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THE MEANING OF THE TERM 'TRANSFINITE'

Nov. 7, 1988

by Lyndon H. LaRouche, Jr.

F o r e w o r d

My numerous published writings on the subject of my profession, economic science, and in related matters of physical science and aesthetics, present a very specific, very elementary, and unavoidable point of conceptual difficulty for most science professionals, and others. The difficulty is, that like all truly elementary matters in scientific work, the central notion involved is simple, but yet conceptually profound.

The mental block which is the source of the difficulty for professionals, centers around two generally accepted be- liefs, mistaken prejudices, inflicted upon the professional from the outset of his or her education, to which most are habituated throughout the remainder of their lives.

Should scientific professionals, or laymen turn to almost any popular dictionary, to settle a dispute respecting the putative meaning of the verb "to reason," the result is exemplified by the first putative meaning asserted in Simon and Schuster's <Webster's New Universal Unabridged Dictionary>:

> REASON: <v.t.> 1. to analyze; to think logically about; to think out systematically."

Excepting outright irrational superstition, little could be more subversive of scientific understanding than the definition of reason as equivalent to formal logic. Unfortunately, just such an absurd definition prevails in those circles.

Among even most physical-science professionals, and, of course, engineers as well, the popular confusion of <reason> with formal deductive logic is coupled with a related derivative of deductive <euclidean geometry>, the widespread preference for Cartesian analytical geometry and modern statistical

methods over the contrary methods associated with Leonardo da Vinci, Johannes Kepler, Gottfried Leibniz, Gaspard Monge's Ecole Polytechnique, and the circles of Carl Gauss, Bernhard Riemann, et al. As a consequence of the general illiteracy of textbooks, classrooms, and professional papers available, on these accounts, most physical-science professionals are not even aware that this crucial distinction exists.

Were he pressed on such issues, an objecting reader might rush to textbooks and dictionaries, or rely upon what passes for a kindred quality of oral authority, to prove that my views are, in his opinion, simply <wrong>.

An obvious error in such a reaction, is that I have contributed discoveries in Leibniz's science of physical economy which are not only valid, but of a quality bearing upon fundamentals. To such effect, I have fought for proven hypotheses respecting the curvature of sub-atomic physical space-time, in addition to the development of my original work in the field of economic science. Moreover, it is clear that I have effected these contributions from the standpoint of the anti-Cartesian method of such as Kepler, Leibniz, and Riemann.

A similar pattern occurs in the case of classical music.

The standpoint of classical aesthetics, as Leonardo da Vinci typifies this, is demonstrably the standpoint from which classical composers including J. S. Bach, Wolfgang Mozart, and Luwdig Beethoven worked. Later, especially following the 1815 Treaty of Vienna, the irrationalist dogmas of Immanuel Kant and Karl Savigny, joined with such influences as Oxford University's John Ruskin, in eradicating the principles of classical fine-arts composition from the universities and specialist academies. In music as such, the hoaxes of anti-classicist Wilhelm Helmholtz's <Sensations of Tone> took over much of musical instruction, as well as invading elementary physics texts.

In consequence, most taught musicological theory today is a collection of irrationalist fads, to the effect that the bare principles of classical composition have been made, for most professionals, as much a "lost art" as were ancient Egyptian hieroglyphs before the modern discovery of the Rosetta Stone. The mere mention of Kepler in a musical-academic circle, is often sufficient to detonate an explosion of blind hysteria.

In consequence of these circumstances, whenever I write on matters of physical economy, physical-science topics, or aesthetics, I am implicitly obliged to include a summary elaboration of three elementary features of scientific method as a leading, if subsumed portion of the literary presentation as a whole. First, the rigorous proof from which my grounding in scientific method is derived "hereditarily," my rigorous disproof of the central theses of the famous <Critiques> of Immanuel Kant, in defense of Leibniz's method; second, the axiomatic basis for the form of <non-euclidean geometry> introduced by the fifteenth-century Nicolaus of Cusa, central to the work of Leonardo da Vinci, Kepler, Desargues, Leibniz, and Monge later; and, third, the significance of the further elaboration of elementary non-euclidean geometry by Gauss, Dirichlet, Riemann, Weierstrass, Cantor, et al., during the nineteenth century.

If the summary of these three topics were the limit of the background information I were obliged to supply in so many locations, I would have omitted something crucial. All of my important contributions depend upon a very specific something which goes qualitatively beyond what the bare exposition of those three topics suggests. My unique contribution to scientific knowledge is my proof of the implicit intelligibility of those creative-mental processes exemplified by an individual's valid fundamental discovery in physical science, a discovery which was indispenable for defining Leibniz's conception of <technology> as a measurable magnitude in physical-economic processes.

It follows, that most of those things I have to report, which are sufficiently important to justify presentation in some depth, must have such supporting information included. I am obliged to include in such presentation, not only a summary of the Kantian Paradox, elementary <noneuclidean geometry>, and the principles of the Gauss-Riemann complex domain; I must also represent in intelligible form, the bare essentials of my work on the creative-mental processes as this bears crucially upon the internal history of science, upon the causal correl- ation among <technology>, <power-density>, and <physical productivity>, and are at the center of the principles of classical aesthetics.

The same contigency exists in connection with all those matters of theology which bear directly upon crucial issues of statecraft, and with phenomena of individual mental life and

social behavior generally.

Recently, during the past several years, in consequence of the crucial-experimental validation of my hypotheses respecting the curvature of sub-atomic physical space-time, important new lines of inquiry are opening upon along the frontiers of mathematical physics. Presently, this features the urgency of reexamining the work of a close collaborator and critic of Bernhard Riemann, Eugenio Beltrami, on the subject of the role of negative curvature within the postive curvature of the Riemann Surface Function.

The consideration of negative curvature is essential for intelligible mapping of what are termed the "strong" nuclear forces of the atomic nucleus. This need is underscored by the crucial-experimental validation of my "keplerian" hypotheses respecting the curvature of sub-atomic physical space-time.

These questions are not confined to the laboratory side of experimental physics. These bear upon more or less immediately applicable new technologies, which will, without doubt, revolutionize day-to-day life on Earth and in man's exploration and colonization of nearby astrophysical space. This signifies, for example, new qualities of materials in increasingly commonplace use, and new kinds of productive processes associated with them.

The same considerations bear upon what is called today the "non-linear spectroscopy" of optical biophysics. That includes unlocking crucial among the supposed mysteries of the way in which inorganic sub-atomic processes function within the characteristic features of living processes.

For the reasons so listed, and related ones, it is not a satisfactory state of affairs, that I should be obliged, as I have been up to now, to continue repeating summaries of the essential features of my scientific method on each occasion I must report on a matter whose comprehension depends upon the reader's acquaintance with those background features. It were required, that I issue a reference-document, in which these background features are summarized, which may be employed as written reference respecting future reports requiring such background briefing.

That is the function of this present paper.

Defining <Transfinite>

It will become clearer, as this report proceeds, why I have referenced the <transfinite> in the title of this piece. However, it is probably obligatory, that I supply here an introduction to the use of that term.

It is the popular view, that what our brain tells us we have sensed, presents a kind of mirror-image of the physical reality prompting such sense-experience. Such faith is contrary to crucial experimental evidence. Also, modern studies of the physiology of eye-brain physiology, show us that our mental-perceptual apparatus, rather than providing us mirror-images of physical reality, affords us excellent instrument-readings on the world about us. Science depends upon our acquiring the knowledge needed to interpret those instrument-readings properly.

This conforms to a famous passage in Plato's dialogues. The images which our perceptual apparatus provides to us may be compared with the distorted shadows which firelight casts on the walls of an otherwise darkened cave. Modern physical science began with the work of such fifteenth-century scient- ific discoverers as Filippo Brunelleschi and Leonardo da Vinci, in exploring the anomalous features of vision which show simple linear perspective to be a misleading representat- ion of the world about us.

If we know how our perceptual apparatus distorts the image of reality, we know that the shadows on the wall of Plato's Cave are distorted images of real persons and objects. Hence, we may reconstruct the image of reality by knowing the factor by which the shadows are distorted.

If we are ignorant of the history of science's treatment of this fallacy of naive sense-perception, and if our ignorances encourages us to combine naive ideas of sense-certainty, with the false notion that deductive method is "reason," the result is formal, deductive euclidean geometry. The adoption of such a view of euclidean geometry as the axiomatic basis for a physics, yields the views of that hoaxster Galileo Galilei, of Rene Descartes, the mathematical schema adopted by Isaac Newton.

The euclidean-cartesian system assigns the quality of

"matter" to the assumedly self-evident points of euclidean geometry. Deductive geometry's image of the self-evident existence of the point, becomes, in a deductive physics, the demonstrable absurdity of the "mass-point" moving in straight lines unless acting upon by external "force."

So, we have the cartesian system of coordinates, X, Y, and Z, of cartesian analytical geometry. Implicitly, we have also the dimension of time, T. However, in this view, space and time are empty, have no assumed "substance" in themselves. The result is the image of "mass-points" roaming, by natural inclination, in straight lines, in empty space nd empty time.

Any image of physical space, time, and matter defined in such cartesian terms of reference, X, Y, Z, and T, we call a <discrete manifold>. Any deductive system of mathemat- ical functions, referenced to a <discrete manifold>, repre- sents a <finite> function, which are nothing but <finite> even in the case that slovenly classroom and related speech bearing upon such functions employs so often a scientifically meaning- less word, "infinity."

Descartes obliged himself to confess, that certain ex- isting realities and agencies could not exist within the scope of representation by <finite>, deductive functions of a <dis- crete manifold>. God was relegated to such excluded categor- ies, and so were the creative functions of the human mind. To the extent anything not representable by a <finite> funct- ion was shown to be actually or possibly an agency or event acting efficiently upon the universe represented as a discrete manifold, this was, for Descartes, a matter of <deus ex machina>.

In classical philosophy, all matters not representable by means of deductive representation of assumed sense-certain- ty were assigned to the domain of <metaphysics>. This term, <metaphysics>, did not signify that such non-deductive exist- ences were merely matters of religious or similar <faith>; it signified merely than they represented existences whose effic- iency could not be denied, but which could not be encompassed by any mode of thought, such as formal, deductive logic, which is congruent with deductive forms of <finite> functions.

