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On LaRouche's Discovery

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Nov. 21, 1993

The central feature of my original contribution to the Leibniz science of physical economy, is the provision of a method for addressing the causal relationship between, on the one side, individuals' contributions to axiomatically revolutionary advances in scientific and analogous forms of knowledge, and, on the other side, consequent increases in the *potential population-density* of corresponding societies. In its application to political economy, my method focuses analysis upon the central role of the following, three-step sequence: first, axiomatically revolutionary forms of scientific and analogous discovery; second, consequent advances in machine-tool and analogous principles; finally, consequent advances in the productive powers of labor.

These discoveries were initially the outgrowth of 1948-1952 objections to the inappropriateness of Norbert Wiener's application of statistical information theory to describing both the characteristic distinctions of living processes and of communication of ideas.[1] I countered with a contrary, non-statistical definition of negentropy, as that meaning of the term might be derived from the common, physically distinguishing characteristic of an evolutionary biosphere. This non-statistical counter-definition of negentropy was then stated in terms of a successfully self-developing physical economy; the efficient impact of scientific discoveries' communication within such a negentropic physical-economic process was treated as most typical of the communication of ideas in general.

That was the initial core of my discovery, up to the year 1952. Yet, up to that point, the appropriate mathematical representation of such a form of physical-economic negentropy was still wanted. The third step, taken through an intensive 1952 study of Georg Cantor's 1897 *Beiträge,*[2] opened the doors of the transfinite domain upon a fresh insight into relevant features of Bernhard Riemann's contributions.[3] Thence, the applied form of my definition of physical-economic negentropy acquired the title of "LaRouche-Riemann Method."[4]

I. Negentropy in Physical Economy

Initially, during 1948-1952, I made two principal arguments against Norbert Wiener's application of statistical method to living processes. The first of these two was, that, insofar as we employ the term "negative entropy" to signify the characteristic distinction of living processes in general, the phenomenon referenced cannot be described either in terms of a simple time-reversal of thermodynamical statistical entropy, or in terms of the term "energy" used as a notion reducible to a scalar measure of heat. The second of the two objections was, that, for similar, related reasons, statistical information theory has no appropriate application to the processes of generation and communication of ideas.

On the first of these two classes of objections, the kernel of the matter is, that, for the case of an indefinitely

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successfully self-developing biosphere, the imputable ratio of free energy to energy of the system increases at the same time that the total energy of the system increases, and, that, similarly and concurrently, the ratio of free energy to rising energy-flux density is also rising.

The second of the two objections is brought to light more conveniently, by examining the analogous case of a successfully evolving physical economy. The obviously intrinsic advantage of this choice of subject-matter is that metrical characteristics of the phenomena are predefined in the clearest way: input-output relations of physical labor and physical consumption, defined in *per capita* and *per* square-kilometer measures. The most readily accessible illustration of this argument is provided, broadly, by successful models of modern, post-fourteenth-century economies of the type addressed by Leibniz's 1672-1716 work of founding that science of physical economy also known as the science of technology.[5] Such cases are typified by the characteristic feature of generally increasing intensity of use of heat-powered machinery. The measurement of such model cases in terms of both *per capita* and *per* square-kilometer caloric values of input and output, leads to an array of inequality relationships, by means of which the most relevant relations can be measured comparatively in terms of chronological successions of changes of state of each such economy studied as an integrated whole process.

Only the evolutionary model of such a heat- powered process of increase of the productive powers of labor brings the meaningful issues into focus. By contrast, any zero-growth, non-evolutionary model of physical economy is axiomatically entropic, and corresponds to no durably successful model of national or global economy.

For the evolutionary case, progress in scientific and analogous forms of knowledge is the driver of those changes in practice which lead toward a consequent expression of the indicated, life-like negentropic forms of economic development. It should be stressed, that this role of generation and communication of ideas is illustrated by considering Leibniz's study of the proposals for an industrial development based upon the combination of heat-powered machinery and analogous thermodynamical development of modes of production and transport generally. This Leibniz case is a bench-mark from which the history of physical economy in general may be traced backward and forward in time.

That Leibniz case, of increase of the productive powers of labor through employment of the heat-powered machine, has two readily identified, ironically juxtaposed aspects. First, immediately, there is the simpler aspect, the increase of productive powers of labor, in some functional correlation with increase of heat power supplied efficiently *per capita* and *per* square kilometer. In the complementary aspect, on account of nothing other than some improvement in employed principles of design, one machine, using no more power than a comparable second machine, yields greater increase of the productive powers of labor. The second case, the general notion of an efficient improvement in design principle, illustrates the notion of *technology.*

For purposes of analysis, the term technology must denote a set of all those machine-tool and analogous principles of design which may be derived commonly from, implicitly subsumed by a specific, axiomatically unique quality of scientific or analogous discovery. Reference the refined design of a crucial experiment employed to demonstrate the proof of principle of a crucial scientific hypothesis. Each type of such refined experimental design for that same crucial hypothesis subsumes a set of machine-tool principles, or a *technology;* all of the sets subsumed by crucial proof-of-principle design for that same hypothesis constitute a family of such sets, or a family of *technologies* derived from that proof of principle.

Thus, does scientific discovery lead, typically, through subsumed technologies, toward consequent increases in the productive powers of labor. The relevant task of analysis in physical economy is to show that such generation and transmission of valid creative discoveries, as ideas, is the source of the realized negentropy of physical economies, and, hence, of negentropic increases of the potential population-density of mankind in our universe. My argument, in opposition to statistical information theory, was, that the generation and transmission of such noetic (negentropic) ideas exhibits fundamentally the principle underlying, bounding externally, the transmission of ideas in general.

This discovery posed two paradoxes. The first of these paradoxes is the formal difficulties posed by stating that the characteristic of all physical-economic processes which meet persistently the standard of increasing potential population-density, is negentropy. The apparent paradox lies in the fact that I defined negentropy as corresponding to an increase of the ratio of free energy to energy, and to energy-density of the system, under the condition that the energy of the system is continually increasing both *per capita* and *per* square kilometer.

The second of these two paradoxes is the notion of the functional role of technology's mathematical discontinuities in the theory of heat-powered machinery.

Perhaps it may be said, that, as treasures of pagan mythology are guarded by dragons, forbidding paradoxes often deter the timid from reaching out to the crucial discoveries otherwise within their reach. These apparent paradoxes of my argument proved not the weakness, but rather precisely the strength of my case against positivists such as Wiener, John Von Neumann,[6] *et al.*

II.
The Paradoxes Of Negentropy

To define my post-1951 attack upon the metrical problem, consider the following.

The two paradoxes identified above should be recognized as echoing the issue of Isaac Newton's confession as to the source of his so-called "Clockwinder" paradox. Newton warned, thus, that the false-to-nature image of an entropic universe had infected his *Principia* through defects inhering in what he regarded as his only available choice of mathematics.[7] But for my adolescent grounding in such relevant works as the *Clark-Leibniz Correspondence*[8] and *Monadology,*[9] I, too, would probably have been frightened off the track of my discovery by the appearance of the indicated paradoxes.

The influence of Leibniz upon my view of these two paradoxes is situated historically, summarily, as follows.

In synopsis, the relevant background of Newton's *"Clockwinder" problem"* is this. Although the solar-astronomy roots of modern mathematical science reach back far beyond 6,000 B.C. in Vedic Central Asia[10] and in the culture of China,[11] a comprehensive, mathematical basis for a unified body of science ("natural philosophy") was first founded by Nicolaus of Cusa, *et al.* during the early middle decades of Europe's fifteenth-century Golden Renaissance of Cusa, Piccolomini, Toscanelli, Leonardo da Vinci, Raphael, *et al.*[12] The complication, leading to Newton's "Clockwinder" problem, was the spread of a Venice-directed opposition to the Council of Florence, an attack which featured the neo-Aristotelian empiricism of such Gasparo Contarini associates as Pomponazzi[13] and the Franciscan cabalist Francesco Zorzi.[14] Through this continuing influence upon England of such Venetian potencies as the notorious Paolo Sarpi, we have Baconian empiricism and British philosophical liberalism generally.

Respecting the two paradoxes originally posed to me by my theses against statistical information theory, the relevant problems in mathematics are a tangle of two respectively distinct, but interlocked sets of problems. Once this tangle is understood from an historical vantage-point, my solution to the cited paradoxes is more readily intelligible.

The founding work of modern science is Nicolaus of Cusa's *De Docta Ignorantia,*[15] in which the pivotal mathematical discovery referenced is Nicolaus' revolutionary treatment of Archimedes' theorems on quadrature of the circle.[16] Nicolaus' new solution for these theorems[17] is also a form of demonstration of the general solution for the ontological paradox depicted within Plato's *Parmenides* dialogue.[18] Nicolaus's discovery is, in fact, an illustration of Plato's principle of human knowledge: *hypothesizing the higher hypothesis.*[19]

To this, the anti-Renaissance associates of Gasparo Contarini counterposed, violently, the dogma of *neo-Aristotelian empiricism,* the deductive treatment of sense-certainty, which is otherwise recognizable as the philosophical "materialism" of the Renaissance's seventeenth and eighteenth centuries' principal adversary, the Enlightenment. Thus the spread of the Enlightenment's cabalistic empiricism is typified by the influence of such notables as Francis Bacon, Robert Fludd, Elias Ashmole, René Descartes, Isaac Newton, John Locke, and Immanuel Kant.

The view of the problem of quadrature from the standpoint of Plato's *Parmenides* shows, perhaps most efficiently, the root of Newton's "Clockwinder" failure, and exposes also the more general form of practical differences in scientific results between the two opposed, Renaissance and Enlightenment, methods of work. This shows explicitly, in this way, the implication of my initial treatment of my own two scientific paradoxes.

The gist of the matter is as follows.

The Archimedean quadrature of the circle relies upon the so-called method of exhaustion famously employed by Plato's collaborator, Eudoxus. By simultaneously inscribing and circumscribing regular polygons, of the same species, and by increasing the number of sides of these polygons, equally and concurrently, we may estimate the value of π accurately to any desired decimal place. Slovenly thinking would argue, mistakenly, from this, that the perimeters of the two polygons must ultimately coincide with a circular perimeter.[20]

The same species of philosophical problem arises in deriving the uniqueness of the five Platonic solids. In the case of quadrature, what exhaustion proves, is that, never, even at conjectural infinity, could the number of sides be increased sufficiently to produce coincidence of the polygonal and circular perimeters. Thus is illustrated by the fact that a circle, as a species, is not constructible by a geometry premised hereditarily upon the axiomatic assumption of self-evident point and straight line; another, axiomatically different geometry must be adopted, one in which circular action supplants axiomatic definition of point and straight line.

Two points representing the case are relevant for understanding my solution to the negentropy paradoxes.

First, very briefly, the fact that point and straight line are theorem-existences in a geometry premised upon circular action, but not the reverse, shows that the non-circular forms externally (epistemologically) bounded by circular action (in this sense of external bounding) have only that inferior, dependent existence, dependent upon the necessary existence of the higher. This, notably, is an

argument congruent with the ontological proof of existence of God. Thus, the mind must, so to speak, leap from the falsely imagined elementarity of the simpler, to recognize that the elementarity lies actually in the superior. Thus, does human reason free man from subjugation to the bestiality of neo-Aristotelian sense-certainty. This appearance of an ontological leap typifies the phenomenal guise of creative thought.

This is the same species of problem posed by Plato's *Parmenides,* that problem, which, as paradox, blocks the pathway to that true knowledge, which is opposite to mere sense-certainty, derived uniquely, not from simple deductive sense-certainty; this true knowledge is typified by the recognition that a necessary existent, which bounds externally a set of phenomena of mere sense-certainty, is the relative ontological reality, the relative One, which adumbrates the mere shadow-existence of sensory appearances.

