Part II: What Are Economic Shock Waves?

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In Part I of this article,[1] Lyndon LaRouche explained how his scientific predecessors—including Philo of Alexandria, Nicholas of Cusa, Georg Cantor, and Leonardo da Vinci, established a rigorous basis for political economy in their investigations of the laws of the physical universe. Given special emphasis in this "demystification" of the workings of the LaRouche-Riemann econometric model—whose performance for the past two years has put other forecasting services, including Chase Econometrics, Wharton, and Data Resources to shame—was the application of 19th-century mathematical physicist Bernhard Riemann's theory of shock-wave generation to economic processes. Now, we resume our summary presentation of the potential function employed in the LaRouche-Riemann method.

Thermodynamic Potential

The first estimation of potential relative population-density is simply geometrical: the potential number of persons sustained per unit of habitable area by means of the nature-altering activity of the inhabitants.

Our first analysis of the function F(*P*) correlates: increases in potential per capita with ordered changes in both the division of labor within society, and in shifts in demographic characteristics of the whole population from which the labor-force is drawn.

These changes correlate with what is observed in first-approximation as an increase of the energy-flux-density of society's activity. In first approximation, we observe that increases in potential correlate with long-wave increases in the number of useful kilowatt-hours of annual energy-throughput, both per square-kilometer of habitable land and per individual inhabiting that land.

The correlation of these changes in energy-flux-density with changes in proportionalities in demographics and division within the labor-force, subsumed under the requirement of increasing per-capita potential, implicitly requires a thermohydrodynamic function.

In this form of the function, we are determining economic value in terms of a generalized statement about the physical space in which successful reproduction of society is occurring.

[1] ["What Is an Economic Shock Wave?" *EIR*, Vol. 9, No. 47, Dec. 7, 1982.]

Economic value, per-capita potential, is defined as increasing society's growth-potential within such a generalized physical space.

In other words, rather than viewing an economy mistakenly, in terms of money producing money, or goods producing goods, we determine the potential to produce useful goods as a subsumed, secondary calculation, derived as a by-product from primary knowledge of transformations in generalized per-capita potential.

This was already the implicit standpoint of U.S. Treasury Secretary Alexander Hamilton in his December 1791 *Report to the U.S. Congress on the Subject of Manufactures*. Hamilton showed that the unique source of human wealth was technologically driven advances in the productive powers of labor. Per-capita potential is but the implied, more rigorous way of defining increases in the productive powers of labor.

In respect to demographics, advances in the mental power for labor by members of society requires advances in education of the young and cultural generally. This requires, in turn, a reduction of the death and crippling-illness rate, an increase in longevity. For example, a modern economy can not be sustained without a significant rate of growth in the number of members of the labor-force, and also a modal longevity extended into the upper range of between 80 and 90 years of age.

Parenthetically, apart from rentier-financier looting of pension funds and related monetary and cost-inflation, the. source of the problem of meeting of the costs of the 65–85 age-range sector of populations of industrialized (and post-industrialized) nations is principally twofold. First, the rate of growth of the labor-force age-interval's population-segment is too small, thus increasing the ratio of per-capita retirement-costs to per-capita producing labor-force. Second, insufficient support for clinical treatment and research into the general problem of degenerative disease fosters impairment of functional capacity within the 55–85 age-range groups of the population, preventing society from enjoying the voluntary contributions of members of that age-interval.

Emerging policies, which are economically incompetent, as well as immoral, promote reduction of medical care for victims of costly diseases in the above-55 age-brackets. The trusty night-nurse with the euthanasiac pillow is emerging as the heroine of the insurance-company accountants and actuaries: "passive help in dying" is rapidly being superseded by a policy of "active help to die," a poor sort of euphemistic disguises for the plainer term, "murder" of the sick.

Heretofore, proper measurement of statistics on degenerative disease, such as cancer, shows that improved standards of living under industrial society's conditions have, up until recently, reduced the incidence of cancer and related kinds of degenerative disease. Since degenerative disease is principally a disease of aging, by its nature, we must measure the incidence of degenerative disease by age-group intervals. If the number of cancer-cases has appeared to increase, this is chiefly because more people are living long enough to incur an increased risk of such disease.

It is morally intolerable that society should content itself with an arrangement, by which increasing portions of its aging population are classed implicitly as useless. It is also economic imbecility. Our objective should be to remove juridical, customary, and medical barriers to extending the capacity to function fully into the last years of life. This means mastering the problem of the aging of tissue, a matter of inquiry which centers around the energy-transport functions of tissue within interacting functions of the human body as a whole, areas in which medical and related science are presently proximate to major advances. If we can ensure Uncle Max expectancy of a high quality of biological substrate for full-capacity mental function and physical mobility during the interval from 80 to 90 years, we have accomplished what is necessary both morally and to the benefit of the economy.

This is not a proposal to take away Uncle Max's pension. He has earned the pension, and deserves not to be cheated. However, as a proud human being, both Uncle Max and his wife deserve to have the opportunities and capacities to choose to make some sort of meaningful contribution to society for the duration of their lives. We shall all be enriched if that arrangement is better established.