The physical discoveries forced to the surface by the most successful work of Gaspard Monge's Ecole Polytechnique,

and more emphatically by the work of the Ecole's post-1814, German and Italian successors, especially the circles of Carl Gauss, showed that no modern physics could be competent unless it located the elementary existence of the universe within the realm which Descartes had relegated to <deus ex machina>, a domain which classical philosophy had assigned to <metaphys- ics>. To unify what had appeared matters of the <finite> with the larger reality, what was required was the physical uni- verse of the Gauss-Riemann complex domain.

Instead of the popularly misunderstood meaning of the term <metaphysics>, the nineteenth-century development of the mathematical physics of the complex domain chose the term <transfinite>, a term which correctly implied its relation- ship to the notion of those <finite> functions situated within a cartesian or neo-cartesian notion of <discrete manifold>.

By approximately the beginning of the present century, two related but mutually opposing views had been developed, out of this work on transfinite functions, of Gauss, Rie- mann, et al.

By that latter point, as the case of Professor Felix Klein's Go:ttingen university illustrates the point, the prevailing view of <transfinite> functions was that they were a necessary way of representing adequately, physical relations within a neo-cartesian, neo-euclidean image of the <discrete manifold>.

What was usually termed "non-euclidean" geometries, in an understandable, but misleading way, from that point on, illustrates that first view of the <transfinite>. The example of Professor Hermann Minkowski's famous lecture on the subject of Special Relativity, is an example of the way in which the misuse of the term "non-euclidean geometry" was popularized for popularized classroom usage today.

As later portions of this report clarify the point, Minkowski et al. used "non-euclidean" to signify "neo-euclidean" geometries.

The second, view, that of Riemann et al. in their lifetimes, but a minority view among their successors at the turn of the century, is that the complex domain derived from a Gauss-Riemann form of the <non-euclidean> constructive geometry of Cusa, Leonardo, Kepler, and Leibniz, represented the

real universe, and the image of the discrete manifold never better than a distorted shadow of reality. In other words, elementary physical reality is <ontologically transfinite>.

However, both of these referenced readings of the term "transfinite" were in opposition to the views then prevailing in the English-speaking world, and to a large degree, in France, too. One of these nineteenth-century opponents of Gauss and Riemann, the famous James Clerk Maxwell, spoke for the faction of his co-thinkers, Kelvin, Clausius, Helm- holtz, et al., as a whole, when his justified his failure to acknowledge his reliance on material "borrowed" from the work of Gauss, Weber, and Riemann on electrodynamics, by stating that he refused to give credit to any work based upon "geomet- ries other than our own."

From the radically neo-cartesian, deductive standpoint of Kelvin, Maxwell, et al., what we treat as <transfinite> functions appear to be merely "non-linear" ones. "Non-linear" is the name of a class of physical phenomena which can not be represented intelligibly as <finite functions> of a deductive sort.

On that much, we agree with the deductive formalists. It is admissible, and convenient to reference such physical processes as functionally "non-linear." However, <transfinite> is no mere synonym for "non-linear." The principal work done within the scope of the Gauss-Riemann complex do- main, is defining intelligible representation, in the form of mathematical-physical functions, for any physical process which reality presents to us, no matter how arbitrary that process might appear to be. It is when we address the means for construction of those complex functions which solve "non-linear" problems, that the term <transfinite> must be introduced.

The difference between "non-linear" and <transfinite> is analogous to the difference between the man who laments, "I am broke," and the more optimistic view of impecuniousness referenced by the impoverished man taking gainful employment. "Non-linear" is the name of the mathematical impotence; "transfinite" is the name of the relevant potency.

From the Gauss-Riemann view of the <ontologically transfinite>, the which is also this reporter's view, the elementary nature of matter, and the elementary laws of the physical

universe, is the subject of nothing less than <transfinite functions>. Hence, <transfinite> is the name of that which subsumes everything elaborated here, and of the essential nature of each and every topic, whether of physics, physical economy, aesthetics, theology, or statecraft, addressed from this vantage-point.

I. K A N T R E F U T E D

It is perhaps indispensable that we begin what follows with a brief autobiographical note, bearing upon the sequence of developments leading those features of this report which are either the author's own original discoveries, as they are in some significant part, or the manner in which those discoveries afforded a fresh view of other materials employed.

The explicit connections began for the author at the age of twelve, 1935 to be precise. Initial readings in philosophy suggested to him the project, of taking a list of prominent modern philosophers in the order of the dating of their first principal published writings, and proceeding from Francis Bacon through Kant in that manner. He relied upon a home-library collection of Eliot's <Harvard Classics>, and as much supplementary material of relevance as he could obtain either from other content of his parents' library or the Lynn, Massachusetts public library.

By the age of fourteen, the writer had become a committed student of Leibniz, to the point that he could not accept the axiomatic-deductive view of taught secondary-school mathematics; he continued the remainder of his project of philosophical studies from that standpoint. By the age of fifteen, he had begun a good portion of his reading of a Kemp-Smith edition of Kant's <Critique of Pure Reason>, sufficient that he had adopted the notion of refuting Kant, in defense of

Leibniz.

During this period, although he had not studied Plato in any serious degree, he developed his own version of a socratic method, partly from Leibniz's work, and as a methodological standpoint implicitly forced upon him by the need to cope with the fallacies of Kant's neo-aristotelean dialectic.

Shortly after the war, an encounter with the Paris edition of Professor Norbert Wiener's <Cybernetics> provoked an

angered response. The enraging feature of an otherwise stimulating and intriguing book, was Wiener's inhuman definition of "information theory" in general, and his use of Boltzmann's H-theorem to misdefine the notion of the phenomena Boltzmann defined as <negentropic>. It was apparent, that these fallacies in Wiener's work represented a nasty systematic error in Wiener's choice of scientific method, a crude copy of the fallacies of Kant. An encounter with some relevant writings of John von Neumann, during the immediately ensuing period, reenforced this reporter's sense of the importance of refuting such nonsense.

The importance attached to such an undertaking was two-fold. First, in the specific matter at issue, Wiener represented a mechanistic (positivist) misconception of mankind, of a variety we might have hoped we had freed civilization with the conclusion of the recent world war. Second, the crucial issue at the center of Wiener's and von Neumann's wrong choice of method, was essentially the same blunder at the center of Kant's <Critiques>. The undertaking so motivated, has shaped everything of more than passing usefulness this reporter has accomplished since.

By 1952, the original line of explorations, focussed upon the possibility of producing an alternative to Wiener's "information theory," by showing the possibility of a correct sort of intelligible representation of the creative-mental processes, had settled upon Leibniz's science of physical-economy as the medium in which to situate the representation. The enforced leisure of a long bout of convalescence from hepatitus, brought the rudiments of the solution to completion during 1952-1953. What is reported here rests axiomatically upon the work completed up to that latter time.

For reasons which should become evident in the course of the text, the following order of topics has been chosen.

This present section is devoted to the subject of the reporter's refutation of the Kantian Paradox, and to the significance of viewing the results of that refutation in the setting of economic science. It is to be understood, that the usage of the term "economic science" in this text always signifies nothing other than what Leibniz defined as the the science of physical economy: the causal correlation among <technology>, as Leibniz defined the term, <power-density>, and <physical productivity> of the operatives component of the

total labor-force.

The section following that defines the relevant features of an elementary <non-euclidean>, or <constructive> geometry, without which references to the Gauss-Riemann complex domain are not intelligible.

The third section traces the derivation of the complex domain from the elementary <non-euclidean> geometry set into motion by crucial discoveries of Nicolaus of Cusa. In that setting.

In the concluding section, after that, the text sums up what we have accomplished during the preceding sections.

Kant, Briefly

As much as we need know of Immanuel Kant (1724-1804) for our purposes here, is the following.

By his mid-twenties, Kant appears as a pro-newtonian opponent of Leibniz. By the end of his thirties, he was more emphatically an adversary of Leibniz, now adopting for this purpose, the posture of an advocate of the irrationalist "moral philosophy" of David Hume. Later, during the 1770s, he distanced himself from Hume's turn in the direction of what were to appear as Jeremy Bentham's explicitly immoral empiric- ist radicalism, without abandoning any of those features of Hume he had advocated earlier. It is the writing of his <Critique of Pure Reason>, during that period, which begins the kantian dogma as it has been generally identified by the three <Critiques> and his <Prolegomena> since that time.

Kant's <Critiques> adopt a neo-aristotelean form of deductive logic and defense of sense-certainty, as the premises of his method throughout. The central feature of the kantian "system," is his effort to show that human understanding of the creative processes of mind (<synthetic judgment a priori>) can not be achieved from the basis of deductive logic combined with sense-certainty.

He recapitulates the results of this effort in the last, and most wooly-headed of his <Critiques>, the 1790 <Critique of Judgment>. Amid the debris, he asserts two conclusions flatly. First, that creative processes exist, but they can not be supplied an intelligible representation for the human mind. Second, on the same grounds, that there is no intelligible standard of truth or beauty possible in art.

The first of the two assertions, we shall reference hereafter as "the kantian paradox": creative processes exist in the real universe, but, according to Kant, the existence of those processes can not be rendered intelligible.

It was the first of these two assertions which Wiener and von Neumann copied from the influence of Kant and the postiivists. There is nothing of importance axiomatically embedded in Wiener's approach to "information theory," which is not argued more rigorously, if also falsely, by Kant. Implicit- ly, the same is true respecting the relevant aspects of the work of von Neumann. By an adequate examination of the fal- lacies of the Kantian thesis, a sufficient basis for refuting Wiener is elaborated.

Although this reporter was obliged to concentrate on the first of the two central dogmas from the <Critique of Judgment>, it was also required that he show that classical fine art is subject to intelligible principles of truth and beauty, and to derive the proof of this from refutation of Kant's dogma on <synthetic judgment a priori>. That was the scope of the 1948-1952 project.

We now summarize the formal proof.

Kant's Logical Gap

Any fixed or expandable number of theorems, each and all mutually consistent by standards of deductive formalism, form what is termed a <theorem-lattice>.

Such a lattice is premised upon an underlying set of <axioms> and <postulates>, in a manner modelled upon deductive euclidean geometry. Each of the axioms and postulates included in that set may be explicitly stated, or are inferred by the theorem-lattice as a requirement of consistency. Each and every theorem of a deductively consistent theorem-lattice, is consistent with the set of axioms and postulates underlying that lattice.