Thus, Cusa's treatment of quadrature implicitly defined ("hereditarily") the non-algebraic higher mathematics which Leibniz and Johann Bernoulli proved physically by the case of light refraction, a quarter-millennium later.[21] This gave modern science two levels of mathematics, the lower, the algebraic, and the higher, the non-algebraic, the latter later called transcendental.

Second, still later, by the same method of discovery employed in Plato's *Parmenides,* and used by Cusa in his treatment of Archimedean quadrature, Georg Cantor, two hundred years after Johann Bernoulli's announcement,[22] announced the discovery of a third, still higher domain of mathematics, the transfinite, superseding the transcendental.[23] It is only a view of the relatively subsumed, transcendental, space-time continuum, a view obtained from the standpoint of the transfinite, which permits an adequate comprehension of cognitive problems underlying the deductively apparent paradoxes of negentropy.

By 1951, the specific, narrowly defined difficulty which confronted me was, that any function defined in terms of those successive, axiomatic transformations which correspond to generalized, continuing scientific-technological progress, cannot be represented functionally by any generally accepted form of classroom mathematics. I view that as a more general form of the difficulty which trapped a misled Newton into an entropic, "Clockwinder" morass.

I expressed my own notion of negentropy in such paradoxical terms which posed that conception most simply. To this purpose, I adopted conditionally the implicit assumption of customary, classroom algebraic physics, that any body of algebraically formal scientific knowledge, up to the moment of an axiomatic-revolutionary advancement of principle, is being perfected formally as a consistent, deductive theorem-lattice. In that case, the arrival of the axiomatic-revolutionary discovery represents, deductively, an absolute mathematical discontinuity separating axiomatically knowledge preceding the discovery from that which follows. So, the formal representation of a function corresponding to a succession of such axiomatic discoveries is depicted essentially as a function in terms of what appeared to deductive formalism as absolute mathematical discontinuities.

It follows, that if the discoveries of that succession each represent implicitly an increase of the productive powers of labor, the historically cumulative density of the formal discontinuities so portrayed represents an increasing *power* of knowledge. This notion of power of a so-selected succession of formal discontinuities, describes the needed alternative to ordinary classroom notions of function. Such is the functional form of this alternative definition of both biological and physical-economic negentropy.

My 1952 study of Cantor's *Beiträge* provided the key to developing this conception further. Following that study, later the same year, I was electrified by re-reading the relevant, most crucial passage of Riemann's habilitation dissertation.[24] Applying the Cantorian implications of my own notion of negentropy to Riemann's stated crucial problem of a continuous manifold "sent sparks flying in all directions." Cantor's transfinite was key to bringing the two elements together in this way, my own and Riemann's.

This combined view of the universe of physical economy's experience, seen as a functional continuum, guided me to construct revisions in the applicable theory of knowledge: to exclude all residues of sense-certainty's notion of linear ontological elementarity, and to replace these entirely by the elementarity of universal, negentropically evolutionary *change,* in Heraclitus' and Plato's sense of the ontological elementarity of nothing but change.

This required that the popular idea of a mathematical certainty must be put aside, to be superseded by a corrected view of the theory of knowledge. No system of deductive contemplation of our sense-experience can be human knowledge; we know the universe only to the degree we surpass sense-certainty by reflection upon the willful means through which we increase man's power over our universe.

This aspect of mankind's relationship to nature is the central feature of the Leibniz science of physical economy. All matters are subject to crucial tests in terms of choices of pathway of scientific changes in axioms, pathways which generate successive increases in mankind's potential population-density, as the latter relationship to our universe is measured relative to our planet Earth.[25]

I argued that this physical-economic definition of

knowledge implicitly defines a superior scientific method, and, therefore, a fresh overview of the term "mathematics" from a higher standpoint.

In recent decades, I have underscored the following, subsidiary form of that latter argument. I argue that what these reflections pose for mathematics is typified by the ontological paradox of method central to Plato's *Parmenides.* That dialogue is to be recognized, taken together with Cusa's treatment of quadrature for this purpose, as a forerunner of Cantor's conception of the transfinite, and also as a precedent for Kurt Gödel's derived, comprehensive refutation of the radical positivist fallacies permeating axiomatically the central mathematical theses of Betrand Russell, John Von Neumann, and other beliefs of that positivist genre, including Wiener's information theory.[26]

Typical of this ontological implication of the *Parmenides* is Cusa's discovery, that the circle does not come into existence, "even at infinity," by means of any merely formal geometry of the axiomatically rectilinear theorem-lattice kind. As an outcome of that discovery by Cusa, *circular action,* also known (later) as Leibnizian *least action,* is recognized *ontologically* as an independently higher form of existence, an existence which bounds externally all merely algebraic space-time.

From this argument, it follows, that the term "reason" must not be used as Kant does, must not be degraded to a mere synonym of mechanistic, linear "logic." Reason must signify, typically, valid modes of those kinds of axiomatically-revolutionary discovery, modes by means of which ontologically higher forms of existence, such as Cusa's circular action, are shown to be the necessary existence bounding externally an array of inferior, predicated phenomena. Hence, the recommended use of the descriptive term "creative reason," to place the needed emphasis upon this intelligible use of the terms "creative" and "reason."

Such is the principle of creative reason demonstrated by Cusa's treatment of quadrature. One should return to this application of Plato's *Parmenides* by Cusa, to illustrate the proper, constructive-geometrical standpoint from which to comprehend the ontological implications of Cantor's superseding of transcendental, merely mathematical, merely symbolic space-time, by the higher ontological standpoint of transfinite *physical space-time.*

It must be recognized, in this way, that the successive levels of mathematics—algebraic, Leibnizian non-algebraic (transcendental), transfinite—define a transfinite array of predicates of a shared common *type.*[27] All three of these are each traceable directly from Cusa's treatment of Archimedean quadrature.[28] Each is separated formally from its predecessor by an axiomatic-revolutionary change, a true mathematical discontinuity (singularity). Each change is effected in an equivalent way, referenced to a common point of origin; and, thus, the array qualifies as a *type.* Each change illustrates the Platonic principle of *hypothesis;* the array as a *type* illustrates the Platonic principle of *higher hypothesis.* That array of successively higher *types* which is physical scientific (as distinct from merely mathematical) progress, is a higher *type* of a transfinitely ordered array of higher hypotheses: in other words, a *higher type,* corresponding to Plato's notion of hypothesizing the higher hypothesis.

Thus, Cantor's discovery of that transfinite which bounds externally the mathematically transcendental, might appear to be the solution for the mathematical appearance of a paradox in my definition of negentropy. Certainly, this was an indispensable step, but did not represent a complete solution of that paradox. Negentropy is essentially a notion of causality; mathematics, even a merely mathematical notion of the transfinite, is not a true physics, but only a higher form of symbolism; such mathematics cannot represent causality as such. Another step was required. A turn to Riemann's work, later during 1952, pointed the direction to the needed next step.

III. Negentropy as 'Ontologically Transfinite'

Situate Riemann's significance for my work, by restating briefly the context for the 1952 reading of, especially, Riemann's *Hypothesen.*

From 1948 on, through 1951, my anti-reductionist notion of negentropy was developed into approximately the form it may be broadly described today. Yet, until my "electrified" reactions to successive, 1952 studies in the work of Cantor and Riemann, it remained unclear to me how to situate this seemingly paradoxical conception with respect to generally accepted forms of classroom mathematical physics.

The geometrical solution to this paradox was supplied, in large part, by aid of Cantor's *Beiträge,* but only with respect to mathematical formalities. As already stated, *mathematics as such cannot represent causality,* and the central feature of my notion of negentropy is causality as the elementarity of physical space-time. An ensuing study of relevant features of Riemann's arguments respecting the metrical qualities of a continuous manifold, prompted a conceptual insight into this remaining difficulty.

The explicit solution to the remaining margin of paradox is not to be found within those writings of Riemann which were published during his lifetime.[29] The relevant, electrifying, crucial passage from the habilitation disser-

tation had produced its needed effect only because two leading notions from the history of science were brought to bear upon that 1952 re-reading. The first of those two was the Heraclitus-Plato concept of the unique, universal, physical elementarity of change.[30] Re-read Riemann's crucial passage to the effect that the continuity of negentropy, as elementary change, is the ontological *type,* or *characteristic,* which defines a continuous manifold as continuous. The second of these two is Leibniz's 1714 *Monadology.* For emphasis, read that *Monadology* as it was incompetently attacked by Leonhard Euler.[31] On this latter account, regard Cantor's transfinite in its aspect as a devastating refutation of Euler's blunder, and, thus, a definitive, formal rehabilitation of Leibniz's *Monadology.*

Viewing my 1952 reading of the Riemann *Hypothesen* more broadly, five crucial conceptions were thus conjoined by this treatment of Riemann's uniquely relevant argument. *First,* the Heraclitus-Plato notion of the unique physical (i.e., causal) elementarity of *nothing but* change. *Second,* Leibniz's *monads. Third,* the Cantor mathematical transfinite. *Fourth,* my notion of negentropy. *Finally,* Riemann's treatment of the metrical paradoxes of a continuous manifold. If one substitutes for the materialist's fantastic, discrete elementarities of sense-perception-like objects, the Leibnizian sovereignty of existence of the individual monad, and if one were to show necessary and sufficient reason that a continuum, premised uniquely upon an elementary ontological quality of negentropic change, must necessarily develop such efficient monads, the paradox, as paradox, were implicitly resolved.

That proof of the existence of monads which will be shown here, as I developed it, is provided from the combined standpoint of both the theory of knowledge and physical economy. An intervening, preparatory report must be provided at this point: assuming that negentropy of the relevant form does exist, what are the elementary mathematical implications of the existence of such a phenomenon?

From the standpoint of a *discrete manifold,* the discontinuity which is typical of a negentropic "power" function occupies a space-time location within the transcendental manifold *analogous to* the *transinfinitesimal* difference between an indefinitely extended algebraic quadrature and never-obtainable congruence with the relevant circular perimeter. It represents thus a Dedekind-like "cut," an interruption in the continuity of any otherwise apparently continuous line of the maximum of transcendental density of *denumerable* locations. It appears in merely mathematical space-time as an otherwise empty location of virtually-zero, virtually null-dimensional scale.

This is analogous to proposing for physics, that the discreteness of any sub-atomic, ostensibly elementary particle consists only of the virtually null-dimensional, mathematically circumscribed singularity embedded within a functional notion of that volume of merely mathematical space-time which the particle, as a phenomenon, is estimated to occupy.

The portent of this, is that the non-algebraic (transcendental) mathematical domain defines the location of phenomena in space-time. It cannot represent causality as such. It can pin-point the space-time "location of matter" with virtually inexhaustible refinement, but it does not define physical existence in any other sense than that of space-time location. As useful, even indispensable as this may be, it does not define a *physical space-time,* the latter the higher domain within which causality is expressed.