Are we to be accused of injecting a moral issue into scientific inquiry? The more we advance in scientific knowledge, the case of the nuclear weapon illustrates, the more clearly we are confronted with evidence demonstrating the ultimate indivisibility of proper moral from proper scientific concerns as such.

In respect to demographic profiles of the population taken as a whole, the task of scientific inquiry is to adduce the characteristic change in such profiles correlating with increased per-capita potential.

Within the population as a whole, we focus on the labor-force as a whole. We note, first, the correlation between changes in profile of the labor-force and changes in overall demographic profiles, correlating such connections, again with increase of per-capita potential.

First, we focus on the percentile of the total labor-force required to produce all raw materials, as typified by agriculture and mining. Although mining is often conducted in rural regions, we classify mining functionally as urban, rather than rural. So, we are observing the shifts in total percentile of the labor force engaged in raw-materials production, and within that, and correlated with that, shifts in emphasis from agriculture to mining and related activities.

The smaller the percentile of total labor required to meet the raw-materials requirements of the population as whole, the greater the relative per-capita potential of the society as a whole. Two leading conceptual issues must be stressed in this connection.

First, the number of persons which can be sustained by aid of per-capita raw-materials development, is the first-approximation determination of per-capita potential relative population-density for the society as a whole. Agriculture, most emphatically, is measured both in terms of yields per hectare, and number of hectares for agricultural operative. This correlates with the percentile of habitable land developed for high-yield agricultural (and mining) potential.

Accordingly, as the raw-materials producing percentile of the labor-force required decreases, the general tendency is for increase of per-capita potential of the society as a whole.

For example, the shift through the agricultural revolution (circa 10,000–12,000 years ago or more), up to the Industrial Revolution in powered machinery, increased the potential human population of the Earth from the order of approximately 10 millions individuals to between 500 millions and 1 billions individuals. The Industrial Revolution, including the relatively recent development of nuclear-energy technologies, has increased the potential population of the Earth toward tens of billions of individuals. Prior to the beginning of the Industrial Revolution, approximately 90–95 percent of the labor-force was required for rural occupations. Through the Industrial Revolution, with modern agronomy, the use of modern technology reduces the required rural labor-force to less than 5 percent of the total.

The process of increased per-capita potential is complicated by the fact that required "objective" per-capita consumption of society rises with advances in per-capita potential.

We employ a symbology which appears Marxian, but which, strictly examined, is not—as the relevant distinctions are provided in such sources as the recent book-length policy-study, *Operation Juárez*. Overall, we analyze the labor-force as a whole among the following components: C = costs of maintaining the equipotential of capital preconditions for productions of goods; V = consumption-costs, measured as a percentile of the production of goods by the labor-force, of goods sustaining the households which supply the goods-producing sector of the labor-force as a whole; S = the Gross Operating Profit of society, after deducting $(C+V)$ from total goods-output-activity of the goods-producing labor-force; d = the combined household-consumption and capital-equipment goods-costs of the non-goods production sector of the total labor-force. Subtracting d from S, yields S' = Net Operating Profit.

This yields the most characteristic boundary-conditions for economic growth:

$(S/C)+V$ = Productivity
rising C/V = Capital-Intensity
$S/(C+V)$ = Rate of Profit

and associated constraints.

Generally, the rate of profit (of society as a consolidated agro-industrial "firm") must rise, despite the requirement that absolute consumption per-capita must rise in correlation with rising productivity.

In first approximation, we translate these constraints into per-capita values measured in kilowatt-hours of energy-throughput. We correlate per-capita goods-production with kilowatt-hours equivalent, and measure production in terms of "energy-payback" functions.

To recapitulate so far: We correlate rising per-capita potential with increases in kilowatt-hours throughput both per-square-kilometer and per-capita. Then, we treat the function as, in first approximation, an energy-payback per-capita function, and correlate this with shifts in demographic and division of labor profiles and constraints.

A rising value for $S/(C+V)$, on condition that C/V increases and $d/(C+V)$ increase less rapidly than $S/(C+V)$ and S per-capita, implies a rising per-capita and total value for $S'/(C+V)$. A rise in the latter ratio, of value 0 or higher, correlates with a minimal precondition for rising per-capita potential.

What productive labor (production of goods) must accomplish is both an increase in the ratio $S'/(C+V)$, and an increase in per-capita S' for the society as a whole. Otherwise, the society is entropic—i.e., dying of lowering of per-capita potential. So, per-capita S', combined with rises in $S'/(C+V)$, correlates with per-capita potential. What productive labor of society is producing is not simply goods, but rather increased potential for increasing per-capita potential.

On condition that we understand the limitations of making measurements in the approximation-terms of per-capita kilowatt-hours, what we have described thus far represents, approximately, the thermohydrodynamic model we require.

Refining the Notion of Energy

Such a "model" would fail to parallel reality under definable ranges of conditions, if we accepted fully the kind of notion of "energy" associated with Helmholtz and his followers. The reduction of energy to a scalar fluid, and a simple equation of energy-flux-density with equivalent of temperature, ceases at critical points to serve as a crude but useful approximation.