The requirement of deductive consistency causes the lattice as a whole to be subsumed by what is termed, descriptive-

ly, the "hereditary property." No existing, or possible theorem of a deductive theorem-lattice contains anything which was not already implicitly asserted by the set of axioms and postulates underlying it. That set is the "genetic material" of the lattice, so to speak; no consistent theorem of that lattice contains anything not implicitly contained within the "genetic material."

Any mathematical-physics doctrine whose mathematics is a formal-deductive one, whether it is based on the assumption of truth of sense-certainty, or not, represents a commitment to limit the definition of "scientific knowledge" to an expandable array of consistent theorems of a deductive theorem-lattice. Even the "neo-euclidean" geometries commonly associated with Special and General Relativity, are derived from a <discrete manifold>, and define functions which are deductively <finite>.

Thus, to the degree that formal mathematical-physics adopts the <intent> to perfect its theorems in such a way as to converge upon the requirements of a consistent deductive theorem-lattice, we may, and must examine that mathematical physics from that standpoint. <Kant assumed such an intent, and his argument is fully subject to demonstrations based upon the fact of that intent.>

In experimental physics, there is a special class of experiments customarily distinguished as <crucial>: <crucial experiments>. Such experiments are designed to test absolutely, not statistically, the existence or non-existence of something which is either required, or not permitted, by a theorem, or an hypothesis in the form of a theorem.

For the moment, we limit the definition of <crucial experiments> to the deductive mode in which Kant situated his paradox. For that limited case, the theorem or hypothesis is <crucial>, if it is truly consistent with a formal theorem-lattice of mathematical physics.

All scientific revolutions in physics are the consequence of an actual or assumedly valid fundamental discovery effected by means of a crucial experiment. This case is by no means an hypothetical, or rare one; physics is rich in such crucial experiments.

Our use of the principle of "crucial experiment" here, is key, both for understanding the proof which Kant asserts he

has given, and to refute Kant's assertion on its own ground.

<If a single crucial experiment disproves but a single theorem of a deductive theorem-lattice, each and every theorem of that lattice is also disproven.> We expand this argument, as follows.

If a disproven theorem is consistent with the theorem-lattice in which it is situated, then it is "hereditarily" consistent with the set of axioms and postulates underlying that lattice. Let us assign the arbitrary label, Lattice A, to the theorem-lattice to which such a crucially disproven theorem belongs. We must examine the set of axioms and postulates, to isolate those features of the set which have "hereditarily" generated the crucial-experimental error in the disproven theorem. We must alter the set of axioms and post- ulates, to bring them into agreement with the crucial-exper- imental evidence nearing upon the disproven theorem of Lattice A.

Any alteration in a set of axioms and postulates, such as those of Lattice A, produces a new set of axioms and post- ulates. Two results follow:

First, every theorem in Lattice A must be altered, to conform to the altered set of axioms and postulates. This "hereditary" alteration of all of the theorems of a theorem- lattice, generates a new theorem-lattice.

Second, assigning the arbitrary label, Lattice B, to the new theorem-lattice so generated, no theorem of Lattice B is consistent with any theorem of Lattice B, and none of Lat- tice A with any of Lattice B.

In practice, the procedure is much more complex; how- ever, none of the things we have just said need be modified on that account.

Take as an illustrative case, the controversy over the choice of a new postulate, to replace the discredited "para- llel postulate" of euclidean geometry.

By the beginning of this century, a substantial accum- ulation of crucial-experimental evidence had brought a largely reluctant scientific community, at least the relatively best scientific minds of the time, to the point it was forced to concede a point Gauss et al. had already proven, and that

approximately a half-century earlier.

However, even those who led in demanding the crucial correction, were unwilling to consider adopting the purely constructive geometry of Gauss et al., in place of the dis- credited euclidean one. Instead, they proposed to reform euclidean geometry along the lines we have just described the transformation of a deductive theorem-lattice, immediately above. What they proposed, instead of adopting a non- euclidean geometry, was to reform euclidean geometry to the effect of retaining virtually everything excepting the para- llel postulate.

In some cases wittingly, in others perhaps unwitting- ly, the proponents of Special Relativity represented them- selves as having adopted the actually non-euclidean geometry of Gauss, Riemann, et al. What they did, was to adopt some of the conclusions which Gauss, Riemann, et al. had reached, by means of a non-euclidean geometry; however, they retained every feature of euclidean geometry but the one change in the parallel postulate. They named the result, a "neo-euclidean geometry," a "non-euclidean" one.

It will be recalled, that the chief contenders for the new postulate were two. The first, that of Gauss-Riemann. The second, the hyperbolic curvature of Lobachevski. They might well have considered a third, a Riemann Surface Function of positive curvature, modified at each "point" of singularity by a Beltrami negative curvature, a change on the agenda of inquiries today; they did not. The point we are emphasizing by this illustrative case, is that the crucial evidence disproving the parallel postulate indicated two leading cases of possible substitute choices of neo-euclidean postulates; a third, not notably considered, could have been added.

This illustrates a more general case. Immediately, the crucial-experinental proof, that a particular theorem of a theorem-lattice is false to reality, although hereditarily consistent with the lattice itself, usually suggests, hereditarily, several possibilities for change of the flawed element within the corresponding set of axioms and postulates.

Hence, for any Lattice A so affected, there exist some alternate, plausible modifications of the set of axioms and postulates. The effect defines, implicitly, a correspond-

ing array of alternate theorem-lattices from which to choose the replacement for Lattice A. Let us designate the members of this array as implied Lattices B, C, D, ... , N. We must choose among these.

Obviously, we must study carefully each and every new theorem generated by transforming a theorem from Lattice A, into a revised theorem for the new lattice. Obviously, we require crucial-experimental tests of each revised theorem. We must choose, from among the array B, C, D, ... , N, that one which is consistent with all the crucial-experimental evidence for all members of the theorem-array.

In actual practice, the procedure is more complex. This is so chiefly because, despite the intent to perfect the consistency of a deductive-formal sort of mathematical physics, the formal and experimental consistency of that theorem-lattice is never better than approximate.

In practice, most scientific opinion is stubbornly resistant to correcting crucially proven errors. Sometimes, a theorem is faithfully taught as a consistent theorem of physics even generations after it has been disproven. So, the so-called "Second Law of Thermodynamics," already disproven about two centuries before it was first advanced by Kelvin and Clausius, in 1850, and massively disproven afresh since, is still taught as solid doctrine in textbooks and classrooms today.

Similarly, it is the tendency in the scientific professions, to receive crucial evidence disproving some theorem not as an occasion to correct the theorem-lattice, but rather to patch up appearances by such means as suffixing new values of calculations into standard reference-tables.

This sort of stubborness, and the lags in formal scientific consistency associated with it, ensures that no extant formal mathematical physics is ever consistent, despite the intent that it must be made to appear so. On this account, the actual process is messier than our illustration suggests. Yet everything we have said remains true as a matter of principle.

The ideal process we have described, as distinct from the messier state of actual scientific practice, is an image of the intent governing what we term a <scientific revolution>. A crucial discovery sets off a transformation in the structure

of the mathematical-physics theorem-lattice. During this process of transformation, the leading issue is to determine which choice of alternate lattice is crucially consistent with the evidence bearing upon each theorem revised to conform to that lattice. The completion of that process of selection, in that manner, is the intent of the process associated with implementing a <scientific revolution>.

For convenience here, tet us assign the label, Lattice B, to the alternate theorem-lattice chosen by the indicated sort of sifting-process. Let us assume the case, as typified by a neo-euclidean change in the parallel postulate of euclidean geometry, that the amount of change in the set of axioms and postulates of Lattice A, prompted by crucial-experimental evidence, is of the smallest imaginable degree.

From this standpoint, let us focus our attention on the logical gap between Lattices A and B, the gap defined by the want of any consistency, pairwise, among theorems each members of the respective lattices. This "logical gap" of inconsistency between the two lattices, is comparable to a <mathematical discontinuity> of <finite mathematics>. or, more meaningfully, a <topological singularity>.

From the standpoint of deductive logic, of which <finite mathematics> is but one disguise, this "gap" is logically an irreducible "point," analogous to the axiomatically self-evident "point" of euclidean geometry. It is axiomatic, in all deductive systems, whether logic, euclidean or neo-euclid- ean geometry, or any <finite mathematics> of the <discrete manifold>, that logic collapses into a state of psychedelic paranoia whenever it is challenged to explain, "What is inside that point?" So, it is the case with the point-like "logical gap" between two deductive theorem-lattices which differ from one another by the smallest conceivable axiomatic degree.

This difficulty is illustrated by the proposition, that to map the "point-like space" of inconsistency between Lattices A and B, in terms of deductive method, we must be able to construct a set of axioms and postulates which prove the necessity of existence of the internality of that point, hereditarily.

The history of the differential calculus, most briefly, illustrates the problem.

The specifications to be satisfied, to develop a differential calculus, were detailed by Johannes Kepler. This aspect of Kepler's work is to be seen in terms of the problems underscored by his development of the world's first mechanical arithmetic calculator, developed to assist his astronomical calculations.

These projects, specified by Kepler, were taken up in France, by the circles of Desargues (of Desargues' theorem fame), Fermat, and, most notably, Blaise Pascal. Pascal constructed a mechanical calculator, referenced to Kepler's design of his own calculator, and worked upon differential number-series derived from the standpoint of a non-euclidean, or constructive geometry.

Gottfried Leibniz, who had already attacked the same problem, independently, before his arrival in Paris to work under a Jean-Baptiste Colbert "science scholarship," devoted the portion of the years 1672-1676 in Paris largely to the completion of a differential calculus, making use of the unpublished work-papers, as well as published work, of Pascal. He also developed an improved mechanical calculator, referenced to the preceding designs of Kepler and Pascal.

In 1676, just before leaving Paris, Leibniz submitted a paper on his discovery of the differential calculus to a Paris printer for publication. That paper exists still today, unless it had been destroyed, maliciously, during the recent eight years.

Approximately ten years later, members of the London Royal Society attempted to parody Leibniz's discovery of the differential calculus, with Newton's useless theory of fluxions the result. By the early nineteenth century, the deductionist faction in european science had given up the effort to defend Newton's concoction. The effort was made, to reconstruct Leibniz's differential calculus in deductive terms agreeable to that party. The featured result of this was the later-popularized absurdity of Augustin Cauchy, as hallowed in modern undergraduate textbooks.