It is thus indicated, that we must not confuse the two mutually distinct ontological states, mere space-time and physical space-time. We must think of the *transcendental* as a certain image of space-time, a subsumed phase-space of the higher, externally bounding, *transfinite* domain of *physical space-time.*

Such reflections should prompt a reflection upon the character of those Cantor writings, notably his *Grundlagen* and *Mitteilungen,* which preceded his *Beiträge.* The *Beiträge* unveils the formal discovery of the transfinite; the preceding writings, especially those cited two predecessors, enable us to recognize the process of Cantor's thinking, grounded, from the outset, in Karl Weierstrass's treatment of some of the demonstrable boundaries of Fourier analysis.[32] Cantor's extensive review of both ancient and modern philosophy[33] is an integral part of his preparations for developing the concept of the transfinite. As Cantor stresses the implications of his proof, that a higher-order mathematics, the transfinite, bounds externally the transcendental, space-time domain, require us to adopt afresh Plato's theory of knowledge. Specifically, Cantor's *transfinite* domain corresponds precisely to the intent of *Becoming* in Plato's theory of knowledge, as Cantor himself insists; similarly, the *Absolute,* which bounds demonstrably the transfinite, corresponds ontologically to that *Good* which bounds externally Plato's *Becoming.*[34]

This view of the Cantor to Plato parallels is not an optional topic in mathematics today. The central structural feature of the organization of the transfinite domain as a whole is Plato's theory of knowledge: *hypothesis, higher hypothesis,* and *hypothesizing the higher hypothesis.*[35] Cantor's notion of *type* and *equivalence* are cognate with that threefold structure of Plato's theory of knowledge.[36]

Cantor's emphasis upon the Classical philosophical theory of knowledge was in no sense gratuitous or even dispensable. Like the Cantor of my 1952 studies, I faced the requirement for a kind of proof which cannot be supplied merely by any localized sort of laboratory experiment. The appropriate experiment can be conducted only

in the domain of physical economy in general. One must re-pose the Classical theory of knowledge as a study of the science of physical economy from the vantage-point of the study of the internal history of fundamental ("axiomatic") discoveries of higher principle within physical science in general. One must then prove whatever is adduced from the study in respect to progress in principles of composition in the Classical forms of plastic and non-plastic arts.[37] This proof, or its reflections, therefore occupies a leading place in my writings on political-economy or policy-shaping in general.[38]

The characteristic, absolute superiority of our human race over all lower species, is expressed implicitly by mankind's rise from a bestial, baboon-like, rock-artist-like potential population density of circa ten millions living individuals, to a technologically-determined potential of more than twenty-five billions today. This change is owed entirely to a quality which the Christian's Latin terms *imago Dei* and *capax Dei,* the Mosaic tradition of Genesis 1, that man, male and female alike, is cast in the image of God. This likeness is by virtue of that power of *creative reason* which is most simply illustrated by a revolutionary-axiomatic superseding of inferior by superior principle of scientific practice.[39] Thus, in effect, mankind is the only super-species, the only species which can willfully self-develop itself to the physical-economic equivalent of a succession of successively higher species.

To state this pivotal point very briefly, this quality of being such a "super-species" of creative reason is the image of negentropy as far as the human mind is capable of defining that notion. As such a "super-species," insofar as our physical-economic practice is premised upon such a continuing process of science-driven increase of our power of physical-economic practice, *per capita* and *per* square kilometer of our earth's habitable surface,[40] our conscious reflection upon our revolutionary practice is this idea of negentropy, this notion of the ontologically transfinite. This identifies a Platonic conceptualization of that ontological reality which adumbrates the mathematical imagery of Cantor's *Beiträge.* That is what is fairly described as my updated presentation of Leibniz's principles of a general theory of knowledge.

My argument on this point is summarily as follows.

IV. The Theory of Knowledge

The adequate solution to the paradox of negentropy lies within the domain of a theory of knowledge, an epistemology. We proceed to that as follows.

It is useful now to introduce the relevant, subsidiary argument, that perhaps the most notable feature of my work in this field is that these discoveries were not already established standard as textbook knowledge long prior to my initial, 1948-1952 work in this area. The shocking fact is, that such properly obvious consequences of Riemann's and Cantor's combined contributions were left to be adduced by one of my then modest qualifications in mathematics. Situate this point in the appropriate terms of reference: If one takes into account the most recent 550 years of science, especially the indispensable internal political history of science, the irony of my discoveries is crucially, and most instructively anomalous; it is not rightly considered to be mysterious.

Similar anomalies have appeared in the history of science in the circumstance that the discovery in question has been implicitly forbidden by some more or less intimidating imposition of false axiomatic assumptions upon established institutions of learning, such as commonplace classroom opinion. In my own case, the root of such false, but commonplace opinion is, of course, ultimately traceable to the Venetian neo-Aristotelians of the late-fifteenth and sixteenth centuries; but, the circumstance bearing directly upon the irony of my successes are to be traced to the more recent, special U.S.A. conditions arising in mid-twentieth-century teaching since around the close of the nineteenth century.

To illustrate the kind of argument required: The combination of London-directed,[41] French Jacobin lunacy, and, later, conditions imposed by the 1814 Congress of Vienna, ended France's more than two centuries of supremacy in science and technology.[42] Similarly, Anglo-Saxon empiricism's subjugation of both the U.S.A. and continental European classrooms came about chiefly through the political hegemony institutionalized under the Versailles and later Yalta-Potsdam peace agreements. The same political logic applies to changes in Twentieth Century scientific opinion within the United States.

Until the close of the nineteenth century, at first French, and then, later, German world-leadership in science had been the standard of leading educational and governmental institutions. The cases of Bache[43] and Agassiz[44] are illustrative of the influence of Gauss in particular.[45] At the turn of this century there occurred the onset of a sweeping change, toward radical empiricism in the cultural paradigms of relevant U.S. institutions. The concurrence of President Eliot at Harvard University, of Jim Crow law, and the nearly successive U.S. presidencies of Confederacy admirers Theodore Roosevelt and Woodrow Wilson, were all cut from the same piece of treasonous political cloth. The patriotic, economic-protectionist tradition of Washington, Monroe, Adams, and

Lincoln was supplanted once again by the "free trade" and related dogmas of those presidents upon whom Britain's villainous Lord Palmerston had most relied, Pierce and Buchanan. At the onset of the century, William James and the British Fabian Society's John Dewey had been unleashed to ruin U.S. public education. Gradually, scientists in the Bache tradition, such as Chicago's Harkins,[46] were supplanted, at least in large degree, by a dominant role of increasingly radical expressions of empiricism.

These changes in culture fostered corresponding effects in the teaching and practice of science, of political economy, of philosophy, and of history within the world's increasingly hegemonic, Anglo-Saxon Establishment institutions. That politically aversive indoctrination of most among the elites of the world's nations trickled down to its effects upon the opinion-shaping in the classrooms, and among the populations generally.

The specific relevance of this for the case at hand is signalled by comparing this twentieth century imperial rise of empiricism to a related *pogrom* against Georg Cantor by the cronies of Leopold Kronecker.[47] That shameful political lynching of Cantor was a correlative of the same empiricist mob's malice shown so prominently by Bertrand Russell and other members of the Cambridge Apostles in their continuation of the earlier efforts of Kelvin, Helmholz, Maxwell, and Rayleigh to bury the principal achievements of Riemann, Weber, and Weierstrass.[48]

But for such specific historical circumstances, all that which is in my original contributions would have been well established knowledge long before my initial work of 1948-1952. Consequently, my role has resembled that of the rude little boy in Hans Christian Andersen's celebrated tale of "The Emperor's New Suit of Clothes." Beginning 1948-1952, I worked to fill a vacuum which had been created almost solely through a pervasive, political corruption of prevailing classroom opinion.

In this circumstance, looking at that retrospectively today, what I did was to extend what I had learned from the hand of Leibniz, to meet the challenge of refuting Wiener's "information theory." By aid of re-reading Riemann's dissertation through the transfinite eyes of Cantor, I developed a fresh overview of the theory of knowledge. This fresh overview, on which I report now, was required to resolve the remaining paradoxes posed by my locating of negentropy *elementarily* within the higher domain of the ontologically transfinite.

What is now to be said here may be read in part as parallel to Leibniz's 1695 "Système Nouveau de la Nature."[49]

The neo-Aristotelian system of deductive sense-certainty, as introduced to the sixteenth century by the gnostic Venetian associates of Gasparo Contarini,[50] is self-obliged by its own formalities to reduce everything to some smallest, discrete, finite, elementary particles. This system regards sense-impressions as virtually mirror-images of a reality outside our skins. Within such a linear materialist system, as for Aristotle himself, neither an intelligible notion of creation, nor of living processes, is logically possible; entropy rules always, everywhere. Formally, for Aristotle, his own existence is, speaking formally, like Newton's "Clockwinder" universe, a logical-mathematical impossibility. If, according to his own system, the historical Aristotle ever existed, that would be sufficient proof that his system had no right to exist. If the prescribed system of knowledge implicitly prohibits the existence of the knower, that system has no right to exist.

The remedy for this fallacy of Aristotle's system was already defined by Plato before the completion of Aristotle's own studies at the Athens School of Rhetoric, the latter headed by the Sophist Isocrates. Negatively, in the sense of Plato's dialectical method of Socratic negation, we can demonstrate rigorously the necessity for the ontological elementarity of negentropy, i.e., for the Platonic elementarity of Heraclitus' notion of universal change. We can also represent this by means of a rigorously Platonic approach to use of constructive geometry, as Cusa thus treated the paradox of Archimedean quadrature. However, we cannot show this positively by means of any among today's generally accepted forms of classroom mathematics; this difficulty is, once again, an echo of Newton's "Clockwinder" paradox.

We cannot render this notion of negentropic elementarity intelligible from the standpoint of sense-certainty. That is key to the formal fallacy permeating that Boltzmann theorem employed by Norbert Wiener's "information theory": that is also the form of the sundry kindred blunders of John Von Neumann, on economy and the human mind.

By means of what faculty can we overcome such paradoxes? Plato provided the general approach needed, but an adequate solution can be achieved only from the standpoint of the Leibniz science of physical economy. The contributions of Cantor, Riemann, and so on, were indispensable, Platonic steps toward my solution of the crucial, relevant issues of an intelligible theory of knowledge; but, *until these preliminary results were situated within the domain of physical economy, no adequate proof of the principles of knowledge is accessible.*

The form of this required solution is indicated by treating this issue in first approximation in its aspect as a problem in physics. A valid axiomatic-revolutionary discovery in natural philosophy is expressed, as customary, in the form of one or more crucial-experimental designs,

experiments which demonstrate the principle of the discovery, each in a crucial way. Each such successful design, adequately refined, supplies a new principle to be incorporated usefully in either sundry machine-tool designs, or some similar use. The application of such designs, accompanied by the transmission of the corresponding new knowledge, expressed as use of improved tools of production, improved products, and so on, results in an increase in the physical productive powers of labor, *per capita* and *per* square kilometer. In other words, an increase in the potential population-density of mankind.

So, the continued successful existence of mankind[51] relies upon the mental processes which generate and replicate valid, newly-discovered, axiomatic-revolutionary changes in scientific and related knowledge. It is by adopting such manifestly creative states of mind, instead of naive sense-certainties, as the subject of conscious reflection, that we may access the pathway leading to the required theory of knowledge. This policy was the pivotal conception which emerged during my inquiries of the 1948-1952 interval, guiding me to my conclusions, through the pathways of Cantor and Riemann.

This emerging overview of the most crucial problem to be solved, prompted me to turn my earlier notions of geometry upside-down. Rather than build up a geometry, by extension, from primitive, linear sorts of axiomatic formal and ontological assumptions, take the reverse course. That which efficiently bounds externally as the relative macrocosm, is to be seen as the relatively elementary. It is the whole so defined which determines the part. This supplied me a corrected notion of the statement: "The whole is always greater than the sum of its parts." This view of the axiomatic structure of geometry-in-general freed my conscience from any further reliance upon accepted forms of classroom mathematics.

The realization that, axiomatically, none of the relevant epistemological paradoxes I was facing could find a model representation in terms of any presently accepted notion of a theory of functions, forced me to focus upon the internal history of mathematical physics, in search of some notion of an ordering-principle among axiomatic-revolutionary discoveries. The obvious place to begin a first attempt is the discovery addressed inclusively, and crucially, in Riemann's habilitation dissertation, the famous, ubiquitous theorem of Pythagoras. After all, obviously, the thirteen books of the *Elements*[52] bring the student from reconstructing that theorem, through, step by step, to Plato's five regular solids inscribed within a sphere. Give up those ordinary notions of denumerable ordering central to all algebraic and transcendental functions; seek a more modest notion of necessary ordering. For every axiomatic-revolutionary discovery, certain other such discoveries are necessary predecessor, and every valid such discovery is a necessary successor of others. Every professionally qualified teacher of mathematical physics employs that guiding notion in constructing efficient lesson-plans.