The best way to cope with such risks of error is to return to the initial notions of *work* and *power* as developed by Leibniz, and to forget entirely the Aristotelian notion of "energy" introduced by Helmholtz *et al.*

Leibniz's notion of work was developed in connection with studies of the effectiveness of heat-powered machines, as measured by comparative work accomplished. Per-capita work is our proper starting point. Work must be measured in first approximation, per capita and per square-kilometer of habitable area. The Leibnizian notion to be preferred to Helmholtz's "energy" is relative power to accomplish work. What we must measure, in first approximation, is the relative power to accomplish work both per capita and per unit of habitable and work-place areas. We would therefore prefer "work-flux-density" to the Helmholtzian overtones of "energy-flux-density."

In our case, work is measured as increase of per-capita potential relative population-density. This requires some clarifying remarks.

In schoolboy thermodynamics, we resort to the following useful approximations to prepare the student for a fruitful mastery of the subject.

We divide the total energy-throughput of a thermodynamical process into two principal sub-sectors. The first is the portion of energy-throughput which the process itself must consume to prevent itself from "running down." This subsector of the throughput is often termed "energy of the system." The residue of the energy-throughput of the process, after deducting costs for "energy of the system," we usually term the "free energy" of the process. This "free energy" (less wasted portions of it) is the amount of energy available either to do work on the system itself, or on some external process.

The significant thermodynamical function of a process which is not running down is the conversion of part of the total energy-throughput into usefully applied free energy. Crudely, the distinction is between starting a coal-fire on one's living-room floor, and thus burning down the house, and consuming the same amount of coal in a steam-boiler to accomplish useful work. In first approximation, we measure work as the process of reorganizing the energy-throughput of the universe to the effect of realizing beneficial changes in the universe through focusing free-energy to accomplish such changes. Or, to employ another of the writer's conceits, one expends more effort entering a house by breaking through a wall than by entering through a door. The fact that one expends more energy in the first option does not make it more productive.

Therefore, thermodynamics does not simply measure watts of throughput. The critical measurement begins with defining the ratio of free energy to energy of the system. Rising values of $S'/(C+V)$ are implicitly an increase of the free-energy ratio. Those systems (processes) in which the value of this ratio declines and becomes increasing negative, are either absolutely or relatively *entropic*. Those processes in which the ratio is maintained, or increases are termed as exhibiting "negative entropy," or, as abbreviation, "negentropy."

It is of crucial importance that we define very carefully the frame of reference we select to define a process. Every competent statement in mathematical science depends upon the principle of closure. Competent statements must be closed in mathematical form, a form which reduces to the appropriate geometric construction. Those statements must be closed not only in respect to mathematical form, but this condition of closure must also be the experimental characteristic of the phase-space selected for analytical treatment.

For example, in burning coal or petroleum products, the effect upon the fuel, the mines, oil-wells and so forth is decidedly entropic. The question is properly whether or not this combustion generates free energy usefully applied: in first approximation. How useful? *Is the per-capita potential of the society after combustion and use of free energy applied greater than before?*

We must always take the entire society as a process, an entire society occupying habitable area. That society and its area represent, in good approximation, a closed thermodynamical system. In accounting for all the things we relatively or absolutely destroy by the activities of that society, is the per-capita potential of the society as a whole increased or decreased? In a more general way, *the universe itself develops with aid of destroying some parts of itself (entropically) in the course of increasing the negentropy of the universe as a whole.*

We have just said, in respect to the universe, a very shocking thing, and quite deliberately so. It is now the point to begin progressing back toward the subject of shock-waves, by way of explanation of our argument that the universe as a whole is negentropic.

Our Negentropic Universe

It was emphasized by da Vinci and Kepler, among others, that all living processes are distinguished by the harmonic characteristic of the Golden Section, corresponding to the musical-harmonic interval of the fifth. This, as we indicated earlier, correlates with self-similar growth of the general kind typified by our illustrative use of the self-similar triangles in **Figure 1**.

More generally, all negentropic processes have an adducible Golden-Section characteristic. So, as Kepler was first to demonstrate empirically, does the universe in general. Is this then proof that the universe as a whole is negentropic? Is the universe as a whole, in some special sense, a living being? Does God exist as a consubstantial Being, in other words?

Let us imagine inscribing our self-similar triangles-sequence in **Figure 1** into the interior of a cone. Let the bent inscription be inscribed within the spiral on the surface of the cone, and the resulting image be projected onto the base of the cone.

What is such a cone? It is a growing circle, readily described by the obvious mathematical function generating the cone. The axis from the apex to the center of the base of the cone is the time-axis of reference for this process. *Such a cone is the simplest adequate approximation of what we signify by any negentropic function otherwise defined as a self-reflective potential-function.*

This implies the argument, that the discrete-manifold universe may be imagined, for pedagogical purposes, as analogous to the base of such a cone. A real space, a continuous manifold's hyper-space, is projected as image into the smaller number of dimensionalities of the discrete manifold, into which reality is, so to speak, squeezed for perception. We wish to go no further with that analogy, we do not wish to appear to reason from analogy beyond this pedagogical device as used thus far.