The failure of both Newton and Cauchy is a guise of the kantian paradox under examination here. The operative term central to the failures, is the word "infinitesimal." A more indicative description of "infinitesimal," is "the immediate vicinity of smallness approximately equivalent to a euclidean

axiomatic point, including the point itself." In Newton's case, infinite series was the tactic employed to explore this sort of infinitesimal; in the case of Cauchy, the effort was to adduce the calculus from the standpoint of cartesian analytical geometry. Kant adopted the standpoints of both Descartes and Newton as the standpoint of method employed to treat the matter of the kantian paradox.

The reason no such problems existed for Leibniz, will be made implicitly clear in the next topical section of this report. The problem of the point, as a topological singularity, confronts us, in a different setting, in situating the significance of Beltrami's negative curvature of physical space-time within the setting of a Riemann Surface Function of postive curvature, and also in Dirichlet's topological treatment of the point as singularity, the basis from which the Riemann Surface Function is derived within a Gaussian constructive geometry.

What the failures of Newton and Cauchy illustrate, relative to the contrasting discoveries of Leibniz, is that the existence of the point is inherently, axiomatically paradoxical in all formal logic, including the <finite mathematics> of the <discrete manifold>.

The emergence of Lattice B, relative to Lattice A, by prompting of a crucial-experimental hypothesis, is the prototype of a valid fundamental discovery in physical science. This has also another significance, bearing upon the notion of the fundamental laws of the universe, to be considered at a later point, here. For the present moment, it is the subjective side, valid fundamental discovery, which occupies our attention.

To illustrate the point, let us employ the arbitrary labellings, Lattices C, D, E, ... , N, in a different way than we have done in the preceding portion of our review.

Let Lattices A, B, C, ... , N, represent the view of successive, valid scientific revolutions, since the beginning of the fifteenth century, from the standpoint of a <finite mathematics> of the <discrete manifold>. Each of these successive lattices is separated from its immediate predecessor, and also all other lattices of the series, by the kind of logical gap we have indicated for the case previously given.

In this way, we have implied that fundamental scient-
ific process is a continuing process, to such effect that the
preceding state of progress conditions the possibility of its
successor. Since that process is demonstrably a real one, it
is implied that there must exist some intelligible representat-
ion of the process as a continuous function in the sense the
general notion of a mathematical physics implies.

However, this process is one in which the most charact-
eristic feature of the process is an ordering and density of
what <finite mathematics> regards as mathematical discontinuit-
ies. It must be a mathematical function which adopts <the
density of such discontinuities per interval of continuing
action> as the characteristic feature of the function to be
supplied. Indeed, the search for the basis on which to re-
present such a continuing function is the characteristic feat-
ure of the leading currents in nineteenth-century science, from
Gauss through Riemann, Beltrami, and Cantor.

Kant conceded that such a progress existed, but denied
emphatically that it could be mapped "teleologically." The
denial was premised upon the argument we have described thus
far. Since the "logical gap" can not be repesented by means
within the powers of deductive method, and since Kant refused
to consider any alternative to deductive method, he pronounc-
ed the "logical gap" to be unintelligible. Hence, he assert-
ed that the mental processes of the type responsible for valid
fundamental scientific discoveries, the creative mental pro-
cesses, were unintelligible.

That is the kantian paradox.

Wiener & Physical Economy

At the beginning of the nineteenth century, Newton had
been discredited. During the 1794-1814 period of the work of
Monge's Ecole Polytechnique, British science had become stag-
nant, and but for a few contributions to astronomy, irrelev-
ant. The world's leadership in physical science and techno-
logy was in France, where it had lain since the middle of the
seventeenth century. Immediately prior to 1815, world lead-
ership in physical science was provided by the collaborators and
students of Monge, including Lazare Carnot, Fourier,
Legendre, and so forth. The quarrel within science was
between Leibniz and Descartes, with LaPlace a leading polit-

ical spokesman for the Cartesians and the mechanistic stand-
point of the same anti-Leibniz eighteenth-century Enlightenment
on which Kant based himself.

A change occurred, steered from the 1815 Congress of Vienna, during the years 1815-1819. The principal target of the "venetian party" of Count Capodistria, the controllers of that Congress and authors of the Holy Alliance, was the influence of the American Revolution and the continued existence of the United States itself. The chief subsidiary target was the influence of Leibniz in science. To this latter purpose, Monge and his program of education were ejected from the Ecole Polytechnique, Lazare Carnot was exiled to Germany, and French science was placed under the direction of the Holy Alliance's neo-cartesian darlings, LaPlace and his protege, Augustin Cauchy.

The systematic persecution of French science in France was the circumstance under which Alexander von Humboldt, the brother of the friend of Friedrich Schiller, and Prussian education minister Wilhelm von Humboldt, transferred world leadership in science to Germany. Alexander von Humboldt and his circle sponsored the cause of the persecuted French science of Monge and Carnot, using a remarkable scientific publication known as <Crelle's Journal> as the vehicle for maintaining the continuity of the physical science being persecuted in France.

By virtue of a political accident, that Go:ttingen university was under Hannoverian supervision, Gauss's direct leadership of nineteenth-century German science was not institutionalized until the 1840s, although the work of Gauss had been highly honored by Carnot's and Monge's circles during the napoleonic period, and although Gauss was a leading influence even during the early period of Queen Victoria's reign, when Go:ttingen science was being virtually suppressed by Hannoverian policy.

Precisely at the moment Gauss's Go:ttingen emerged as the leading center of German scientific progress, a major, international onslaught against the work of Gauss and his collaborators was launched, in 1850, through the vehicle of a circle of scientific thugs including such famous names as Kelvin, Clausius, Helmholtz, et al. The beginning of this onslaught, was the assertion of what came to be known as "The Second Law of Thermodynamics." Accompanying this was a sys-

tematic effort, characterized by Kelvin accomplice James C. Maxwell as a commitment to discredit any scientific work on the continent representing "geometries other than our own."

This war against the work of the circles of Gauss was based upon the rise of positivism in France, and the use of the cult of "neo-Kantianism" as the vehicle for attempted legitimizing of French positivism in Germany.

As a consequence, the whole of nineteenth century physical science in Germany itself, and wiithin Europe as a whole, became primarily a battlefield of political warfare between the liebnizians, centered around the circles of Gauss, and the neo-cartesians centered around Kelvin et al.

As the writings of Kelvin, Clausius, Maxwell, and Rayleigh are explicit on this point, the principal motive of their work was not the search for scientific truth, but pol- itical warfare against Gauss's circles. Out of this political warfare by the anti-Gauss faction, came the work of Ludwig Boltzmann, who established a systematic basis for what became known as statistical thermodynamics.

The focal point of Boltzmann's work was the class of phenomena described in statistical mechanics as characterized by "negative entropy," or <negentropic> phenomena. This class of phenomena had been studied more or less exhaustively by Leonardo da Vinci and his collaborators, a study which provided the crucial basis for Kepler's astrophysics.

Since the work of Leonardo and Kepler, it was well understood in all leading work of physical science, that the harmonic ordering of living processes' growth and morphology of function is the paradigm for the notion of what we call <negentropy> today. All living processes are characterized by an harmonic ordering congruent with the Golden Section, whereas, except at the extremes of scale of astrophysics and microphysics, non-living processes are characterized by a different harmonic ordering, not harmonically congruent with the Golden Section. Why this distinction must necessarily exist in our universe was not adequately understood until the work of Gauss and his successors in elaborating the Gauss-Riemann complex domain.

Today, when we say <negentropic>, we signify processes whose characteristic harmonic ordering is congruent with those

of living processes, and thus congruent with the Golden Section. When we say <entropic>, we signify processes whose characteristic harmonics are those which Leonardo da Vinci associated with non-living processes. These distinctions were elaborated further by Kepler, and form an integral, central feature of his astrophysics.

For reasons explained in following topical sections of this report, all physical processes characterized by <negentropy> are not only harmonically ordered in congruence with the Golden Section; there are also characterized, from the standpoint of <finite mathematics>, by an increasing density of <mathematical discontinuities>. Hence, from the stand- point of naive <finite mathematics>, they belong to the class of "non- linear" processes, as we have indicated the nature of "non-linearity" of the creative processes, relative to the kantian paradox.

Hence, there are two verbs for which <finite mathematics>, and formal deductive logic generally, can provide no intelligible sort of physical referrent: "to create," and "to live." Intelligible referents for these two verbs exist, but they are all of the specific form of "non-linearity" which confronts a <finite mathematics> in Leonardo's and Kepler's treatment of the characteristic harmonic ordering of living processes.

The interesting, if most fraudulent feature of Boltzmann's work in statistical mechanics, is his attempt to show that he could "explain away" the existence of such <negentropic> processes, by showing the nature of the statistical improbability of accidental occurrence of such <negentropic> effects within a <discrete manifold> characterized by overwhelming probability of <entropic> states. In effect, he argued that <negentropic> processes are nothing more than highly improbable, but possible states within a process which is overall characteristically <entropic>. In a later sect- ion of this report, we shall see how fraudulent Boltzmann's argument was, from the standpoint of mathematics itself.

For the present moment, it is sufficient to emphasize the subsidiary point, that actually <negentropic> processes are of a special class of "non-linear" processes, which can not be represented by any mathematical construction, such as Boltzmann's, consistent with a deductive form of <finite mathematics>, or represented physically in terms of

ontological assumptions axiomatically characteristic of a <discrete manifold>. What Boltzmann did, was to employ the conceptions of statistical method hereditarily traced to La Place, at their worst.

This construction by Boltzmann, his so-called H-theorem, was adopted by Professor Norbert Wiener et al. as the basis for what became known as "information theory." The related notions associated with John von Neumann's work, are axiomatically of the same nature of scientific fraud.

Once this reporter, during 1948, had identified the formal aspects of the fraud perpetrated by Wiener et al., the question was more clearly posed, of which physical referrent to choose, on which to base a comprehensive rebuttal of Wiener's "information theory" hoax? For reasons to be made implicitly obvious in this report, the choice of physical referrent was Leibniz's definition of <economic science>, a science of <physical economy>.^*/

NOTE: [Page 24 of this manuscript text] The best choice of political-economy in which to situate the study of physical economic processes is that known as <The American System of political-economy>, as officially defined as U.S.

policy by Treasury Secretary Alexander Hamilton's Dec. 1971 Report to the Congress, <On The Subject of Manufactures>. The American System of political-economy, even during most of the eighteenth century prior to Hamilton's work, had been indebted to the work of Leibniz in all respects treating the physical features of the economic process.