This approach to, implicitly, teaching mathematics and physics, shifts the focus from learning theorems and their formal proofs, to replicating in the student's mind the experience of each crucial, original axiomatic-revolutionary discovery as this occurred, in essence, in the original case, in the mind of the putatively original discoverer. Instead of treating theorems as the principal subject, make the subject the process of axiomatic-revolutionary discovery as replicably experienced by the student in each case. Make that moment of *Platonic hypothesis-formation* the subject.

Then, next, find the ordering-principle—the Cantorian *equivalence, type*—among a series of such successful acts of hypothesis-formation. Determine, according to such an adduced equivalence, the *type* of ordering of a network-sequence of such hypotheses according to the rule of "necessary predecessor"/"necessary successor."

The following step must be to render that adduced ordering-principle, that *type,* the intelligible subject of conscious comprehension. This is done, in first approximation, by contrasting this scientific method, as a Platonic method, to Aristotelian formalism. The recognition of the incurable fallacy of all Aristotelian and analogous argument, from this standpoint, is the beginning of a true epistemological insight into the required principles governing a scientific method.

That view of the *type* of ordered hypotheses, is rendering the higher hypothesis an intelligible subject of conscious comprehension, in turn. It is at this stage of the process of inquiry, that the crucial features of my definition of negentropy become adequately intelligible; the essential paradox is thus solved.

Reconsider the steps just described.

In a preliminary way, this pedagogical approach to the internal history of science has a well-established basis in Christian Classical humanist secondary education. The case of Groote's Brothers of the Common Life, and, later the Schiller-Humboldt educational reforms, are obvious references.[53] These great Christian humanist educational reforms were reflected also, if in a diluted way, in the later examples of pre-1970, pre-catastrophe, U.S. secondary education.[54] In the better schools, as reflected in traditional professional scientific practice still, the student comes to know an axiomatic-revolutionary, or related discovery of principle by both its approximate date of occurrence, and the personal name (plus a short biographical sketch, perhaps) of the discoverer. I emphasize: that discoverer as an individual thinking person, whose discovery today's student can master only by replicating the mental process

of discovery which occurred in that historic moment of discovery by the original discoverer.

As already noted, a teacher's good lesson-plan must reflect some degree of insight into the matter of arranging topics of principle according to "necessary predecessor"/"necessary successor." The crucial difference of emphasis proposed, relative to such established classroom precedents, is to shift the emphasis from getting to the accepted proof of the theorem, to concentration upon the internal features of the mental process of formulating the relevant hypothesis.

Thus, to each valid, axiomatic-revolutionary discovery assign the name of *hypothesis.* As said above, assign to the idea of an *equivalence* in ordering of necessary successive hypotheses, an *higher hypothesis.*

In the classroom, and here, too, the notion of hypothesis is brought into clearer focus, by contrasting hypothesis with the theorem-proofs of a formal, deductive theorem-lattice. In the latter case, every provable theorem of that more or less indefinitely expandable array will be deductively consistent with a set of axioms and postulates which underlies the initial germ-kernel of theorems of that lattice.

Let us denote such deductive consistency of formal theorem-lattices by a term borrowed from the customary usage of our adversaries, "hereditary principle."[55] Every possible theorem of a consistent theorem-lattice will be nothing but a reflection of the original body of "genetic material," the underlying set of axioms and postulates. The *Platonic hypothesis,* generated by the Platonic dialectical method of Socratic negation, overturns one or more of the axioms and postulates of any theorem-lattice of reference.

Thus, for the hereditary form of theorem-lattice, the theorem-proof of deductive consistency is the characteristic mental activity of the student. Once we introduce true discovery, and therefore *hypothesis,* theorem-proof is submerged; creative mental activity as such is everything. It is in this latter domain of conscious thought, and only here, that my notion of negentropy becomes adequately intelligible.

The challenge immediately presented at that juncture in our argument is the following: *If we abandon formal theorem-proof, as we must (since we are replacing axioms or postulates), what is the nature of proof of hypothesis?* The required proof has two fundamentally distinct aspects, two aspects which ultimately dissolve into one another, but not at first consideration.

For the student, the first kind of proof encountered is study of crucial discoveries from the past. Once that student has adduced a sense of the equivalence (higher hypothesis) of valid past discoveries of an axiomatic-revolutionary quality, the student's first resort, at each confronting of an unfamiliar such discovery, is to test that discovery for its quality of Cantorian *equivalence.*

Later, that student may acquire a second notion of proof, a proof rooted in the Leibnizian notion of a science of physical economy. If an hypothesis satisfies the standard of equivalence, and also increases implicitly humanity's potential population-density, it is *relatively valid.*

These two proofs merge into one historically. The equivalence among past discoveries (hypotheses) reflects the test of an implicit increase of mankind's potential population-density.

That is the general principle of the relevant theory of human knowledge, but only in one aspect, natural science.

V.
Language and Negentropy

This brings us to the last of the principal issues posed by Wiener's "information theory," to the subject of communication of ideas. We focus upon the idea of a language in its most general sense of a medium for communicable aspects of ideas. Within that setting, we treat the crucial special case of ideas which, by their nature, cannot be communicated literally. Consider the case for those ideas which correspond to Platonic hypothesis.

Since all ideas are subsumed by the notion of metaphorical communication of ideas of hypothesis, and, since language as a whole is bounded thus by those same principles, the notion of metaphorical provocation of hypothesis is the crucial case for all communication.

In the instance of every new Platonic hypothesis, language appears primarily as a mode of posing paradoxes to such effect that a speaker's new idea, which cannot be identified literally in existing language, can be replicated nonetheless in the mind of the hearer.[56] This leads us to the broader proposition, that *ideas* are not *primarily* sensual imageries, but are, *primarily, elementarily,* those valid, intelligible conceptions which cannot be named at first communication by a recognizable term of established usage. That is to say, that all valid ideas first appeared to existing language in no other form of communication but metaphor. Among such new ideas, the highest class, subsuming all other classes, is that of axiomatic-revolutionary ideas. Ideas of this class refer to a quality of sovereign mental activity within the speaker, an idea whose form is that of, variously, Platonic hypothesis, higher hypothesis, or hypothesizing the higher hypothesis. For reasons outlined above, all ideas were introduced to language first in the guise of metaphor. Then, and, even after many gen-

erations of use, those ideas were, and are still subject to those same functional notions of idea demonstrated by the case for Platonic hypothesis.

Perhaps the best illustration of metaphor, is the paradoxical quality of Plato's *Parmenides.* The same principle so shown by the *Parmenides,* is employed as the central feature of Nicolaus of Cusa's original solution to the ontological paradox of Archimedean quadrature.[57] *The metaphor* is the ontologically required, indivisible concept which unifies a paradoxically juxtaposed set of predicates for the case the latter reflect the same function. For Plato's *Parmenides,* the indivisible *one* is always existent in *the ontological form of change,* Heraclitus's ontologically unique quality of *universally elementary change.* The form of this change may be compared to Cantor's principle of transfinite *equivalence;* for Cantor's mathematics, Heraclitus's *change* is the highest *type* in Plato's universal *Becoming.* In Cusa's titles *De Docta Ignorantia*[58] and "De Circuli Quadratura,"[59] the passage from the "Parmenides paradox," of an endless series of regular polygons, to the circular perimeter as an ontologically higher form of an axiomatic existence, is characterized by a shift from Euclidean space, to the higher, non-algebraic domain of space-time; the axiomatic *least-action,* or *isoperimetric* definition of the circle is closed *action* expressing a constant change, and *equivalence,* a higher *type* than formal Euclidean geometry, or algebra.

In both cases, Plato's *Parmenides* and Cusa's axiomatic-revolutionary treatment of quadrature, we are presented with examples of a true metaphor in approximately the barest-bones form of representation. *Cusa's non-algebraic generation of the circle, as constant change, is the metaphor represented by Archimedean quadrature.* That circle's existence cannot be competently defined in the axiomatic framework of ordinary Euclidean geometry; to construct a circle, we must employ a ruse of construction excluded from the underlying set of axioms and postulates of Euclidean theorem-lattice. We must employ *rotation,* as one does by drawing the circle with a compass. Rotation is the ordering of *action* in *non-algebraic space-time,* not Euclidean space.

This cannot be brushed aside with the argument that I am stretching a point here. There is a four-hundred-fifty year, connected historical development, from the origin of Cusa's discovery, through Leonardo da Vinci, Kepler, Fermat, Huygens, Leibniz, Bernoulli, and then to Hermite, *et al.* at the close of the nineteenth century, to define rigorously the transcendental distinction of π.[60] It is often, that proverbial, smug hand-waving at the blackboard is employed to evade even the most devastatingly crucial issues. Such has been the long, stubborn refusal to acknowledge that rotation is, axiomatically, ontologically external to a formal Euclidean theorem-lattice, or, as Augustin Cauchy's calculus has often been read to evade, the truth is that asymptotic limits are not theorems of the theorem-lattice employed to describe the relevant function.

All formal language, such as a grammatically literate spoken language, is laden with equivalent axiomatically ontological limits. Thus, contrary to the nominalists, all important ideas are introduced to a subsequent state of communicable recognition by means of initially metaphorical identification.

Those were the considerations, although more crudely formulated at the time, which obliged me to include in my 1948-1952 work on negentropy a corresponding treatment of the principal characteristics of metaphor in communication. For the purpose of this study, I chose then musical settings of poetry which had been composed during the 1780-1900 interval. The composers selected were chiefly Mozart, Beethoven, Schubert, Schumann, Loewe, Brahms, and Hugo Wolf. The central sub-topic of this study was two or more alternative musical settings of the same poem. The poets upon whom I concentrated were Goethe and Heine. The focus was upon the use of musical forms of metaphor in relationship to the natural musical vocalization in hearing and the poetic enunciation of the spoken line.

Later, beginning 1982, at my urging, aspects of my 1952 results were reconstructed with improvements by some of my musician associates. The latter study, of the 1982-1991 interval, is reported in the recently published Book I of *A Manual on the Rudiments of Tuning and Registration.*[61] The object of both this latter and the original study was to show the connection between creativity *per se*'s expressions in both the domain of natural philosophy and Classical art-forms. To treat the implications of negentropy for communications in general, thus to refute "information theory" adequately, it was necessary to demonstrate a relevant degree of *equivalence* of creativity *per se* in one medium to that in the other.

As I have identified this recently in "History as Science,"[62] the case of the Indo-European language family shows language in general to be premised centrally upon three elements.

First, the spoken language as typified by reading Classic Vedic hymns and Sanskrit from the standpoint of philologist Panini.[63] This working assumption of the 1948-1952 period was referenced then chiefly to the Classical English-language poetry, from Shakespeare through Shelley and Keats. Years later, the argument was given a selected crucial test against the Italian of Dante Alighieri's *Commedia.*

Second, the visual space-time field of geometry. This correlates with the most essential feature of spoken action, the transitive verb. By this use of the verb, we are

able to locate qualities of transformation in space-time.

Third, music. All spoken language is governed by musical principles, even in the rudest of violations of those principles.[64] The application of this to choral singing among naturally determined different species of singing voices is again *bel canto polyphony. Bel canto polyphony* determines faultlessly a well-tempered tuning of the temper used by Bach, Mozart, Beethoven. This is determined by the natural harmonics of the biological speaking and singing apparatus of human beings all as members of but a single species. Thus, the system of well-tempered, Classical,[65] *bel canto* polyphony was not an historical accident of taste preferred only by some people, in some time and place. This was the musical medium implicitly ordained by God; it is implicitly imbedded in the genotype common to all members of the human species, past and present. The same argument governs the principles of *vocalization* of a spoken form of language.[66] Music is derived from the natural vocalization of Classical forms of poetry, as the Vedic hymns typify this general case.

