need greater firepower and mobility in our warfare against parasites and pathogens. We need the full range of biological armament, including that of optical biophysics, to defend our populations against insidious weapons, and epidemic disease not otherwise mastered efficiently. It would be insane not to include optical biophysics, too, in the spectrum of SDI technologies.

Of course, we need better computers. We need them to assist equipment dedicated to acquiring targets, for aiming beams, and so forth. We need them to control the "new physical principles" of SDI, as those weapons also appear as new tools of production. We need true parallel processing urgently; we need analog-digital hybrids of a new type, more urgently. These needs are defined, either directly, or implicitly, by the auxiliary requirements of systems incorporating the three classes of technology we have identified here.

More than we require computers, we require:

1) A forced-draft increase in energy-supplies, otherwise our economy will break down before any significant degree of economic recovery could be effected: we are surviving with present levels of energy capacity, only because of the extensive collapse of our agro-industrial sectors.

2) A forced-draft increase in capital-goods production, especially in machine tools and related categories, otherwise new technologies can not be translated into production.

3) A revival of basic economic infrastructure, in transportation, water-management, and urban-industrial infrastructure.

4) A rapid and extensive shift of capital flows, away from recently burgeoning "service industries," into employment in energy-intensive, capital-intensive, goods-producing industry and agricultural improvements.

There are two reasons, it might appear to some, that the United States has a surplus of food. Principally, most citizens are eating poorly, for financial reasons, as reflected in diseases whose spread shows a lowering of immunological potentials. Secondly, a temporarily, artificially over-priced dollar, enables the U.S. to import foodstuffs even from foreign nations where near-famine conditions exist in parts of the population, while adding to the permanent and growing U.S. trade-deficit; once the dollar drops to competitive levels, the food-shortages will become apparent.

Similarly, we appear not to have an energy-shortage, because the collapsing economy's consumption of energy is shrinking. "Demand" is dropping only more slowly than import-fed consumption, because the economy is collapsing.

If we continue the "price-mechanism" policy-trends building up since 1967, the mechanisms which Leontief proposes to "inform," not change, we as a nation are doomed. The undertaker, the Soviet empire, is anticipating our earlier need of his services.