However, since the 1870s, especially since the 1880s, the American System of political-economy had been replaced in practice of the U.S. government by the dogmas of the British East India Company's Haileybury School, of Adam Smith, Jeremy Bentham, Thomas Malthus, David Ricardo, and John Stuart Mill. The most consistent representation of the British East India Company's dogmas in political-economy, is that elaborat- ed, on the basis of adopting the work of the Physiocrats and Ricardo, by Karl Marx. Hence, by refuting the axiomatic errors characteristic of the four volumes of Marx's <Capital>, we address most directly the axiomatic fallacies which Marx admired and adopted as the foundations of his work, from the political-economy of the British East India Company. Marx is the most consistent of all exponents of the work of Adam Smith, to such effect, that by refuting Smith one automatic-

Leibniz, in the development of the science of physical

NOTE: [Manuscript page 24, cont.] ally refutes the entirety of Marx, and vice versa.

Opposition to Marxian socialism aside, Western economies today, to the degree they believe themselves to operate on the basis of the political-economy dogmas of Smith, Malthus, Ricardo, and Mill, actually operate on the basis of the dogmas of Karl Marx, even in the sense of an erosive destruction of entrepreneurial economy, converging upon a hybrid system of global power-sharing with Moscow's imperium. This is consistent, and not accidentally, with the softness toward Moscow exhibited among some of the world's notable financier potencies, and the sponsorship of sundry leftist causes by such financier potencies.

Marx's <Capital> is based upon the same assumption adopted by the avowedly pro-socialist Wiener: the prevalence of universal entropy. This is exhibited early in <Capital>, in the reference to the "cell-form" of "value," is characteristic mathematically of Marx's simplistic predecessor of von Neumann's "solutions to simultaneous linear inequalities," is exhibited grossly in Marx's models of "simple and extended reproduction," and is the basis for Marx's kantian-paradoxical "Internal Contradictions" of <Capital III>. Note, at several points, Marx is sufficiently aware of the hoax-quality of his constructions to warn the reader he is ignoring the role of technological progress in his linear constructions. He is apparently aware, that if technological progress is taken into account, his entire theory collapses.

This reporter's treatment of Marx's fallacies, from this standpoint, was one of the topics which he addressed during the relevant period. By examining the political-economy of the Physiocrats, Smith, et al., in this light, the similarities and differences in the governing ideologies of respectively western and Soviet economies were adduced in a way which permitted analysis of the subjective factor, the source of the differences in performance between modern political-economies and the potential of the physical economies which those political-economies subsume politically.

This approach to application of principles of physical economy to the reported Gross Domestic Product data of UNO-interfaced national governments and supranational institutions, was indispensable for the actual problems of empirical analysis posed to physical economy.

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economy, over the interval 1672-1714, defined physical economy as treating the causal correlation among three elements of a function: <technology>, <power-density>, and <physical productivity> of the operatives ration of the total labor- force of societies. He was the first to define rigorously the term <technology>.

Leibniz's economic science was adopted as part of the <cameralism> curriculum of universities in Germany, and continued to be taught so into the early nineteenth century. It was taught in eighteenth-century France under the rubric "polytechnique," and thus formed the basis for the system of polytechnical institutes of several nations, including Italy. Through students of Leibniz's work in the United States, including circles associated with William Penn and Cotton Mather, Leibniz's economic science made its way into the think- ing of the future United States during the early eighteenth century, and was combined with the banking and credit polic- ies of the pre-Andros Massachusetts Bay Colony, to the effect seen in the three principal reports to the Congress by Hamilt- on, establishing the anti-Adam Smith <American System of political-economy> of the George Washington, Monroe, and John Quincy Adams administrations, and of the American Whigs and President Abraham Lincoln.

In Germany, the American System is represented by the influence of Friedrich List, and Leibnizian economic science is the basis for the work of such associates of Carnot and Monge as Chaptal, Ferrier, and the same Dupin whom U.S. secret intelligence's counterintelligence operative Edgar Allen Poe chose as the model for the hero of his famous detective stories. Legitimately, Leibnizian economic science is often identified as an advance within the current of political-eco- nomy of France's famous minister Jean-Baptiste Colbert, and would be rightly viewed as a continuation of the earlier work of Leonardo da Vinci, and of the Anglo-French "commonwealth party" of such as Jean Bodin, during the sixteenth and seven- teenth centuries.

Leibniz took into account the propositions treated by such as Leonardo and the early cameralists, and transformed these matters into the subject of physical science. This reporter's own work in economic science is premised directly on the stipulations provided by Leibniz.

For reasons made clearer in the succeeding sections of

this report, the solution to the kantian paradox must necessarily define implicitly a mathematical function whose included effect is to measure <technology> as Leibniz defined <technology>. In that case, such a function enables us to measure the causal correlation of advances in technology with the constraint of increasing levels of <power-density>, and resulting increases in the <physical productivity> of the operatives ration of the total labor-force of a society.

If we define the labor-force of a society as determined by characteristics of demopgraphy, such as life-expectancies, and by obvious sorts of reference to the composition of the family household, the effect of what we may attribute to be technological progress in the history of mankind, is expressed as an increase of not only the potential level of population, but, more rigorously, the <potential population-density>.

Population-density as such is expressed in the obvious way, as the number of persons self-sustained by the physical productivity of operatives per average unit-land-area inhabited. The <potential population-density> is expressed, for initial approximation, by a limit of population-expansion, relative to an existing level of productive technology; that first-inspection limit is the point at which further expansion of population-density causes a fall in per-capita output of the society as a whole.

This limit is expanded, to a higher value of <potential population-density>, by technological progress. This technological progress takes the form of increase of the level of technology of productive practice. That may be accomplished, up to a limit, by deploying existing, relatively more advanced technologies in use, to replace the use of less advanced ones. With that considered, the limit on expansion of <potential population-density> is defined by the highest level of technology available for use. Thus, the most crucial feature of technological progress, is the raising of the limit beyond that represented by the highest of the levels of technology in use. It is the expansion of that limit, to higher levels of <potential population-density>, which defines the required function in a general way.

The possibility of effective use of a higher level of technology, is conditional upon the <power-density> available, both per-capita, and per unit of land-area. The two

have a combined expression as <power-density> per per-capita unit of population-density. The required physical definit- ion of <power-density> is supplied in an appropriate setting, later in this report. It is sufficient, at this point, to state that the level of <technology> which can be effectively employed in a society is delimited by the <power-density> per per-capita unit of land-area.

In practice, for convenience, <power-density> per per-capita unit of land-area is treated as a <cpnstraint> of a function expressing the causal correlation of technological progress with increase of the <physical productivity> of the operatives ration of the total labor-force, within the total population.

This configuration of considerations of physical economy defines the required correlation between the creative processes, as typified by successive, valid fundamental discoveries in physical science, and the increase of the <potential population-density> of society. That approach correlates the formal refutation of Wiener's hoax with the most appropriately conclusive class of physical evidence.

Estimates by an associate stipulate, that for the case of an hypothetical "primitive hunting-and-gathering society," living under conditions of a cenozoic wilderness, the approximate potential population-density is one individual per ten square kilometers, or a limit upon the planetary population of approximately ten millions individuals, of very low life-expectancy, living at a bestial level of culture and subsistence.

Today, there are more than five billions persons. Had existing levels of technology, such as those available at the beginning of the 1970s, been applied generally, this planet could sustain more than fifteen billions persons at a standard of consumption and life-expectancies comparable to those of western Europe and North America during that period. Thus, the <potential population-density> of this planet has been increased by a factor of three decimal orders of magnitude, without taking adequately into account the higher standard of living supplied per individual.

With the frontier technologies presently available for development, and rather rapid deployment following their development, the <potential population-density> could be in-

creased by an additional decimal order of magnitude over the coming two to three generations, speaking conservatively.

On this account, since no animal species could double its <potential population-density>, even approximately, this historic distinction of the human species, shows that those creative mental-processes, upon which we rely for the generation and efficient assimilation of scientific and technological progress, sets man absolutely apart from, and absolutely above all species of beasts.

Hence, all efforts to estimate human population potential by methods of "animal ecology," or kindred approaches, is an axiomatic absurdity. Similarly, every effort to define "human nature" as premised upon a hedonist sort of "seeking of pleasure, and avoidance of pain," instinctively, is an absurd likening of human nature to that of the beasts. The creative mental processes, as typified by valid fundamental scientific discoveries, are the characteristic feature of individual human nature, and of societies. The existence of the human species depends entirely upon them.

To make clear the way in which an intelligible representation of those creative processes is to be supplied, contrary to the kantian paradox, we must next turn to the subject of <non-euclidean>, or <constructive> or <synthetic> geometry, and then, in turn, examine the relevant implications of the more advanced form of <synthetic geometry> elaborated by Gauss, Riemann, et al.

II. NON-EUCLIDEAN GEOMETRY

It is demonstrable, that the geometry practised by the classical Greeks, and their egyptian (cyrenaic) contemporaries, prior to the writing of <Euclid's Elements> by "the false Euclid," was not a deductive geometry, but of a form called <constructive geometry>. However, the form of <constructive>, or <non-euclidean> geometry known to modern Europe is that first given to us in the <De Docta Ignorantia> ("Of Learned Ignorance") by Nicolaus of Cusa.

We know, from Cusa's handwritten sermons, that the crucial discovery included in that work was accomplished during the course of his reworking of the theorems on the subject of "the quadrature of the circle," by Archimedes. He

reports, in those sources, that he had discovered a super- ior solution, a solution which is a featured element of <De Docta Ignorantia>, and also his later writings on matters of method of the physical sciences.

The simplest feature of this discovery is a proof known to modern topology textbooks as <the isoperimetric theorem>. This theorem, usually attributed to the form it was recapit- ulated by Bernouilli and Euler, shows how we may construct a demonstration that the circle is the smallest perimeter enclosing the relatively largest area, and the sphere the smallest surface enclosing the relatively largest volume. Following Cusa's elaboration of a "Maximum Minimum" principle, in his <De Docta>, the Bernouilli-Euler work on this matter is associated with the generalized notion of the minimum surfaces relative to a quantity of work accomplished if a surface is considered as representative of the action employed to accomplish that work.