It should be interpolated here, as a relevant point to be stressed. "Text" in the sense the term is used by "Deconstructionists" such as Jacques Derrida, does not—or, certainly should not—exist.[67] As the pagan god was reminded, his invention of writing was useful, with some potentially disastrous side-effects, of which Derrida is one. Written text should be heard by the writer and reader as it is being read, or written. The music—the vocalization of the spoken word, as shadowed on the written page—is an integral part of speech, as the geometry of space-time is also an integral part of speech, as Plato was first to show, as Leonardo da Vinci and Kepler later emphasized.

Fifty years ago the following point was not considered further than our present account has gone up to this moment. Even this much of the treatment of relevant musical matters so far, already includes some supporting material dating from times later than 1952. This, and the point now to be added respecting Plato's regular solids, are included here as they provide crucial supporting evidence for those conclusions respecting the theory of knowledge already reached, if on a narrower basis, forty years ago.

The Classical Greeks, who knew well-tempering in Plato's time,[68] recognized, more broadly, that natural beauty in art was characterized, in vision and in hearing, by harmonic orderings consonant with those of living processes. The whole design of the Classical Athens Acropolis attests to this.[69] Plato documents this.[70] Two key followers of Nicolaus of Cusa, Luca Pacioli and Leonardo da Vinci, demonstrate[71] that; Johannes Kepler bases the beginnings of a comprehensive mathematical physics upon the common harmonic characteristics of vision, music, and Plato's five regular solids. In modern language, this current in mathematical physics indicates Kepler to be the initiator (guided by Pacioli and da Vinci) of what is most fairly named today "quantum field theory."[72]

We are speaking of a theory of knowledge. We are gauging these queries against Riemann's referenced warning, on the subject of the metrical features of a continuous manifold. Thus: how can man come to know the crucial implications of the five Platonic solids? What is the nature of the available evidence on this matter? What was available to Plato's Classical Athens?

We have referenced the Acropolis. The Greeks knew the principles as artistic, and architectural proportions according to an harmonics of circular sections. They recognized, thus, as natural visual beauty harmonic orderings consonant with that Golden Section which is characteristic of Plato's five solids. This Golden Section-pivoted harmonics was recognized, as by da Vinci[73] and Kepler[74] later, as that characteristic which distinguished living from non-living processes. It is the metrical characteristic of actions governed by negentropy, as I defined negentropy, earlier here, and forty-odd years ago. The Golden Section was also recognized by Plato, for example,[75] as the characteristic of musical training. We have just considered the natural basis for that well-tempered system of *bel canto* polyphony, congruent with the Golden Section, which is implicitly determined by the human genotype. In short, vision and hearing are the imbedded metrical guides to our communicable forms of representation of our universe, in terms of the Golden Section's implications. Nonetheless, it is in the implicitly well-tempered underlay of the determination of a least-action mode of vocalized speech and singing, where lies the aspect of language in which this metrical principle of thinking is imbedded. The well-tempered, *bel canto* polyphonic domain is the model for a quantum field, the model for a quantum-field conception of the metrical qualities of our physical space-time universe.

That leads directly to the principal point respecting a theory of knowledge.

Knowledge is accessible to mankind only in the forms corresponding to a theory of Cantorian *types,* in terms of hypothesis, higher hypothesis, and hypothesizing the higher hypothesis. We can know only *change,* the notion of universal elementarity of change which is associated with the writings of Heraclitus and Plato. That change is known to us in terms of *hypothesis,* or, in Cantor's terms, *types.*

However, the distinction between truthfulness and falsehood, respecting principles of nature, requires an experiment, an experiment which can be of but one *type,*

physical economy as the practice of maintaining progress in increasing the potential population-density of mankind. This is uniquely the form of experiment which tests the relative validity of those choices of higher hypothesis (*types*) which govern the generation of those axiomatic-revolutionary discoveries which foster increase of potential population-density.

Thus, the popularized notion of "objective science" is so dangerously misleading that we must regard it as absurd, or even worse. Knowledge is *subjective,* in the sense that we must act upon principles of discovery which can be known to us only by proving their validity in practice in terms of the benefit to mankind as a whole, a benefit which is crucially centered upon the requirement of the continuing increase in the potential population-density of our species as a whole.

The source of our personal knowledge to this effect, is the reliving of history from this standpoint. The idea of a Christian Classical humanist education, such as that of Groote's Brothers of the Common Life, or the Schiller-Humboldt reforms, the reliving of moments of great, axiomatic-revolutionary discovery, as if to replicate that moment from within the mind of the original discoverer in one's own mind, is a typification of the relevant way in which the child and youth must be developed morally and formally at the same time.

By means of such an education, emphasizing the principles stated here, the mind of the child and youth, repeatedly experiencing the replication of valid axiomatic-revolutionary hypotheses in this way, is enabled to apply the same mental capacity, of hypothesizing, to the ordering ("necessary predecessor,"/"necessary successor"), the Cantorian equivalence of a series of valid hypotheses. Thus, this latter equivalence, or higher hypothesis, is the proper referent for the term *scientific method.* Since conflicting *scientific methods* may be compared by the same method of hypotheses, the student's mind is equipped, and thus impelled to enter into consciously hypothesizing the higher hypothesis.

This activity within the individual defines a self-critical capability in respect to all aspects of his or her individual practice, and to observing the manifest mental processes and characteristic practice of others, including entire nations and cultures, past, present, and prospective future. Thus, by this developed subjective mental discipline, which is the proper notion of the scientific faculty, the individual judges relative truth, relative falsehood, right and wrong, superior and inferior qualities, and kindred judgment of those qualities for which mere "matters of taste" are not to be tolerated by a people which prizes its own continued moral fitness to survive.

From this relative knowledge, we are assured of a few things of an essential practical importance respecting absolute matters.

For example, Cantor references this domain by equating his own *transfinite* to Plato's *Becoming,* and his *absolute* to Plato's *Good. Becoming* is *physical space-time,* in which development occurs through *change.* Absolute, or Good, is reflected in the process of Becoming, as a process of perfecting, conceived as a perfected instant, a *One,* everywhere more than co-extensive with the Becoming. That said, return to the Becoming, and to those notions which have a relatively changeless quality, relative to the marginal uncertainty of approximations.

Once we grasp the idea, that man is distinguished absolutely above all other living creatures, solely by our willful capacity for effecting voluntarily axiomatic-revolutionary improvements, increases in mankind's command over nature, that voluntary creative activity, the activity of *Platonic hypothesis,* that axiomatic-revolutionary activity, compared with the resulting change in man's *per-capita* power over nature, is the phenomenon to which all rational employment of the term "knowledge" is referenced.

It is not the observed relations among sense phenomena, which is the subject of knowledge. The proximate subject of knowledge is the *changes* in sensory phenomena's patterns of behavior which have been, are being effected cumultatively, historically, through the creative faculty of hypothesis generation. It is the relationship of such changes to increases in potential population-density, and to man's breaking through barriers of technology, to make richly habitable the deserts, or barren planets beyond our own, which test, historically to present date, those adducible principles of higher hypothesis which are thus shown to be the most reliable known choices of guides to truth respecting man's relationship to nature.

All along, there are certain virtually absolute social truths, with the moral force of *natural law,*[76] embedded in the cumulative evidence of historically successful, Platonic higher hypothesis.

First, the sacredness and lawful sovereignty of the individual person's life, by reason of that creative faculty expressed as Platonic hypothesis.

Second, the subsumed sacredness of the parental household, for its interdependent loving (*agapic*[77]) functions of procreation and nurture of new, individual personalities through the ages of infancy, childhood and youth, to blossoming as a young adult with developed creative powers.

Third, the derived sacredness and functions of those institutions we know as republics under *natural law,* those more powerful, less mortal agencies whose function is to defend the sacredness of individual creative life, to defend the institution of the parental household, and to foster and protect the benefits of creative individual work

to the advantage of all present and future generations of mankind.

The Monad

We now come to certain concluding points of summation so crucially important, that I must set them somewhat apart from the immediately preceding pages of this concluding section. The first of these is my fresh proof of the *monad*.

Consider, from the standpoint of language as I have defined language: How do we know with the authority of necessary and sufficient reason, that man possesses an individual soul? It is most appropriate to state the case of the monad in that form, because for Gasparo Contarini's Aristotelian cronies, such as the exemplary Pomponazzi, for all consistent Aristotelians, the individual soul could not exist. Thus, for all empiricists, and other neo-Aristotelians, the individual soul does not exist, but rather a "bolshevik," e.g., a "collective soul." For whomever rejects the notion of Platonic hypothesis, the individual soul cannot exist; that is the functional connection I am stressing here.

Turn to our earlier treatment of the subject of metaphor.[78]

Any idea, in its guise either as an original discovery, or in its transmission *de novo* as it might have been an original discovery, cannot be transmitted as a literal intent of the language-medium employed, but only as the intent which reposes in the individual user of that language. The idea cannot be addressed by any formal analysis of the language-medium employed. This predicament is a consequence of the fact that any true discovery corresponds to a formally absolute discontinuity in any system of deductive representation previously employed. Relative to language as such, true ideas lie only in the individual, creative mental processes of each person participating in the communication.

This illustrates, and also demonstrates implicitly the relationship between a true, i.e., negentropic continuous manifold and individual existence of the form shown as the originally metaphorical character of all communicated ideas. The truth on this point has been right under everyone's nose for millennia past. Here lies the kernel of Leibniz's *Monadology,* and my own. Here lies the key to exposure of a *politically corrupted* Leonhard Euler's perversely falsified attack upon Leibniz's *Monadology.*[79] The crucial point here is this; no idea corresponding to a Platonic hypothesis may be communicated to another person except as metaphor; no language can explicitly, literally transmit a true idea. Ideas are transmitted by aid of use of language, but this in a manner comparable to the common features of Plato's *Parmenides* and Cusa's solution for the paradox of quadrature. *Ideas* do not exist among individuals, but only within individuals. They exist within individuals only by being generated *de novo* within each person. They may be communicated only by use of paradox, i.e., metaphor, to provoke the replication of the original generation of the idea within, and by means of the sovereignly individual creative mental, hypothesis-generating processes of that individual person.

That shows us the following. By virtue of the creative-mental, hypothesis-generating processes of the person, *each and all persons are singularities within, of the physical space-time domain.* They are *higher monads.* That point is crucial. This next is also crucial.

The form of both higher hypothesis, and hypothesizing the higher hypothesis, is the form of negentropy as I have defined negentropy in opposition to Wiener *et al.* Thus, to take higher hypothesis as a subject of conscious reflection is to be conscious of this form of negentropy *as an object of conscious thought,* a *thought-object.*[80]

This next is also crucial, similarly.

Also, that which defines the individual person as having intelligibly a personal soul, is the principle of Platonic hypothesis. To wit: the reason Aristotelians could never solve, or even comprehend the *Parmenides* paradox is not only that the joke against the Eleatics is equally applicable to Aristotle and to Sophists generally. The reason no language could communicate ideas literally is that ideas are generated by functions of discontinuities, that ideas are characteristically of the domain of higher transfinite types. This is the characteristic of negentropy; this is also the proof of the uniqueness of the individuality of the *monad,* of the person.

This next, then, is also crucial.

The idea of a true continuum must be nothing other than a continuous function of hypothesis-generation, an higher hypothesis. That higher hypothesis must be of the characteristic form of negentropy, a form equivalent to the verb "to create."

This next crucial argument follows.

All true human knowledge is of the form of hypothesizing the higher hypothesis. Thus the forms of this process of generating knowledge are the forms equivalent to knowledge of the real world, that real world which is mankind *increasing its per-capita* power over physical space-time. That increasing is the equivalence of the higher hypothesis as itself a process. That process, taken as a subject of willful consciousness, is human knowledge, is *science* in the most comprehensive meaning of the term science since the work of Cusa and Leibniz.

Next, the crucial issue here: that which is elementary within the process of conscious knowledge, defined in this way, is the idea which corresponds to what is elementary in that transfinite universe of Becoming which lies outside our skins.