Our purpose here is, first of all, to illustrate that the notion of self-reflective potential functions is geometrically comprehensible. We have used the cone to illustrate the simplest kind of geometrical construction which demonstrates that point.

At this point, we turn to resort for a space to a good deal of descriptive summary, to avoid dwelling on specialized questions in detail.

The rigorous definition of a negentropic universe is first summarized, to our best available knowledge, in Riemann's 1854 dissertation, "On the Hypotheses Which Underlie Geometry." The characteristic action of the universe is the increase of the number of relative degrees of freedom of the continuous manifold from any given number n, to $n+1$. Riemann elaborated this from the vantage-point of a topological principle which he named "Dirichlet's Principle," after his teacher, Lejeune Dirichlet. The principle of Riemann Surfaces' generation is directly the outcome of this.

It is these qualitative (geometrical) leaps in the self-elaborating processes of continuous manifolds, which define those kinds of phase-changes in observed discrete manifolds suited to be the subjects of unique experiments. These changes—phase-changes—occur through the mediation of generation of what are called singularities in the process. These singularities require a continuous manifold of a relatively higher order for their comprehension. It is the successive ordering of the universe in terms of such phase-changes, which properly defines man's accessible knowledge of the lawful ordering of the universe.

Such a universe, one whose most characteristic geometrical action is n into $n+1$, is intrinsically a negentropic universe, as Kepler's work implies.

The negentropic process of economic development, to higher levels of per-capita potential, is of this same form. That is the essential "secret" underlying the unique success of the LaRouche-Riemann method.

The only net work accomplished by all of the activities within a society is the work measurable as an increase in per-capita potential. That work is the only fundamental measure of economic value. All other approximations of measurement of economic value are competent only to the extent they are coherent with the fundamental measurement.

Let us now glance at the relationship between shock-waves and generation of singularities. Let us reference Gauss's mathematical approach to treatment of the orbit of a planet (for example). Let us imagine that all of the mass of the planet was originally distributed throughout the orbit, and that the planet still looks much that way from the standpoint of reference of a continuous manifold. How does the planet come into existence as an approximately solid body? Our educated guess given here is not settled astrophysics, but merely informed speculation. Even so, this pedagogical trick aids us in pinning down a point.

Let us imagine that the mass initially distributed throughout the orbit "is hydrodynamic." In this medium introduce a wave, and let the wave propagate a shock-wave, thus creating the concentration of matter into the form of the point-planet within the orbit.

This leaves us some difficulty in accounting for the periodic table of elements distributed among the planets of our solar system. Existing physics argues that the gaseous envelope generated (spun off) by a star of our Sun's class would not fuse such a periodic table unless something like polarized magnetic fusion within the envelope had generated such a range of fusion-products. For the moment, let us treat such heart-warming speculations as healthy intellectual fun, as exercising our speculative faculties.

This view of planetary orbits intersects the approach E. Schrödinger adopted for treating the determination of that singularity known as the electron, Schrödinger referencing explicitly Riemann's 1859 shock-wave paper.

Such illustrative speculations having done their work, we now put them to one side. The fact is, that we have proven otherwise that phase-changes in economic processes do conform mathematically to the principle of shock-wave generation. This is consistent with the fact that if our universe is Riemannian, all productions of singularities by a continuous process must be geometrically analogous to shock-wave generation.

The Economic Shock-Wave

The interesting feature of the wave generating a shock is the relationship between the frequency and amplitude of the plane-wave, a relationship better examined by treating the plane-wave formation as a projection of a cylindrical spiral in hyper-space. As the relative amplitude of the wave increases, by virtue of increase of frequency, for example, the potential of the wave to generate lateral movement of matter is increased. This means generation of shock as this relative balance rises above critical values, and a correlative effect of concentration of highly increased shock-energy.

Among the more significant aids to the development of the LaRouche-Riemann method, particularly in work conducted toward the close of the 1950s, was the keen pleasure of working-through Max Planck's own account of his development of notions of the quantum of action. In Planck's report of his own work on this matter, the significance of this quantum-notion has a far more universal significance than the modern schoolbooks seem to comprehend. Arthur Sommerfeld, for example, recognized that the spectra could be made comprehensible in this matter was viewed from a Keplerian view of harmonic relationships within a discrete manifold. Sommerfeld's, Schrödinger's, and other important work of the pre-Solvay Conference period into the 1920s all points in the same direction. It was this writer's good fortune to have looked at such matters from the vantage-point of economic science, rather than the usual standpoint of issues within physics narrowly defined. The point of the inquiry was to broaden and deepen knowledge respecting the way in which our universe must be organized to yield the kind of behavior economic processes exhibit relative to changes in technology of productive practice.

It is an elementary exercise, to employ super-imposed projections of spirals on cones, to show a student the elementary topological principle, that the number of singularities generated by continuous processes is rigorously, indeed stubbornly determined. If Planck's account is situated in such a general, Riemannian setting, all of the usual mystification attached to the notion of the quantum drops away, and we view Planck's work in that matter not as some mere attention to a particular matter of microphysics, but as touching importantly upon a pervasive feature of the geometric composition of the universe as a whole, as an enrichment of Keplerian relativism of a sort made possible by the work of Riemann.