In physics generally, the deeper implications of such a constructed demonstration lead to the notion of a principle of <physical least action>, as this was defined rigorously by Leibniz. In its simplest expression, directly referenced to the content of <De Docta>, this introduces the notion of a circular form of (minimum) physical least action, as generating the (relatively maximum) work accomplished by that action, work typified by the area subtended.

This leads us directly to a notion of <multiply-connected> circular action. <Doubly-connected> circular action is defined thus. In every interval, circular action is acted upon by a second moment of circular action, upon which it acts similarly, in turn. Further, implicitly, every doubly-connected circular action is acted upon in every smallest interval by a third circular action.

This notion of <multiply-connected> circular action already defines a <non-euclidean>, <constructive> geometry, and leads, later, to the initial elaboration of a higher form of <non-euclidean>, <constructive> geometry by Gauss.

The introduction of construction according to the principle of even merely doubly-connected circular action, suffices to generate the existence of a point. Continuing this, the existence of the "first straight line" is also generated. From this starting-point in constructions derived from multiply-connected circular action, the entirety of the scope of

<Euclid's Elements> is covered, in the manner presented by Professor Jacob Steiner, Riemann's geometry instructor, in his <Synthetic Geometry>.

At no point in this process, is any axiom or postulate employed, and deductive methods are banned throughout. That is the definition of a <non-euclidean geometry>. This is the method employed by Leonardo da Vinci after Cusa, and of Kepler and Leibniz later. Kepler's astrophysics is already nothing but an astrophysics completely subsumsed, as to mathematics, by a <non-euclidean geometry>. What we have just described as the nature of the origins of such a constructive geometry, and have illustrated by the reference to Kepler, yields the strict definition of a <non-euclidean geometry>, a definition which is not to be changed by any development of mathematical physics during the nineteenth and twentieth centuries.

What Gauss et al. provide, relative to this, is a new development within <non-euclidean geometry>, and nothing different than that.

The commonplace self-deception on this account, is usually the result of comparing the constructive geometry of multiply-connected circular action with the scope of <Euclid's Elements>. The careless observer argues, that since constructive geometry prior to Gauss <appears> to do but little more than cover the same topical area as euclidean geometry, constructive geometry is nothing more than a different way of approaching euclidean geometry.

The fallacy of this argument is more readily shown by examining the history involved.

The political history of the fourth century B.C. Mediterranean littoral was dominated by two sets of events, those leading to the fall of the Persian Empire, and the emerging supremacy of the adversaries of Plato's Academy at Athens following the assassination of Alexander and many of his family members and closest allies. The victors of those latter developments had been allied with a circle inside Greece associated with such opponents of Socrates and Plato as Isocrates (of the Athens School of Rhetoric) and Isocrates' protege, Aristotle.

The alliance of those Greek opponents of Socrates and Plato with the Magi of Syria and Canaan (Phoenicia), is

roughly comparable, on many points, to the instance of those western financier interests and social-democrats today seek- ing a global-power-sharing arrangement with Moscow's expanding imperium. There is much more than a mere parallel; the ideologies represented in that way today are hereditarily, and historically derived from the ideologies represented in the alliance between the Magi and such Greeks as Isocrates and Aristotle then.

Out of the victory over Alexander the Great and the Academy of Athens, there came a variety of developments which reached a high-water mark of activity during the second century B.C., including the fabrication of the dogmas of Stoicism and the work of the "false Euclid," <Euclid's Elements>. The latter was chiefly the work of those Peripatetics who had fled to the patronage of Egypt's Ptolemy, from vengeful justice afoot in Athens, following the betrayal and assassination of Alexander.

<Euclid's Elements> represents the fruit of an effort to show than a geometry might have been constructed entirely by means of Aristotle's sort of deductive method. In this form,

despite the different approach to geometry typified by the writings of Augustine on such topics as music, deductive geometry was gradually insinuated into western Europe from Byzantium.

Through the great Cosimo di Medici, copies of original Greek manuscripts were secured from the collection assembled by Photius. These included theological documents which had a major role in the course of the ecumenical 1439 Council of Florence, and a collection of manuscripts of Plato and of Archimedes. All these documents were copied and carefully distributed to selected readership throughout western Europe, under chiefly the patronage of Cosimo. The program of study unleashed was modelled upon the Christian humanist form of secondary instruction of Groote's Brothers of the Common Life, whose graduates are typified by Thomas a Kempis, Nicolaus of Cusa, and Erasmus.

In fact, as Cusa's sermons reference the origins of what is called "the isoperimetric theorem" today, the entirety of <Euclid's Elements> was subjected to the form of criticism known as the method of the socratic dialogue. In effect, the entirety of deductive geometry was turned upon itself, to demonstrate that its own evidence proved it contained an axiom-

atic fallacy. That is what is represented, in a simple way, by the textbook proof of the isoperimetric theorem.

In other words, crucial evidence demonstrated that an existing theorem-lattice was false, and false hereditarily throughout. Instead of modifying some among the set of axioms and postulates of euclidean geometry, as the <neo-euclideans> of Special Relativity purported to do at the beginning of this present century, Cusa et al. discarded all of that set of axioms and postulates, and set out to make a scientific revolution by replacing the entire set of axioms and postulates with what they had proven in a crucial way.

That scientific revolution is <non-euclidean geometry>.

The relationship to the case of the kantian paradox should be more or less obvious. No mere change of some of the set of axioms and postulates solves the kantian paradox; that paradox is inherent in all deductive method. A solution ex- ists, but only if we replace deductive method entirely, by a different method. Hence, the importance of the development of a <non-euclidean geometry> from the starting-point provided by Cusa.

It was more or less obvious, following the work of Cusa and Florentine collaborators associated with Filippo Brunelleschi, that the crucial feature of <Euclid's Elements> which must be a next focus of attention, was the case of the five platonic solids. This study, and some of the practical im-

plications of the results, are the content of Luca Pacioli's
<De Divine Proportione>. Kepler emphasizes, and demonstrat-
es, that the entirety of his hypothesis is based either dir-
ectly upon the work of Cusa, or that of Leonardo, Pacioli,
and their collaborators.

For such reasons, Leonardo, Kepler, Desargues, and
Leibniz are exemplars of the elaboration and use of a <non-
euclidean geometry> based upon multiply-connected circular
action.

This includes a feature of <non-euclidean geometry>
referenced prominently by the twentieth-century <neo-euclid-
ians> of Special and General Relativity. In place of a
Cartesian space of the X, Y, Z, and T orthogonal axes, space
itself is "curved" in the manner implicit in assuming that a
unit quadrilateral is characterized by acute or obtuse inter-

ior angles, rather than right angles, and is therefore
variously spherical, hyperbolic, or elliptic. Such a
curvature of space defines that physical space-time as
self-bounded geometrically.

The curvature of physical space-time was already explor-
ed, especially relative to the physics of vision, by Leon-
ardo. Leonardo proved, for example, that relative to re-
flection of light, or transmission through a flat glass sur-
face, or through a curved lense, the physical space-time of
vision is not rectilinear or spherical, but elliptical or
parabolic. This involves his treatment of the problem of the
<caustic>, a matter already investigated by Brunelleschi in
respect to developing the construction of the dome for the
Cathedral of Florence.

Kepler made a kindred discovery, that the orbital (least
action) pathways of the planets are elliptic, rather than
circular. On that account, Kepler defined the need for a
general solution to the nature of elliptic functions as one of
two leading requirements, including the differential calcul-
us, he bequeathed to his successors. Later, Gauss's reexam-
ination of Kepler's work led not only to a solution of the
problem of defining harmonic orderings among elliptic funct-
ions, but, as from this point of reference in his work on the
arithmetic-geometric mean, the elaboration of a higher form of
synthetic, <non-euclidean> geometry.

During the same period, Leonardo was involved in a more
comprehensive study of the curvature of physical space-time.
This was centered upon the implications of the proof, that in
visual space, only five species of regular polyhedra can be
constructed, the five platonic solids. As Leonhard Euler
reworked this proof more exhaustively later, the key to the
platonic solids is the fact that the regular pentagon and the
dodecahedron whose faces are equal regular pentagons, are

constructed from the Golden Section, and the other four platonic solids derived from the dodecahedron.

Leonardo, Pacioli, and their collaborators observed, that all living processes' morphology of growth and derived function is harmonically ordered in congruence with the Golden Section. This is to be compared with an earlier attempt to estimate the growth of populations of individual species, by Leonardo of Pisa, the famous "Fibonacci series." This arithmetic series converges upon the values given by harmonic ord-

erings congruent with the Golden Section. If we exclude the extremes of scale represented by astrophysics and microphysics, harmonic orderings congruent with the Golden Section are unique to healthy living processes, whereas all non-living processes are not.

So, a non-euclidean approach to the topics of <Euclid's ELements> showed that physical space-time has a definite curvature, and that the limits of this curvature are expressed by harmonic orderings congruent with the Golden Section. Between the extremes of astrophysics and microphysics, only living processes are congruent with this limiting curvature.

Kepler adopted this standpoint of Leonardo's approach to the physics of vision, to advance the hypothesis that the fundamental laws of physics can be adduced from nothing but this curvature of physical space-time. This, as Gauss showed later, Kepler proved crucially, to the degree that all criticisms of his work by Galileo, Descartes, and Newton later, were scientifically absurd.

The crucial proof is the case of the asteroids, Pallas and Ceres. The asteroids were first observed by telescope nearly two hundred years after Kepler had supplied the harmonic values for their orbits. Gauss showed that Kepler's values were the correct ones. What made Gauss's proof crucial, was the significance of the derivation of those values in Kepler's solar hypothesis.

On the basis of a <non-euclidean geometry> of multiply-connected circular action, alone, Kepler calculated not only than an additional planetary orbit existed between those of Mars and Jupiter, but that the harmonic peculiarities of that necessary orbit were such that the planet must have been destroyed by harmonic singularity. He supplied the harmonic values for the orbit of this planet, which was proven, approximately two hundred years later, to be that of the principal asteroids.