From the side of language which corresponds to geometry, metaphor addresses a universe which is *elementarily negentropic change*. This view of *elementarity,* opposite to that of the neo-Aristotelian materialists Bacon, Galileo, Newton, *et al.,* is the sure-footed advantage gained by shifting consciousness from obsessive fixation upon sense-certainties, to a consciously critical examination of those internal mental processes by means of which supposed, and real knowledge is generated. That is the shift from the blind, mystical materialist faith in the elementary particles of Democritus and Lucretius, to the elementary reality of change as such. This is a formal solution for the continuum paradox. Summarize that solution as follows. In place of simply a Platonic view of Heraclitus' "nothing is permanent but change," say "Nothing is permanent but change subsumed by continuing negentropic action," defining *negentropy* as I have defined it in opposition to the statistical vulgarization employed by modern, post-Mach positivists[81] such as Wiener and Von Neumann.

To restate the underlying, applicable argument from the domain of the theory of knowledge, *knowledge* is a term properly restricted in use to identify our own minds' conscious image of those of its own cognitive processes which, as a Cantorian *type,* account for the increase historically of man's increased power over nature, *per-capita* and *per*-square kilometer of our planet's surface.

This leaves one correlated topic of language to be considered at this juncture, the notion of the *quantum field,* as that notion is to be traced from Plato's treatment of the five Platonic solids, through the modern work of Pacioli,[82] da Vinci,[83] and Kepler.[84] The special connections to language now to be stressed here, is the fact that the principles of well-tempered polyphony were already natural principles of human speech and singing even before the first human language were developed. That is to say, implicitly, that this well-tempered quantum field is already a natural characteristic of the mental image of our speaking and hearing any spoken (or, sung) language. This heard characteristic of those language images correlates to such expressions as the Golden Section with the visual, i.e., geometric facet of language. In the field of vision, this notion of quantum field is also associated with the notion of qualities of color attributed uniquely to respectively partitioned sectors of an ostensibly continuously defined frequency-domain of the visible field. We may thus speak, in this sense, of innate ideas, ideas which appear to us as comprehensible, intelligible ideas only from that higher consciousness of our own conscious processes which is Plato's hypothesizing the higher hypothesis.

Thus, the notions of *monad, negentropy,* and *quantum field* are innate ideas whose existence and nature are susceptible of being rendered intelligible to us, if we look at the use of language as a medium for generating those forms of metaphor needed to communicate valid, genuinely creative discoveries of principle by individual persons. If we employ the contributions of such figures as Plato, Cusa, Leibniz, and Cantor to assist us in making ourselves conscious of our own conscious processes, in terms of hypothesis, higher hypothesis, and hypothesizing the higher hypothesis these innate and related ideas are made intelligible to us.

To the degree the human creative processes have been educated, through aid of reliving original acts of creative discovery over a long span of history, to define higher hypothesis governing new discoveries of principle for human practice, that individual mind, seeing its own relevant conscious activity of hypothesis-generation in that way, in that context, is seeing there a mirror of the lawful universality of our universe in its aspect as Platonic *Becoming*. It is in that view of matters that proper notions of knowledge in general, and scientific principles more narrowly, are to be adduced.

NOTES

1. *Cf.* Norbert Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine* (New York: John Wiley, 1948); 2nd ed., (Cambridge, Mass: M.I.T. Press, 1961).
2. Georg Cantor, "Beiträge zur Begründung der transfiniten Mengenlehre," in *Georg Cantors Gesammelte Abhandlungen,* ed. by Ernst Zermelow (Hildesheim, 1962), pp. 282-356; English translation: *Contributions to the Founding of the Theory of Transfinite Numbers,* trans. by Philip E.B. Jourdain (1915) (New York: Dover Publications, 1941).
3. Bernhard Riemann, "Über die Hypothesen welche der Geometrie zu Grunde liegen," in *Mathematische Werke,* 2nd ed. (1892), ed. by Heinrich Weber in collaboration with R. Dedekind. English translation: "On the Hypotheses Which Lie at the Foundations of Geometry," in David Eugene Smith, *A Source Book in Mathematics* (New York: Dover Publications, 1959), pp. 411-425.
4. From late 1979 to the close of 1983, the international newsweekly *Executive Intelligence Review* produced a quarterly economic forecast based upon the *LaRouche-Riemann method*. This report was constructed quarterly from, primarily, a GNP-defined data-base, using a set of constraints supplied by this author. During this peri-

od, that was the only consistently reliable published forecast available from any U.S. source. This forecasting was discontinued during early 1988, at this author's recommendation. The margin of fakery in U.S. government and Federal Reserve System data rendered any report using such data worthless. See"Riemannian analysis predicts industrial top shutdown," *Executive Intelligence Review,* Vol. VI, No. 41, Oct. 23-29, 1979; and "'Spectral Analysis' of Collapse," *New Solidarity,* Vol. X, No. 71, Nov. 9, 1979, p. 8.

5. See G.W. Leibniz, "On the Establishment of a Society in Germany for the Promotion of the Arts and Sciences" (1671) and "Society and Economy" (1671), *Fidelio,* Vol. I, No. 2, Spring 1992 and Vol. I, No. 3, Fall 1992.
6. For John Von Neumann's initial proposal to simulate economics and other "social phenomena" by sets of linear inequalities, see "Zur Theorie der Gesellschaftsspiele," *Math. Ann.* 100, 1928, pp. 295-320, reprinted in *John Von Neumann: Collected Works* (New York: Pergamon Press, 1963), Vol. V, pp. 1-26. See also, John Von Neumann and Oscar Morgenstern, *The Theory of Games and Economic Behavior* (Princeton, N.J.: Princeton University Press, 1944); and Von Neumann's posthumously published *The Computer and the Brain (Silliman Lectures)* (New Haven: Yale University Press, 1958).
7. Sir Isaac Newton states in his famous four theological letters to the Reverend Dr. Richard Bentley: "That gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a *vacuum,* without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it. Gravity must be caused by an agent acting constantly according to certain laws, but whether this agent be material or immaterial I have left to the consideration of my readers. . . ."; cited in *Newton's Philosophy of Nature: Selections From His Writings,* ed. by H.S. Thayer (New York: Hafner Press, 1953), pp. 54-57. See also Samuel Clarke's defense of Newton in "The Controversy between Leibniz and Clarke," footnote 8 below, p. 1104. This point is alluded to by Newton in both the General Scholium to his *Principia* (*Mathematical Principles of Natural Philosophy*), and in the concluding Quest. 31 (Book Three, Part I) of his *Opticks.*
8. See G. W. Leibniz, "The Controversy between Leibniz and Clarke," in *Gottfried Wilhelm Leibniz Philosophical Papers and Letters,* ed. by Leroy E. Loemker (Chicago: University of Chicago Press, 1956), vol. II, pp. 1095-1169, for the problem of Newton's "Clockwinder."
9. See G. W. Leibniz, *Monadology,* trans. by George Montgomery (LaSalle: Open Court Publishing Co., 1989).
10. See Lokamanya Bal Gangadhar Tilak, *The Orion; Or, Researches into the Antiquity of the Vedas* (1893), 5th ed. (Poona: Shri J.S. Tilak, Tilak Bros., 1972), and *The Arctic Home in the Vedas, Being Also a New Key to the Interpretation of Many Vedic Texts and Legends* (1903) (Poona: Tilak Bros., 1956). Astronomical observations recorded in certain amongst the ancient Vedic hymns place their date of composition at an outside limit of approximately 6,000-4,000 B.C. (*The Orion*); more speculative indications of earlier, Arctic astronomical observations in these sources, would push back fragments of these hymns to the period no later than the climate shift accompanying the ending of the last Ice Age (*Arctic Home*).
11. The British holist biologist Joseph Needham, whose encyclopedic writings on the history of science and technology in China dominate twentieth-century scholarship, went to great lengths to discredit or cover up the discoveries made in the nineteenth century concerning ancient Chinese astronomy. The French scientist Edouard Biot and the Dutch philologist Gustav Schlegel, proved from evidence in the Confucian classics that astronomical science was already highly developed in the third millennium B.C.; and Schlegel's research led him to hypothesize that significant mapping of the heavens existed at the extremely early date of the sixteenth millennium B.C. Needham, while acknowledging the authority and competence of these scientists, labeled their findings as "quite absurd" and "purely legendary," lying that they had little support and that they "served to discredit what real historical research might reveal"—this because, in keeping with British historiography, Needham insisted such knowledge had necessarily to be "derived from Babylonian sources." See Joseph Needham, *Science and Civilization in China* (London: Cambridge University Press, 1954), Vol. III; Edouard Biot, *Le Tcheou-Li: ou, Rites des Tcheou,* traduit pour le premier fois du chinois par feu Edouard Biot (Paris: 1851) (Taipei: Ch'eng Wen Publishing Co., 1969); Gustav Schlegel and Dr. Franz Künert, *Shu King Finsterniss,* Journal V.K.A.W.A.-L, Amsterdam, 1890; Gustav Schlegel, *Uranograthie Chinoise* (Leyden and The Hague: 1875).
12. The Golden Renaissance of the fifteenth century is centered around the 1439-1440 Council of Florence as the principal event. Nicolaus of Cusa is the principal figure of that period, whose work on science directly shaped the work of such figures as Leonardo da Vinci and Luca Pacioli and indirectly thus the entire school of Raphael and also the work of Kepler.
13. Pietro Pomponazzi (1462-1525); philosopher who enjoyed the patronage of the Contarini family, he studied and taught at the University of Padua. Pomponazzi took Averroës as his point of departure, and by dichotomizing discourse into the philosophical and the religious, argued that according to reason the soul must die with the body, but according to the teaching of Christianity, we know it to be immortal; this argument appears in his major work, *De Immortalitate Animae (On the Immortality of Souls)* (Bologna: 1516). See *The Renaissance Philosophy of Man,* ed. by Ernst Cassirer, Paul O. Kristeller, and J.H. Randall (Chicago: University of Chicago Press, 1948); also see *Studi su Pietro Pomponazzi,* ed. by B. Nardi (Florence: 1965).
14. Francesco Zorzi (or Giorgi), a Franciscan friar descended from the patrician Zorzi family of Venice. Authored *De Harmonia Mundi* (1525), a mystical work with elements deriving from the Cabbala. Zorzi supported the arguments of King Henry VIII of England when Henry sought the annulment of his marriage to Catherine of Aragon, and he was called to the English royal court, where he remained active between 1531 and his death in 1540. Zorzi was a proponent of a satanic and pseudo-Platonic school of mysticism called Rosicrucianism, which became an important component of English and British Freemasonry.
15. See Nicolaus of Cusa, *De Docta Ignorantia* (*On Learned Ignorance*), trans. by Jasper Hopkins as *Nicholas of Cusa on Learned Ignorance* (Minneapolis: Arthur M. Banning Press, 1985).
16. *Ibid.,* Book I, chap. 3, pp. 52-53.
17. See Nicolaus of Cusa, "De Circuli Quadratura" ("On the Quadrature of the Circle"), German trans. by Jay Hoffman (Mainz: Felix Meiner Verlag); see this issue, English trans. by William F. Wertz, Jr., p. 56.
18. As noted in the text below, there is a precise equivalence as to method between the *Parmenides* dialogue of Plato and the method employed by Nicolaus of Cusa to make his discovery in connection with his reading and reconstruction of Archimedes' treatment of quadrature.
19. See the celebrated image of the Divided Line in Plato's *Republic,* in *Plato: The Republic,* Loeb Classical Library, trans. by Paul Shorey (Cambridge: Harvard University Press), vol. II, Steph. pp. 507a-511e, esp. p. 510a-e.
20. See Lyndon H. LaRouche, Jr., "On the Subject of Metaphor," *Fidelio,* Vol. I, No. 3, Fall 1992, pp. 18-20; see also, Nicolaus of Cusa, "De Circuli Quadratura," *op. cit.*
21. See Johann Bernoulli, "Curvatura radii in diaphanis nonuniformibus. . ." ("The curvature of a ray in nonuniform media, and

the solution of the problem to find the brachistochrone, that is, the curve on which a heavy point falls from a given position to another given position in the shortest time, as well as the construction of the synchrone or the wave of the rays"), *Acta Eruditorum,* May 1697; trans. in D.J. Struik, *A Source Book in Mathematics, 1200-1800* (Princeton, N.J.: Princeton University Press, 1986), pp. 391-396.