The usual mystification of Planck's work is demonstrably the result of attempting to situate the quantum of action within a Cartesian manifold, and attempting to explain the implications of that quantum-conception within the bounds of ontological assumptions acceptable to such a Cartesian standpoint. From such a pathological, Cartesian standpoint, and only such a standpoint, could one commit the wild blunder of confusing relative indeterminacy with statistical "uncertainty."

For example, one might ask oneself why the solar system generated only one planet in each planetary orbit, and why moons of planets, including suspected "wanderers," lie only in Keplerian harmonically determined orbits? Let our astrophysics treat the details of the matter; here, we are inspecting only the broadest, general points of the business. The problem here is the same which confronts in the intrinsic fallacies of the work of James Maxwell, or the Isis-cult-like wild intrusions of Ernst Mach.

When we, as the human race, act upon our universe, what is the geometrical ordering of that universe relevant to the determination of the outcome of our activity?

As I have summarized the matter here, and elaborated it more fully in other published locations earlier, it is a fairly straightforward matter to define the constraints of a process satisfying the requirement of increasing per-capita potential relative population-density. These constraints show us the direction our policymaking must adopt to accomplish service to the cause of human existence, to fulfill the cited injunction of the Book of Genesis.

Our remaining problem, once that set of constraints has been adduced, is to discover what lies in between a directed, purposeful action and the result accomplished for mankind as the consequence of that action. What is the geometry of that cause-effect connection? How may we know the workings of such an underlying geometry of real processes (continuous manifold), from the standpoint of observations directed to the reflected evidence of the discrete manifold?

In our inquiry into that crucial, subsumed matter of economic science, we are obliged to adopt the standpoint of method of Cusa, da Vinci, Kepler, Leibniz, Riemann, *et al.*, the geometrical method of classical "continental science." This method leads us, in the manner we have summarily indicated here thus far, to the judgment that the kind of action within the universe symptomized by the shock-wave phenomenon is the characteristic kind of phenomenon we must adduce in each field of inquiry, including the most general expression of science, as an economic science premised upon increases in per-capita potential.

The kinds of singularities we are obliged to examine, working from that vantage-point, present themselves to us as of several apparently distinct varieties.

The first class of such singularities is associated with, most immediately, increasing complexity of the division of social labor within society as a whole. This division of labor informs us of the direct significance of necessary shifts in the demographic characteristics of populations as a whole.

Next, chiefly aided by developments associated with Leibniz's mobilization of the principles of industrial society's self-development, we look in a more profound way at da Vinci's initial work of defining the general principles of design of machinery. Heat-powered machines, as conceived initially by Leibniz, settle matters left unresolved by da Vinci's work. The extension of the principle of the heat-powered machine to the use of manufactured fertilizers and other products of modern chemistry broadens our comprehension of the implications of Leibniz's treatment of the heat-powered machine as such.

So, in addition to the kaleidoscopic changes of social division of human labor, and associated requirement of an increased number of operatives for the economy as a whole (e.g., enlarged population), we now turn to the increasing number of degrees of freedom in superior machines, and other features of "artificial labor."

This leads us to think of the combined increase of total degrees of freedom of man plus machine, as correlative of increasing per-capita potential. This implies a general notion of each level of per-capita potential as associated with a height n, implicitly the required number of total degrees of freedom corresponding to an existing actual (or hypothetical) level of technology in use, a technology in use corresponding to a more or less well-defined level of per-capita potential. Technological progress, and increase in per-capita potential, develops in the form n into $n+1$.

This development subsumes transformations of the form of shock-wave propagation.

Therefore, as we have already stipulated, we must observe and experiment, to determine how such a shock-wave-like transformation actually manifests itself in the economic process of generating increased per-capita potential. In undertaking this, we must consider not only what appears to be true of observed economic processes as such. We must always bear in mind the general nature of the universe within which man's efforts to increase his mastery of nature are elaborated.

Therefore, *we must define per-capita potential of entire societies in terms of a self-reflective potential-function, and must interpret the leaps in potential as elaborated in a manner analogous to shock-wave propagation.* In other words, taking division of labor and "kilowatt-hours" as an integrated conception of the constraints of the process of rising per-capita potential for whole societies, we must treat the actions linking one level to the next as occurring in a shock-wave-like manner.

That is the essence of the LaRouche-Riemann method.

Science-Technology and Per-Capita Potential

To conclude this report, we address a concrete issue of utmost importance at the present moment: the potential significance of U.S. development of space-based anti-missile beam-weapons. We examine this now essentially from the standpoint of the effects of such development upon the U.S. and world's economy.

Over the recent two decades, there has been an accelerating devolution in not only rates of technological progress, but a recent, virtually catastrophic collapse of basic industrial and related capacity. We have already passed the point of industrial devolution, at which, *from one standpoint in analysis*, economic recovery is theoretically an impossibility.