Had it been proven that no planet had ever existed in that orbit, that would have been a crucial proof of some hereditary flaw in Kepler's hypothesis. The mere discovery of the asteroid belt, tuned between the values of F and F# for a Sun set at C below Middle C, was already a crucial proof of some essential degree of soundness in Kepler's hypothesis; the fact that the asteroids had the harmonic orbital characterist-

ics he had specified for them, was absolutely crucial. This proved, that as far as his construction goes, his hypothesis is accurate. To do better, we must employ a more advanced form of <non-euclidean geometry>.

The phenomena of the asteroids have a further significance, also bearing on proof of a crucial feature of Kepler's method. There is no doubt that the asteroids are the jet- sam of an exploded planet in that orbit. However, the ef- fect of the explosion was absorbed in the eccentricity of the orbital pathways of those pieces of jetsam, while the harmonic orbital values were preserved! What this reflects, although it does not suffice to prove it, in and of itself, is that the laws of the solar system are derived from the curvature of physical space-time, and from no kinematic considerations of the sort associated with the newtonian system's axiomatic feat- ures.

Moreover, Kepler's Third Law, derived from the same basis, is the most important of the laws of astrophysics observations today. Indeed, the very existence of at least most of the planetary bodies depends upon a thermonuclear fusion, at much higher energy-flux densities than within the Sun itself, occurring in an envelope of material, orbiting proximate to the Sun. That envelope is demanded by Kepler's Third Law, as applied to the "shedding" of higher rates of rotation by a rotating star. It is indicated that the fusion occurring in that envelope, at the appropriate point in the Sun's "life," was an electromagnetically polarized fusion, well suited to generate the periodic table of our solar system.

For similar reasons, Kepler's laws prescribe a definite distribution of the content of that envelope, as in spiral arms, to such effect that the higher ranks of the periodic table are concentrated in the inner planets, this side of the asteroid belt, and the gaseous giants beyond. In this configuration, the orbits of the planets are not determined by their relative masses, but their relative masses are determined by the determination of their orbits in a keplerian way.

The point we are stressing, by aid of these illustrations, is the qualitative difference between a mathematical physics premised upon a <non-euclidean geometry>, and a mathematical physics whose mathematics is of the formal deductive sort associated with the <finite mathematics> of a <discrete manifold>.

In the latter case, the mathematics is a mere description of phenomena, a system of deductive description superimposed upon the physical evidence. In a physics based, instead, upon a <non-euclidean geometry>, any statement in the mathematics of that physics is immediately a set of specifications for a crucial experiment. We shall demonstrate this important point by reference to an interesting admission by Isaac Newton.

"Negentropy"

Those physical phenomena which rightly incur description as <negentropic>, share a common harmonic ordering congruent with the Golden Section. This is the correct definition of <negentropy>, and the statistical definition which Boltzmann's H-theorem supplies to "information theory" is absurd even in the case the phenomena referenced can be shown to be negentrop- ic in the sense of harmonic orderings congruent with the Golden Section.

In Kepler's laws, the universe as a whole is a <negentropic> process. We know today, that the curvature of subatomic physical space-time is also <negentropic>. The universe as described by Galileo, Descartes, and Newton, is not. On this point, Newton offered an interesting admiss- ion, apparently overlooked by the nineteenth-century fabric- ators of the absurd "Second Law of Thermodynamics." The reader may verify our summation of Newton's point from the original.

Newton confessed, that his physics caused it to appear that the entire universe was winding down, in the sense associated with a mechanical time-piece. That is true; it his confession of the reason for this appearance which is interesting. He acknowledged that his appearance is absurd, but explained that this appearance must be blamed upon his choice of mathematics, and upon, implicitly, the fact that he would tolerate no different choice from among available mathematical methods. Kepler's alternate, non-euclidean method existed, and Newton professed to be sufficiently familiar with it not only to attack it, but to plagiarize it by means of inverting Kepler's determination of universal gravitation, to arrive at Newton's own.

For reasons implicit in our treatment of the essential

features of the kantian paradox, any system of deductive <finite mathematics> referenced to the <discrete manifold>, describes an <entropic> universe. On this point, we anticipate material to be covered in the third section of this report, to assist us in making clear the relevant implications of material we have covered thus far.

There can be no adequate representation of any <negen-

tropic> process without resort to that higher former of <non-euclidean geometry> associated with the construction of the Gauss-Riemann complex domain. This domain is elaborated through construction, by substituting a conic form of self-similar-spiral action in each place circular action occurs in multiply-connected circular action. The immediate result of multiply-connected self-similar-spiral action, is the generation of hyperbolic forms of mathematical discontinuities, which appear as apparent points of topological discontinuity in one of the successive Riemann (positive) surfaces of a Riemann Surface Function. All negentropic processes are situated elementarily in such a Gauss-Riemann complex domain of such characteristics.

This connection to Kepler's work should not be astonishing. The Golden Section is the metrical characteristic of all projections of the conic form of self-similar-spiral action upon the space which ordinary opinion associates with a dis- crete manifold. The characteristic of real processes mapped within that complex domain, as projected so, is harmonically ordered elliptic metrical characteristics combined with the Golden Section.

Hence, an effort to represent a negentropic process mathematically, requires a mathematics equipped to treat the harmonic ordering of what appear to be mathematical discontinuities as the primary feature of the function constructed.

Hence, the simpler form of <non-euclidean geometry>, employed by Kepler, is conformal with the more adequate results mapped within the Gauss-Riemann complex domain. Hence, it is the characteristic of <finite mathematics>, that is is characteristically unable to consider mathematical singularities of the relevant types, which obliges the finite mathematics of the discrete manifold to ignore all evidence which pertains to the characteristic <negentropy> of a process.

Hence, the superimposition of such a finite mathematics

upon the physical evidence, must always result in the conclusion that the processes considered occur within a characteristically <entropic> universe. Thus, when, later, Kelvin, Clausius, et al. attempted to blame nature for their "Second Law of Thermodynamics," it was not nature, but their bad mathematics which was entirely to blame.

If finite mathematics abandons all semblance of reason, and retreats to the irrationalism of statistical methods, the the result is even much worse. Indeed, that is the history of popularization of statistical methods. Once the crucial evidence, considered even from the standpoint of what is called a classical method of treating the discrete manifold, proved empirically, crucially, that our universe is <non-euclidean>, wherever classical methods showed this, physics retreated into the irrationalist realm of statistics.

Granted, statistical treatment of observations is not entirely useless; it is sometimes unavoidable. However, nothing can be proven by statistical methods; the best we can show is that the observed results are not consistent with the assumptions we have had concerning the processes examined. Statistics never proves that an assumption is correct, and can not not show conclusively that such assumptions are wrong. It merely prompts us, at best, to look into real causes for apparent discrepancies more deeply, and that by methods which are crucial, not statistical. Few professionals in physics or social "sciences" are more irrational, than those who have been induced to believe that "statistics is science."

III. THE COMPLEX DOMAIN

Implicitly, a <non-euclidean geometry> premised upon multiply-connected circular action requires that discard the rectilinear coordinates of cartesian geometry, and replace these by a cylindric coordinates, in which, in the first approximation, simplest illustrative case, constant rotation is occurring in time.

The side-view of each cylinder, projected upon a flat surface, is a simple sine-wave.

The scope of a multiply-connected circular action defines the entirety of the constructable features of euclidean geometry so. With this we can progress approximately as far as

Fourier Analysis, but no further. We must go further.

Simply, in the simpler constructive geometry, we are left with the situation in which the necessity of certain existing forms can not be constructed. The problem of trisecting angles, and explicit construction of the regular heptagon, are simple illustrations of the point.

The simplest way to effect a solution, is illustrated by holding the rate of rotation of circular action constant, while increasing, at a constant rate, the area or volume subtended by constant rates of rotation. This yields, in respect to time, a regular cone inscribing a self-similar spiral.

The plane projection, as upon a flat surface in a plane perpendicular to the axis of the cone, is a spiral whose metrical characteristic is the Golden Section. The other characteristic of each cycle of rotation of the spiral, are projected ellipses primarily defined in terms of four points of reference within each rotation. These ellipses are defined by plane cuts through the cone. The points of reference for the four cuts pertain to the whole of one rotation, the geometric mean, the arithmetic mean, and the arithmetic-geometric mean.

Real processes are defined, by substituting self-similar spiral action for circular action, and deriving the results of multiply-connected action accordingly. Every spiral is acted upon, in each interval, by a corresponding spiral-action. This supplies an initial mapping of reference for the complex domain. These constructions are transformed into the algebraic form of statements, as locus-propositions stated in the appropriate trigonometric terms.

The algebraic form of the characteristics of functions in such complex-domain physical space-time, is trigonometric point-sets, which must be conceptualized as an harmonically ordered density of topological singularities ("mathematical discontinuities") per interval of action of the process referenced.

There is a useful, but inadequate theorem by Georg Cantor, the most important of his theorems, which defines the implicitly enumerability of the density of discontinuities within an arbitrarily small, chosen interval of action. This illustrates the simplest case of problems of the complex domain

to be solved by means of what are called <transfinite functions>.

Cantor's theorem is modelled, at least implicitly, upon an approach to a particular problem treated successively by Euler, Dirichlet, and Riemann: to determine the density of prime numbers between any two numbers. That treatment takes the question of counting prime numbers out of the domain of formal number theory, and situates it as a problem of ordering of topological singularities in a continuous function. At last report, computer iteration of sieving procedures of formal number theory have shown no error in Riemann's function for this.

The work of Gauss and his successors, around Go:ttingen, was centered upon physics problems of electromagnetism, Riemann emphatically so. Why should Riemann, and Dirichlet before him, take up Euler's treatment of prime-number density? In general, as Riemann emphasized in an important among his dissertations, the implicit challenge posed by elaboration of the Gaussian complex domain, was the power of that mathematics to provide the basis for an intelligible representation of any seemingly arbitrary function, on the condition that that function is in correspondence with real occurrences.

The problem centers around defining the density and ordering of topological singularities, such as mathematical discontinuities, as the most characteristic features of a non-linear function. The construction of a function, in Gaussian synthetic geometry, which satisfies that characteristic, is the first requirement to be satisfied, in the several, successive steps of achieving a solution. If and when this aspect of the problem is solved, the next step is to address the problems of scaling the function. There are further considerations, but what we have described is sufficient for our purposes here.