22. *Ibid.*
23. Georg Cantor, *Beiträge, op. cit.*
24. Bernhard Riemann, "On the Hypotheses Which Lie at the Foundations of Geometry," *op. cit.,* pp. 422-425.
25. This view of potential population-density connotes a higher definition of our human species: first, as man in our solar system, and, next, as galactic man yearning toward a universal mankind.
26. See Kurt Gödel's "Richardian paradox," in Kurt Gödel, *On Formally Undecidable Propositions of* Principia Mathematica *and Related Systems,* (New York: Dover, 1992); also "The Consistency of the Axiom of Choice and of the Generalized Continuum Hypothesis," *Proceedings of the National Association of Science U.S.A.,* 24 (1938), pp. 556-557. See also Ernest Nagel and James R. Newman, *Gödel's Proof* (New York: New York University Press, 1958), pps. 60-63, 66, 85-86. Gödel directly refuted Von Neumann's "finitist approach" approach in a letter published in *The Theory of Self-Reproducing Automata,* by John Von Neumann, edited and completed by Arthur W. Burks (Urbana and London: University of Illinois Press, 1966), pp. 53-59. Gödel points out in this letter to Burks that Von Neumann's approach is "in line with the finitistic way of thinking," like that of Alan Turing. In remarks published postumously in *Kurt Gödel: Collected Works* (New York: Oxford University Press, 1990), vol. II ("Some remarks on the undecidability results 1972a" and "A philosophical error in Turing's work"), Gödel states that "Turing in his 1937, p. 250 (1965, p. 136), gives an argument which is supposed to show that mental procedures cannot go beyond mechanical procedures. However, this argument is inconclusive. What Turing disregards completely is the fact that *mind, in its use, is not static, but constantly developing. . . .*" See footnote 6 for relevant works of Von Neumann.
27. For *type,* see Georg Cantor, *Beiträge, op. cit.*
28. Nicolaus of Cusa, "De Circuli Quadratura," *op. cit.*
29. See Bernhard Riemann, "Zur Psychologie und Metaphysik," on Herbart's Göttingen lectures, in *Mathematische Werke,* posthumous papers, *op. cit.*
30. As cited by Plato in *Cratylus,* in *Plato: Cratylus, Parmenides, Greater Hippias, Lesser Hippias,* trans. by H.N. Fowler, Steph. p. 402a; for Heraclitus, see G.S. Kirk and J.E. Raven, *The Presocratic Philosophers,* pp. 184-187, 197-198.
31. See Lyndon H. LaRouche, Jr., "Project A," Appendix XI, "Euler's Fallacies on the Subjects of Infinite Divisibility and Leibniz's Monads," in *The Science of Christian Economy and Other Prison Writings* (Washington, D.C.: Schiller Institute, 1991), pp. 407-425.
32. See Georg Cantor, "Über trigonometrische Reihen," in *Gesammelte Abhandlungen mathematischen und philosophischen Inhalts,* ed. by E. Zermelo (Berlin: J. Springer, 1932; reprinted Hildesheim: Olms, 1966).
33. Here, "modern" signifies the period of Western European civilization beginning approximately A.D. 1400. This style emphasizes that both modern science and the modern form of nation-state republic were founded during the fifteenth century, both as leading, interdependent features of Europe's recovery from the rubble of the fourteenth-century "New Dark Age."
34. See, e.g., Plato's *Republic, op., cit.,* Steph. pp. 505a-520e.
35. See footnote 19.
36. *Ibid.* It is most relevant to note that this Platonic theory of knowledge permeates the philosophy of Plato-student Leibniz, his *Monadology* emphatically; this *monad* also appears under the rubric of *Geistesmassen* in Bernhard Riemann's posthumously published notes on Herbart's Göttingen lectures (see footnote 29).
37. For example, in 1952 this author first described the Classical *lied*'s interface between music and poetry as a "Rosetta Stone," in connection with a project refuting Norbert Wiener *et al.* on "information theory." See Lyndon H. LaRouche, Jr., "History As Science: America 2000," *Fidelio,* Vol. II, No. 3, Fall 1993, p. 32ff.
38. See Lyndon H. LaRouche, Jr.,"The Science of Christian Economy," in *Christian Economy, op. cit.,* pp. 221-223.
39. See Lyndon H. LaRouche, Jr., "The Science of Christian Economy," *op. cit.,* pp. 263-266; "On the Subject of God," *Fidelio,* Vol. II, No. 1, Spring 1993, pp. 24-33; and "History as Science: America 2000," *op. cit.,* pp. 60-64.
40. Man's existence in the solar system is measured relative to the surface of the planet Earth.
41. At the time of the French Revolution, Jeremy Bentham (1748-1832) was employed by British East India Company executive and British Prime Minister Shelburne to run a "radical writers shop" at Shelburne's Bowood estate. Bentham and another East India Company operative, Samuel Romilly, penned many of the speeches that were delivered by Jacobins Marat and Danton during the height of the Paris revolt. It was essential for Shelburne and Bentham that the French republican, pro-American forces be crushed, and France be prevented from adopting a constitutional form of government modeled on the U.S. Constitution. Thus, while supporting the ultra-monarchist forces around Count Mirabeau, the British East India Company simultaneously provided covert financial aid to the Jacobins. Records of payments to Marat, Danton, and other Jacobin leaders are still on file at the British Museum.
42. The systematic destruction of France's Ecole Polytechnique is a leading example of how the Congress of Vienna's cultural policies were imposed. The Ecole had been the world's leading and most vigorous center of advancement of the physical sciences during the 1794-1814 period, under the leadership of its founder, the great Gaspard Monge. Through political intervention, Pierre Simon, Marquis de LaPlace and LaPlace's protégé Augustin Cauchy were assigned to destroy the Ecole's instructional program, exemplified in the notorious cases of Niels Heinrik Abel and Evariste Galois, both of whose work was first suppressed and then plagiarized, following the victims' early deaths. LaPlace's first act in this démarché was to organize the expulsion of Monge. Despite the continued, if much reduced, influence of the collaborators of Monge and Lazare Carnot in France, French science slipped rapidly from its preeminent position worldwide, to a poor second, as Germany's scientific ascendency emerged under the tutelage of the Humboldt brothers and leadership of circles associated with Carl Gauss during the 1820's. See Felix Klein, *Development of Mathematics in the Nineteenth Century,* trans. by M. Ackerman (Brookline, Mass.: Math Science Press, 1979); see also E.T. Bell, *Men of Mathematics* (New York: Simon & Schuster, 1937).
43. Alexander Dallas Bache (1806-1867), a brilliant graduate of West Point, carried the prestigious name and tradition of his great-grandfather Benjamin Franklin. During the 1820's and 1830's, nationalist strategists in Franklin's old Philadelphia political machine (led by Nicholas Biddle, the president of the Bank of the United States, publisher Mathew Carey, and German emigré economist Friedrich List) successfully organized the initial industrialization of the U.S. In 1837, Biddle sent Bache to Europe to work with scientists and educational leaders, including Carl Gauss, Wilhelm Weber, and Alexander von Humboldt. Back in the U.S., Bache formed a patriotic group of the best American scientists, known as the "*Lazzaroni*" (Italian for "beggars"), in close cooperation with the German and allied French scientists. Bache's group designed and organized the U.S. Naval Academy. As head of the U.S. Coast and Geodetic Survey, Bache was chief strategist for the emergence of an advanced U.S. military-industrial capability, and was a leading advisor on intelligence to President Abraham Lincoln.

44. Louis Agassiz (1807-1873), leading zoologist and geologist of the nineteenth century, and one of the greatest naturalists of all time. He was born in Switzerland, trained in Germany at the University of Erlangen, and later worked with the leading French naturalist, Cuvier. In 1846, Agassiz moved to the United States and, as chief professor of the Harvard Lawrence Scientific School, he become a leading member of Alexander Dallas Bache's "*Lazzaroni.*" Together with Admiral Charles Henry Davis, Bache, and Joseph Henry, Agassiz helped found the U.S. National Academy of Sciences in 1863. See his *Contributions to the Natural History of the United States* (Boston: Little, Brown & Co., 1857-62; reprint New York: Arno Press, 1978).
45. The U.S. Coast and Geodetic Survey began operation in 1817 as a branch of the Treasury Department, and was the only Federal government scientific agency during the first part of the nineteenth century. It was directed by F. Hassler until his death in 1843, after which Alexander Dallas Bache assumed its direction. Hassler carried on an extensive correspondence with Carl Gauss, who provided both scientific advice and equipment, continuing to advise the Coast Survey under Bache. In fact, most of Bache's leading assistants were either students or correspondents with Gauss. For example, Benjamin Peirce, who took over after Bache died in 1867, was a leading student of Gauss; Admiral Charles Henry Davis translated Gauss' book on the determination of celestial orbits. See Carl Friedrich Gauss, *Briefen und Gesprächen,* ed. by Kurt-R. Biermann (Munich: C.H. Beck, 1990).
46. William Draper Harkins (1873-1951), professor of physical chemistry at the University of Chicago for almost forty years. His students and laboratory equipment, such as the Chicago Cyclotron, made the success of the World War II Manhattan Project possible. See biographical introduction by T.J. Young to Draper's *The Physical Chemistry of Surface Films* (New York: Reinhold, 1952). Young points out that Harkins and E.D. Wilson published the first calculation for nuclear fusion of hydrogen to form helium in 1915. And, in the early 1920's, Harkins, together with Gans and Newson, was the first to generate and detect the formation of an excited nucleus, (Nitrogen-16) in a Wilson Cloud Chamber, "which may be regarded as the first radioactive element produced artificially."
47. Leopold Kronecker (1823-1891), professor of mathematics at the University of Berlin, politically dominated German mathematics during the 1870's and 1880's. A radical empiricist, he believed that integers alone had a basis in reality, and that all other numbers (e.g., irrationals) were figments of man's imagination; hence, Cantor's development of transfinite numbers was seen by Kronecker as a direct threat to his entire theory of mathematics. As early as 1874 Kronecker tried to block publication of Cantor's preliminary work on the non-denumerability of real numbers. Using his political influence, Kronecker threatened the editors of professional journals against publishing Cantor's work, which he denounced as "humbug"—a slander which, coming from so prominent a figure, had a particularly pernicious influence. Kronecker used his influence to prevent Cantor's appointment to a professorship at Berlin or Göttingen, relegating Cantor to a post at Halle, where he was physically isolated and financially impoverished. The strain of intellectual isolation and Kronecker's constant hounding contributed to the nervous collapse suffered by Cantor in this period.
48. See Bertrand Russell, *An Essay on the Foundations of Geometry* (1897) (New York: Dover Publications, 1956); also "On Some Difficulties in the Theory of Transfinite Numbers and Order Types," *Proc. London Math. Soc.* 4, 29-53, 1907. Russell's collaboration with Alfred North Whitehead in the composition of their notorious *Principia Mathematica* was a desperate effort to refute Georg Cantor's *Beiträge* by limiting mathematics axiomatically to the crudest possible forms of *analysis situs,* those of greater than, less than.
49. See G.W. Leibniz, "Système nouveau de la nature et de la communication des substances" (1695); English trans. "A new system of the nature and the communication of substances," in *Gottfried Wilhelm Leibniz: Philsophical Papers and Letters, op. cit.,* vol. II, p. 739. See also in *G.W. Leibniz: Mathematische Schriften,* ed. by C.I. Gerhardt (Berlin and Halle: 1849-1863; reprinted Hildesheim: 1962), vol. IV, p. 477.
50. Pietro Pomponazzi lectured on Aristotle at the University of Padua between 1487 and 1509, as well as at Ferrara and Bologna. One of his students was Gasparo (Cardinal) Contarini (1483-1542), a descendant of the Venetian oligarchical family, who became the most important Venetian operative during the period of the Protestant Reformation and the initial Catholic Counter-Reformation. Another influence on the young Contarini was Francesco Zorzi (Giorgi), who became his close friend. Among Contarini's close associates were Gregorio Cortese, the Abbot of the Benedictine Monastery of San Giorgio Maggiore, Reginald Cardinal Pole, a sometime-pretender to the English throne, and Gianpietro Caraffa, later Pope Paul IV. Pole and his friend Vittoria Colonna were central figures of the Italian crypto-Protestant movement called the "Spirituali." In 1537, Cardinal Contarini chaired the Holy See's Council on the Reform of the Church, which issued a decree citing Aristotle and condemning Erasmus, thus initiating the process leading to the Council of Trent.
51. LaRouche, "Science of Christian Economy," *op. cit.,* pp. 241-256.
52. *The Thirteen Books of Euclid's Elements,* trans. by Thomas L. Heath (1925) (New York: Dover Publications, 1956).
53. See Wilhelm von Humboldt, "Preliminary Thoughts on the Plan for the Establishment of the Municipal School System in Lithuania" and "School Plan for Königsberg," which are summarized by Marianna Wertz, in "Wilhelm von Humboldt's Classical Education Curriculum," *New Federalist,* vol. VII, No. 10, March 15, 1993, p. 8; see also *Wilhelm von Humboldt, Humanist Without Portfolio: An Anthology of the Writings of Wilhelm von Humboldt,* trans. by Marianne Cowan (Detroit: Wayne State University Press, 1963). Humboldt's reform program was directly influenced by his long association with Friedrich Schiller. See "On Schiller and the Course of His Spiritual Development," by Wilhelm von Humboldt, and Schiller's "What Is, and To What End Do We Study, Universal History?" in *Friedrich Schiller, Poet of Freedom,* vol. II, ed. by William F. Wertz, Jr. (Washington, D.C.: Schiller Institute, 1988).
54. See Carol White, "The Roots of British Radicalism," in *The New Dark Ages Conspiracy* (New York: New Benjamin Franklin House, 1980), pp. 285-333; see also "Origins of the Counterculture," in *Dope, Inc.: The Book That Drove Kissinger Crazy,* by the Editors of Executive Intelligence Review (Washington, D.C.: Executive Intelligence Review, 1992), pp. 533-553.
55. See, e.g., Bertrand Russell, *Introduction to Mathematical Philosophy* (1917) (New York: Simon & Schuster, Touchstone Books, 1971), p. 21.
56. This incidentally, is the proper standpoint from which to appreciate the non-mysterious implications of Kurt Gödel's famous treatment of formally undecidable propositions (see footnote 26).
57. Note both the treatment of the circle in Nicolaus of Cusa's *De Docta Ignorantia* earlier and then, later, the summation of that in "De Circuli Quadratura" (see footnotes 16 and 17).
58. Nicolaus of Cusa, *De Docta Ignorantia, op. cit.*
59. *Ibid.*
60. In 1766-1767, Johann Heinrich Lambert proved the irrationality of the numbers π and e. Based upon Lambert's Theorem, in 1873 Charles Hermite proved the transcendence of the number e. In 1882, F. Lindemann demonstrated the transcendence of the number π as an extension of Hermite's proof for the case of e. See: Johnann Heinrich Lambert, "Mémoire sur quelques propriétés remarquables des quantités transcendentes circulaires et logarithmiques," *Histoire de l'Académie Berlin, 1761* (1768), pp. 265-322; partial trans. in D.J. Struik, *A Source Book in Mathematics, 1200-1800* (Princeton, N.J.: Princeton University Press, 1968), pp. 369-