From the standpoint of the computer-assisted quarterly forecasts for the U.S. economy, in particular, the LaRouche-Riemann method has warned of this worsening trend since early 1980, and those warnings have been corroborated by subsequent developments to date. Unless an appropriate new factor is injected into the U.S. economy, the U.S.A. is now hopelessly doomed by the consequences of 25 years' erosive influence of combined "post-industrial society" efforts and monetarist destruction of the economic basis.

What is the nature of the "new factor" which could change this?

The forecast of irreversible doom embedded in the regular forecasts of the LaRouche-Riemann reporting procedures depends upon the assumption that existing levels of technology in economic use provide the basis for economic recovery. The forecasts in publication have assumed that new technologies would be introduced chiefly as a by-product of a process of recovery based on revival of previously-existing technologies. As long as the forecasting is limited to that sort of assumption, the U.S.A.'s doom is to be viewed now as irreversibly sealed.

Without a "new factor," the condition of the U.S. economy—and most of the world's economy—will become progressively worse. Attempts to resist this decay, unless they include the required new factor, will perhaps slow down the rate of collapse, but will not reverse the direction of the general, devolutionary development.

The situation is such that the direction could be reversed only by a large-scale, top-down introduction of a technological revolution. This signifies something like the work of France's Ecole Polytechnique during the 1790s, or, more recently, the NASA research-and-development drive of the early 1960s.

We have proposed a comprehensive, crash-program approach to early development and deployment of space-based anti-missile beam-weapons. Our primary purpose in developing and circulating this proposal has been to solve the increasingly dangerous continuation of thermonuclear "mutually assured destruction" (MAD). However, our approach to this undertaking has also been shaped by attention to the need for a shock-effect revival of economic growth in the U.S. economy.

Let us restate this in terms most appropriate to this present discussion. Even if beam-weapons were not the strategic priority of the moment, we would have proposed, and did propose earlier crash-program quality of emphasis upon several areas of scientific and technological development also essential to space-based beam-weapons development. This we did for the kinds of economic reasons being stressed at this moment. It developed that space-based beam-weapons, a very large-scale undertaking, greater in scope than earlier work of NASA, is a foremost strategic priority. Since we lack the resources to conduct several crash-programs of such a scale, and since we are obliged to choose beam-weapons development from among all the alternatives which might be considered, it is the beam-weapons development effort which must be used to save the U.S. "economy.

We have elaborated the strategic reasons for beam-weapons development elsewhere. Here, we focus on the principal economic implications of such a crash-program effort.

Although we are already at the verge of completing all of the competent technologies needed for incorporation in space-based beam-weapons development, the completion of the entire package requires massive efforts applied to two categories of problems. There are, in the less costly side of the matter, certain problems of scientific research whose lack of early solution would represent disruptive bottlenecks preventing the development as a whole. In the larger area of investments, the deployment of beam-weapons on a scale sufficient to destroy 99 percent or more of all incoming nuclear warheads involves the manufacturing of a very considerable quantity of advanced hardware. This means, above all, that we must develop the industrial streams to a capacity adequate for the amount of hardware to be produced during the indicated period.

To develop the space-technology required, we have proposed that the U.S.A. emulate the tactic of adopting the NASA manned moon-landing objective. We must develop quickly, Earth-orbiting manned laboratories. We must complete work on the discontinued project for placement of manned stations on the Moon. We should also adopt a manned Mars-landing objective, analogous to the manned Moon-landing objective. The scientific, production, production-capacities, and operations problems mastered by crash-efforts on such civilian projects will foster successful development of everything we require for developing the large number of fixed- and mobile-orbiting space-platforms needed to the military side of the beam-weapons program.

The Mars-landing program strongly implies development of thermonuclear-fusion impulsion for spacecraft. This is "top of the spectrum" for all of the technologies required for powering the movement and other powered functions of the beam-weapons space-stations.

The beam-weapons themselves require developments centered, independently, upon relativistic (shock-producing) beams as such and generation of energy for civilian use through controlled thermonuclear fusion. Therefore, every research-and-development program usefully focused upon relativistic phenomena and thermonuclear fusion must be accelerated, and coordinated in a way which reflects the lessons we ought to have learned from the successes and errors in coordination of the NASA program and earlier Manhattan Project.

What, then, are the pre-calculable effects of such a program, on the scale broadly implied?

Let us proceed by successive approximations. Let us begin by looking at the matter of increased productivity, and then examine this matter of increased productivity more closely, so to adduce the deeper implications.

The first, general effect of any leap in technology is a leap in productivity. In the proposed crash-program, the U.S.A. is concentrating economic resources from relatively lower levels of technology (e.g., lower levels of productivity), to concentrate this portion of total national resources in a relatively very high area of technology (e.g., implicitly very high productivity). In other words, the total "pie" of the U.S. economy is being shifted in composition, so that a relatively larger slice of the pie is being devoted to higher levels of implied productivity than have previously existed in the economy as a whole.

On condition this specialized area's activities spill over significantly into the civilian economy in general, a rapid rise in levels of productivity throughout the economy will result.

This was our experience with research-and-development under NASA. Through the spillover of NASA technologies into the civilian sector, the economy as a whole gained back over ten dollars for each NASA dollar spent. This "pay-back" came in the form of increased per-capita outputs of production in non-NASA areas.

This is to be compared with purely military expenditures. Strictly speaking, NASA was not a purely military-type venture, but the similarities are noteworthy within the discussion.

The production of purely-military goods appears to the economy as production of waste. This is the only significant effect on the economy under the condition that military goods produced embody technologies which are on the average no higher than otherwise employed in the civilian economy. If military production shifts the average level of technology of overall production upwards to a significant degree, the wasteful implications of military-goods production are indirectly offset to that degree.

So, in assessing military spending, or quasi-military cases such as NASA spending, we must take two ostensibly contradictory economic effects into account. The production of military goods as such, is a wasteful deduction from the economy. The military production may be necessary for national survival, but it is nonetheless to that degree a pure tax upon the economy as a whole. To the extent that otherwise wasteful military production indirectly raises the average level of technology in the economy as a whole, a contrary effect is generated. We must weigh the wasteful costs of military production as such against the margin of increased wealth produced through spilling-over of advanced technologies into the civilian economy.

Hypothetically, we could increase the total military-goods production of the U.S.A. to 50 percent of total goods-production without incurring a penny's worth of net increased cost, but only on condition that the level of technological spillover into the civilian sector were sufficient to compensate for the increased military expenditures.

From an economist's standpoint, therefore, the proper military-procurement policy of a nation ought to be based on the very highest possible level of technologies. This coheres with military requirements as such. The mobility and fire-power of a military force is not only the relative capital-intensity of the individual soldier's deployment, but represents the potential power to win wars per soldier.

From this standpoint, the Pershing and cruise missiles are a mistake. These are essentially improvements of the basic Nazi V-2 and V-1 designs respectively, developed in the United States during the earlier 1950s chiefly through importing the skills of the Peenemünde scientists and technicians. The improvements incorporated into present designs are auxiliary. The basic conception is technologically obsolete. Had we maintained a vigorous development program during the 1960s and 1970s, had we not permitted the takedown of NASA R&D by President Johnson's "Great Society" blundering, we today would laugh at weapons of that sort. What we are presently pushing to complete—weapons which make nuclear missiles technologically obsolete—is research and development we might have completed during the late 1960s or early 1970s. Our military policy overall has fallen 16 or more years behind the times, even by that simple standard of reference.

The production of such weapons-systems barely maintains a fraction of previously established, now-shrinking aerospace and associated features of our overall national industrial-technological base. Thus, predominately, the reliance on such obsolete systems, cosmetically presented as "new technologies" has the effect of waste on the economy as a whole.

Before examining the matter of equation of technology and productivity more closely, let us collect and review briefly the kinds of effects modern technologies developed in military, NASA, and other undertakings have either had or could have on the economy as a whole.

In principle, nuclear-energy development deployment without the hindrances imposed over the 1970s would mean approximately a 40 percent reduction or better in the cost of electricity and process-heat wherever employed to supersede existing modes of fossil-fuel and more primitive energy-sources. This reduction in cost reduces directly the portion of C and

V required for energy-production in the economy as a whole, increasing S' directly as well as per-capita S. This means a direct increase in $S/(C+V)$ and $S'/(C+V)$.

Additionally, the best way to improve the impact of electricity production upon the general environment is to replace each conventional generating-station in use with either magnetohydrodynamic-technology fossil-fuel-consuming installations or nuclear generation. When one reviews how much capital has been expended on scrubbing dirty effluent from fossil-fuel consuming energy-generation, we must properly curse ourselves for collective stupidity as a nation.

In assessing both energy-production and industrial processes generally, it is conventional rule-of-thumb to assess both the costs per kilowatt-hour of energy produced, and the power and efficiency of that generation. By increasing the energy-flux-density of the heat-sources, we increase the efficiency of energy-production. and we also generate an increased concentration of power through which it becomes possible to do what was not feasible earlier.

In the case of thermonuclear fusion. we have two principal considerations to be taken into account. The intrinsic advantages of nuclear energy-production over less-advanced modes is both the positive environmental impact of such generation, and the fact that fission-plants operate implicitly at about four times the energy-flux-density possible with fossil-fuel plants. For that latter reason, such nuclear modes are intrinsically far cheaper sources of electrical power, and offer us sources of process-heat potentially to be used at great economic advantage. The high-temperature thorium-cycle gas-cooled reactor is a device most foolishly undervalued in current practice. Although projected designs indicate that thermonuclear fusion plants will operate at about the energy-flux-density of fission-plants, in the first generation of such commercial installations, the future levels of energy-flux-density are in principle almost limitless.

That is the simplest view of the matter, an inadequate view. As we enter into the range of reactions associated with thermonuclear fusion, and technologies adjunct to thermonuclear fusion, we are in the realm of the potential for commercial forms of relativistic physics, entering a realm of human practice in which mankind wields forces of nature beyond anything "naturally existing" in our Solar System. We must think of processes associated with the perfection of thermonuclear fusion in such terms of reference: this represents a breakthrough in technology far greater than was represented by the belated, 18th-century realization of Leibniz's design for the Industrial Revolution.