374. Charles Hermite, "On the Transcendence of *e*" (1873), in David Eugene Smith, *A Source Book in Mathematics, op. cit.,* trans. by L. Guggenbühl, pp. 99-106. For a summary of the arguments of Hermite and Lindemann, see Felix Klein, *Famous Problems of Geometry* (1897), in *Famous Problems and Other Monographs* (New York: Chelsea Publishing Co., 1955), pp. 61-77.

61. See *A Manual on the Rudiments of Tuning and Registration,* ed. by John Sigerson and Kathy Wolfe (Washington, D.C., Schiller Institute, 1992), esp. chap. 11 *passim,* pp. 199-228. See also, Lyndon H. LaRouche, Jr., "Mozart's 1782-1786 Revolution in Music," *Fidelio,* Vol. I, No. 4, Winter 1992.
62. LaRouche, "History as Science," *op. cit.,* pp. 24-27.
63. Panini (c.400 B.C.), grammarian of Classical Sanskrit. P.B. Junnarkar's *An Introduction to Panini* (Baroda: Shanti S. Dighe, 1977) includes the full text of Panini's *Astadhyayi.*
64. *Cf. A Manual on Tuning, op. cit.,* chaps. 9 and 10, pp. 151-198. If the principle of least action is applied to voice training of singers, the result of this is a form of voice training associated with the *bel canto* tradition carved in stone by Luca della Robbia in the Cathedral of Santa Maria del Fiore in mid-fifteenth century Florence, Italy.
65. See *A Manual on Tuning,* pp. xv-xxix.
66. *Ibid.*
67. See Webster G. Tarpley, "The Evil Philosophy Behind Political Correctness," *Fidelio,* Vol. II, No. 2, Summer 1993, pp. 42-54.
68. Aristoxenus (born c.375 B.C.), a student of the Pythagoreans and Aristotle, developed a fully-conceived system of musical tuning presented in such works as the surviving *Harmonic Elements,* whose "tense diatonic" scale has been interpreted by modern writers as containing a system of equal temperament. See *The Harmonics of Aristoxenus,* trans. and ed. by H.S. Macran (London: Oxford University Press, 1902); see also R. Westphal, *Aristoxenus von Tarent* (Leipzig: A. Abel, 1883-93; reprinted 1965).
69. See Pierre Beaudry, "The Acropolis of Athens: The Classical Idea of Beauty," *New Solidarity,* Vol. II, No. 24, June 24, 1988, pp. 6-7; see also, Lyndon H. LaRouche, Jr., "The Classical Idea: Natural and Artistic Beauty," *Fidelio,* Vol. I, No. 2, Spring 1992, p. 8ff.
70. See Plato, *Republic, op. cit.,* Steph. 509d-513e; *Timaeus,, op. cit.,* Steph. 32a, 35b-36b, 54d-55c.
71. See Luca Pacioli, *De Divina Proportione* (1497) (Vienna: 1896), whose geometrical diagrams of the Golden Section-determined regular solids were drawn by Leonardo da Vinci. Reproductions of these drawings appear in *The Unknown Leonardo,* ed. by Ladislao Reti (New York: McGraw-Hill Book Company, 1974), pp. 70-71.
72. This is not the place to take up the distinction between a so-called "quantum mechanics" and a "quantum field theory." It is sufficient to inform the reader that Planck's work leads as readily to a quantum field theory of quasi-Keplerian type, as to a strained quantum mechanics, and without the distressing paradoxes inhering in the latter. A point here is the theory of knowledge; only that implication is being treated in this part of the report.
73. See footnote 71. Leonardo's drawings and studies of plants and plant growth abound in the application of Golden Section harmonics.
74. See Johannes Kepler, *On the Six-Cornered Snowflake,* trans. by Colin Hardie (Oxford: Clarendon Press, 1966), reprinted by *21st Century Science & Technology,* 1991.
75. See Plato's *Timaeus* in *Plato: Timaeus, Critias, Cleitophon, Menexenus, Epistles,* Loeb Classical Library, trans. by R.G. Bury (Cambridge: Harvard University Press, 1929), Steph. pps. 32a, 35b-36b, 54d-55c.
76. This pertains to the intelligibility of principles of higher hypothesis by creative reason. On natural law generally, see G.W. Leibniz. Natural law signifies those universal, endurable principles of the world as Becoming which are naturally intelligible to individual creative reason. For example, as given in the text, the principle of the sacredness of the individual person, the derived sacredness of the family, and the derived relative sacredness of the republic form of government.
77. The term "agapic" signifies the agapic form of love in opposition to erotic love. The reference is, of course, to the Gospel of St. John, especially the famous verse 3:16, and to I Corinthians 13 of St. Paul, as the standard for defining *agapē.*
78. Lyndon H. LaRouche, Jr., "On the Subject of Metaphor," *op. cit.,* pp. 20-26.
79. G.W. Leibniz, *Monadology, op. cit.*
80. See LaRouche, "On the Subject of Metaphor," *op. cit.,* pps. 22-23, 44-47.
81. Ernst Mach (1838-1916) initiated the effort to impose positivism on science in the twentieth century, and is generally credited with founding the fraud known today as modern "philosophy of science." While most of his scientific conclusions have long been proven false—for example, "that atoms [don't] exist"—his general method, particularly his opposition to any notion of causality in science, have become prevalent in modern physics. Mach led a scientific vendetta against Ludwig Boltzmann—eventually leading to his suicide in 1906—because Boltzmann refused to completely abandon the concept of causality in thermodynamics. He afforded similar treatment to Louis de Broglie at the 1927 Fifth Solvay Conference on Physics, and later, to Erwin Schroedinger. De Broglie characterized these events as "a virtual *coup d'etat* in theoretical physics." See Morris Levitt, "Linearity and Entropy, Ludwig Boltzmann and The Second Law of Thermodynamics," *Fusion Energy Foundation Newsletter,* Vol. II, No. 2, Sept. 1976, pp. 3-18; see also Uwe Parpart,"The Theoretical Impasse In Inertial Confinement Fusion," *Fusion,* Vol. III, No. 2, Nov. 1979, pp. 31-40.
82. See Luca Pacioli, *De Divina Proportione, op. cit.*
83. See footnote 73.
84. For Kepler's use of "quantum field theory," see his *Mysterium Cosmographicum (The Secret of the Universe),* trans. by A.M. Duncan (New York: Abaris Books, 1981); chap. 2 contains his explicit reference to Nicolaus of Cusa. For Kepler's discussion of the Divine Proportion (Golden Section), and of the geometric determination of harmonic relations, both in music and astronomy, see his *Harmonice Mundi (The Harmony of the World),* in *Opera Omnia,* vol. 5, (Frankfurt: 1864); English trans.: Books I-IV, trans. by Christopher White *et al.* (unpublished); Book V, trans. by Charles Glenn Wallis, included in *Great Books of the Western World* series (Chicago: Encyclopedia Britannica, 1952).

NOTE

Owing to an editorial error, footnote 49 to Section 2 of Lyndon LaRouche's "History as Science: America 2000," which appeared in the previous issue of *Fidelio* (Vol. II, No. 4, Fall 1993) was incorrect as printed. The corrected note, which deals with Georg Cantor's use of the "power set" to generate the transfinite cardinal numbers, reads as follows:

49. The "power set" is the set of all subsets of a given set. Cantor applied this idea to his transfinite cardinal numbers, and proved that the power set of a given transfinite cardinal number would generate a new, higher-order transfinite cardinal. Cantor's first transfinite cardinal represents the countable or denumerable infinites. The power set of the countable infinites is the non-denumerable continuum, and Cantor demonstrated through his diagonal method that the number continuum is a higher order cardinality than the countable infinites. There may be other non-denumerable aggregates besides the number continuum, as Paul Cohen's proof of the non-demonstrability of Cantor's continuum hypothesis demonstrated. The power set of the number continuum gives a higher order cardinal, the set of all functions, and so on. The capability to generate higher and higher transfinite cardinal numbers is equivalent to Plato's concept of "hypothesizing the higher hypothesis."