This should be referenced immediately to our earlier discussion, in this report, of the meaning of negentropy. The issue of energy is not the total amount of energy produced and used. The issue of energy is the issue of increasing the ratio of free energy to energy of the system, and thus increasing the power of mankind to accomplish the work of increasing per-capita potential. Any invention which substantially increases that power, if adequately deployed, effects a phase-shift upward within the entire economy within which it is deployed.

Proper economic policy of nations would be, therefore, to concentrate as much of S' as possible upon launching such breakthroughs in technology, while using the remainder of S' primarily to deploy such new technologies as they are developed.

What we must also do, is to use up the C of obsolete methods of production as rapidly as possible, by accelerating production from those facilities and reinvesting the "depreciation funds" from those sectors in the new technologies.

In the instance of relativistic-physics applications, we are presently at the verge of breaking through fundamentally all known limits of natural resources. Sand, rock, and rubbish provide mankind all the mineral raw materials it requires, if the technology available is sufficiently advanced. Applied relativistic physics is that technology.

To reach that breakthrough, we must begin to effect the breakthrough in some concentrated area of enterprise. We must reorient increasing portions of industry (and investment) as an integrated production-base for producing and using the kinds of things that breakthrough-technology implies. We must, in that way, shift the composition of the preexisting economy, away from old technologies to technologies on the frontiers of applied relativistic physics.

This represents a qualitative shift in man's relationship to nature, a leap in per-capita potential. That, and that alone, could rescue the U.S. economy from otherwise inevitable disaster.

From this vantage-point, we reexamine afresh the matter of "economic shock-waves." What are the parameters of an economic shock-wave?

The relative height (amplitude) of the "technology-wave" passing through an economy is defined in respect to the existing per-capita potential of the economy. Relative to that potential, a function in terms of $S'/(C+V)$ defines the relative amplitude of the wave. This increase of amplitude is immediately defined (realized) by advances in technology. It is necessary policy, that the relative amplitude of this wave must be sufficient to represent the critical value for generating shock.

Since the LaRouche-Riemann quarterly forecasts for the U.S. economy were first issued, the last quarter of 1979, the phenomenon on which we have been obliged to concentrate has been negative shock-waves. Especially since Volcker's policies of October 1979 took hold of the U.S. economy, during February 1980, the characteristic feature of the economic process has been increasing negative values for the function of $S'/(C+V)$. As we have been able to forecast with high accuracy thus far, this devolution of the U.S. economy's goods-producing sectors and transportation-sector combined, has not been merely a process of gradual devolution, but is most clearly marked by periodic "jumps" downward, these abrupt declines separated from one another by periods of more gradual decline or even, for one period, a slowing-down of the rate of decline. As we stressed in published reports during spring 1980, these periodic "jumps" downward are analogous to phase-changes in physical processes. These phase-changes occur in the manner of shock-waves, and their periodicity is so determined. It is by treating the process of devolution from that vantage-point that the LaRouche-Riemann forecasts have been uniquely accurate to date.

This regular, ongoing study of the U.S. economy has been complemented by similar special studies of several other national economies, and has also been complemented by special research-studies on the history of development of specific industries. It is such varied empirical studies, together with long-range studies conducted over a decade to date, combined with the general validity of the LaRouche long-range forecast of 1959 today, which assures us of such behavior in economic processes generally.

Although the writer and his collaborators are beyond competent argument the world's leaders in economic science today, we would be the first to insist we are by no means leaders in relativistic physics.

In the latter field, the problem is that leading circles have assimilated aspects of "continental science" while rejecting the geometrical vantage-point from which that "continental science" was actually developed; most generally, the flaw is the specialist's political opportunism, his wont to show respect for Descartes, Newton, Cauchy, Maxwell, *et al.*, and to explain the fruits of continental science on terms agreeable to the British-Viennese empiricist-positivist school of cabalism. So, the otherwise gifted and accomplished specialist usually greatly dilutes his intellect, by ignoring those specific, profound issues of scientific method which would lead him to break in methodology and argument with the British school.

Our advantage, respecting the few contributions we have made on behalf of thermonuclear fusion and relativistic physics, is that we have adopted the elementary standpoint of continental science, and are encumbered by few of the kinds of confusion introduced to scientific thinking by the present-day hegemony of the cabalistic standpoint. Our advantage over those far better qualified than we, in certain matters, has been entirely the fruit of the methodological standpoint from which we view numerous of the presently compartmentalized aspects of scientific work, taking them together as what they are in fact, different facets of the same object.

Our occupation, our specialized facet of scientific work, has been economic science viewed as the applied science of technology. We know, from experience in that work, that something important was more or less lost to Western civilization approximately a century ago, something typified by the Riemannian physics we employ as the methodological basis for our work in economic science. So, we attempt to “sell” that Riemannian physics and what it implies back to the profession which has too long underrated it.