Once one is gripped by the importance of that problem, any specific problem which is interesting in those terms of reference, especially the relatively very simple ones, is likely to lure one's efforts. In such instances, the expenditure required to achieve success, or even partial success, is always useful to physics.

That much description is sufficient to situate the matters to which we turn next.

Mind & Physical Economy

Even by no more than simple inspection, it ought to be obvious, that healthy economic growth, if measured in terms of physical economy, has the harmonic characteristics of a living process. Even in the crudest terms of approximation, the expansion in per-capita physical wealth, or expansion of the population, may be approximated by supplying proper coefficients for a modified Fibonacci series. Healthy economic growth of physical economy, signifies a combined effect, which may be approximated crudely by combining two such ser- ies, each with the appropriate coefficients.

One series measures rates of total per-capita physical output, of both households' and producers' goods, subject to the requirement that the household-goods market-basket per capita must increase by some marginal factor. The second ser- ies augments the per-capita output and requirement, in terms of growth of the population.

Such were the considerations which entered into this reporter's judgment, that healthy physical-economic processes are characteristically negentropic, at the beginning of his 1948-1952 project.

The inherently negentropic character of creative-mental processes, is shown in a similar way.

The John F. Kennedy administration adopted two measures which supplied the U.S. economy the best rates of growth, into 1965, during the post-war period to date. These two measures were the President's adoption of a commitment to a "crash program" of aerospace development, which generated the highest rate of surge of technological progress since the war-time period, combined with a program of investment tax-credits which stimulated a flow of investments which, in substantial part, made use of the improved technologies.

As during relevant earlier periods in our national history, and during comparable periods in the history of other nations, average annual increase of the physical productivity of operatives by a factor of between 1.05 and 1.10, are reasonable expectations for Western national economies, whenever governmental monetary, fiscal, credit, and economic policies foster this. Only calamitous events, exogenous to the inter-

nal processes of physical economy, or bad policies, such as those the Johnson administration introduced from 1965 onward, will abort the continuation of such rates of growth.

The continuation of such a pattern of increase of productivity, also approximates a Fibonacci series. We emphasize the Fibonacci series, rather than "geometric growth," to maintain consistency with our reference to the work of Leonardo, above.

In both sets of illustrations, referencing Fibonacci series as a point of comparison, we have merely demonstrated that what we formerly recognized as healthy physical-economic growth, prior to the introduction of the cult of "post-industrial society," in scale and in terms of physical productivity, referenced conceptions which were implicitly statements about <negentropy>. It must be recognized, however, that the historical illustrations which we either actually or implicitly referenced, pertain to society's successful absorption of technological progress, while saying almost nothing explicitly about the way in which advances in technology are generated.

Nonetheless, those illustrations do tell us something about the generation of technology, if only implicitly.

If a society shows a capacity to absorb technological progress successfully, that does indicate that the techno- logy had been accumulated to levels at which it could be absorbed at such rates. What used to be commonplace know- ledge among industrial managers, twenty years and more ago, tells us something about the way in which this absorption occurs.

As Leibniz stressed, there is an apparent causal correlation between the increase of power-density per operative and the physical productivity of that operative. Up to a point, we may use his example of heat-powered machinery: the increase in physical productivity of the operative is apparent- ly a function of the increase of the heat-power supplied to the machine. However, just as <power-density> is a constraint governing the possibility of efficient realization of improvements in technology, so technology might be viewed as a constraint upon the benefits realized from increase of the power-density.

We must examine technology more closely. To simplify his treatment of <technology> as such, we have the following hypothetical case.

Imagine the case, that two machines, each supplied the same quantity of heat-power, at the same rate, and each used for the same type of output, by the same operative, alternately. However, the rate of output by the operative, using one of these two, is greater than the rate of output using the other.

In this case, the difference in rates of output is determined by a difference in the internal organization of the two machines, or the organization of the <power> itself. Hwoever, as will be indicated below, the notion of <power-density> used by this reporter takes account of differences in the quality of the heat-power supplied, to such effect as to exclude every consideration but the internal organization of the machine. For our purposes at this present moment, that qualification can be assumed.

Earlier than twenty years ago, in an age before the spread of the "post-industrial" cult, most literate persons would associate "better internal organization" of one machine, relative to another, with the popular, but largely misleading word, "efficiency." To put aside notions irrelevant to our example, let us add the hypothetical stipulation, that the internal "heat loss" within the operation of the two machines is identical.

In the simplest of examples, what superior internal organization of a machine signifies, is qualities such as the degree of sharpness of cutting edges of tools. This is carried over into preference for the use of a laser as a cutting-tool, relative to a mechanical tool-bit. It connotes also, the gain, by deploying the same number of calories, or watts, at higher "potential" (<energy-flux density>), as the history of rise of productivity of the iron and steel industry over the past several hundred years illustrates the point. It connotes, also, the advantages of greater electromagnetic resonance, relative to the material or process being worked. It takes into account both linear, and more powerful non-lin- ear expressions of electromagnetic resonance.

The harmonic ordering of application of <power-density>, as a governing principle of organization of work, was first

elaborated by Leonardo da Vinci. Leibniz's development of

economic science, defined <technology> as a principle of in-
ternal organization of productive processes to be defined from
the standpoint of physical least action, as a physics based
upon non-euclidean geometry defines physical least action. The
application of the notion of technology to define the principles
of design of internal organization of machinery, was
essentially completed by Lazare Carnot, with considerat- ion to
supplementary work accomplished by other collaborators of
Gaspard Monge. The transition from mechanical, to elec-
tromagnetic features of internal organization, is represent- ed
by the work of such collaborators of Monge as Fourier (Fourier
Analysis) and Legendre.

The work of Fourier and the younger Sadi Carnot carry
relevant linear forms of electrohydrodynamics (e.g., Ampere) to
a limit, at which point linear electrohydrodynamics breaks
down, and a non-linear successor to Fourier Analysis is re-
quired. It is a mistake to assume that Fourier Analysis is
wrong, because of its failures beyond a certain point; such
work brought physics to the point at which such problems were
confronted, and the basis for the next round of scientific
revolution thus brought into view (e.g., the Weierstrass
Function of Karl Weierstrass).

Thus, Leibniz's definition of <technology>, as a not-
ion to be addressed from the vantage-point of non-euclidean
concepts of physical least action, defines a line of inquiry
which is continuing today.

We shall return our attention to that topic below. Now,
we must consider another topic, also viewed from the standpoint
of the common knowledge of qualified industrial management prior
to the "post-industrial" counterrevolution.

Let us trace the history of a successful crucial exper-
iment, from the physicist's laboratory, to its putative end-
result as an increase of the physical productivity of operat-
ives.

The design of a physicist's experimental apparatus is the
work assigned to a special sort of machine-tool industry, the
machine-tool shop formerly associated with the physics depart-
ment of a well-organized university. Similarly, successful
experimental work of physics laboratories is transformed into
tools of production by commercial machine-tool firms, firms

whose work imitates the construction of experimental apparatus
in the traditional machine-tool shop associated with a univer-
sity machine-shop.

The introduction of physics discoveries into commercial
machine-tool firms, in this way, provides those firms not so
much a specific design of machine-tool as a modular principle of
design, a new dimension of generally applicable capability by

that firm. This new capability is then incorporated into specific forms of machine-tools supplied to commercial (e.g., industrial) customers of that machine-tool firm.

So, the new physics principle is conduited, to become the employment of that principle in the machine or analogous process employed by the industrial operative.

All of these connections and relations are susceptible of statements in the form of an adequately defined electromagnetic domain.

For example, in first approximation, we can think of the relative capital-intensity of operatives' production in terms of energy-density. This includes not only the energy employed to power the machine, but the energy consumed by the production and maintenance of the machinery, equipment, and tools employed. More generally, the social division of labor within the totality of the operatives ration of the labor- force, can be expressed as an energy-relationship.

Leibniz described the advance of technology in development of heat-powered machinery of increased power-density, as a relationship between man and nature. This is described as producing an effect, such that one operative, equipped with such machines, might do the work of a hundred other operatives lacking such machinery.

From this standpoint, we divide all output of operatives into two broad classifications. There is the operative who produces a "final" physical product, consumed by households, or by society in ways other than goods used up in the process of production itself. There is the operative employed in production of goods used up in the processes of production. The work of the second, defines the productive relationship of the first to nature. This affects not only the operative of the first classification, but also those of the second.

So, the notion of capital-intensity is properly defined as far as inspection can carry us. Such capital-intensity can be expressed as an energy-density function.

The leading economists of the American System, such as Henry C. Carey, described technological progress as measured in terms of <economy of labor>. This is measured in two successive degrees of approximation.

In first approximation, <economy of labor> signifies that the same quantity and quality of physical goods can be produced with less average labor expended by society.

However, as Leibniz defined the relationship of labor to productivity in his first, 1672 paper on econonics, <Society &

Economy>, a certain level of productive technology requires a corresponding level of consumption by households. In ef- fect, higher levels of physical productivities of operatives, requires higher standards of living of operatives' households. Thus, the effective market-basket of household consumption must be increased, relative to the market-basket required at lower levels of technology.

On the latter account, if growth is to be sustained, the per-capita physical output of operatives must increase more rapidly than the required increase of the standard market-basket. It is the ratio of total average physical output, to average market-basket requirement, which implies the rate of growth sustainable at any level of technology.

So, <economy of labor> must be defined approximately in terms of the second approximation, rather than the first.

If we assume that there is no dysfunctional increase of the ration of non-productive employment, including unemploy-ment, in the labor-force as a whole, <economy of labor>, considered into respect to demographic characteristics of family households, implicitly suggests a <potential populat-ion-density>. Thus, in approximation, a mapping of the increase of <economy of labor> correlates with increase of <potential population-density>.

Again, that does not define the causal relationship between technological progress and increase of potential population-density. It describes the <result> of such a cor-relation. Despite that qualifying limitation, such studies

are indispensable; these are the terms of practical observa-tion in which the crucial experiments, bearing upon the causal correlation, must be conducted.

Also, the considerations identified thus far do show us the nature of the effect of technological progress, that it is intrinsically <negentropic> in effect.

"Information theory," although axiomatically absurd, does address a number of effects which are real ones. We have noted earlier here, that what "information theory" re- ferences as a negentropic phenomenon, is often actually negentropic, even though the statistical theory employed is absurd. Similarly, in "information theory," the effect of driving a process with a source of entropy, usually results in greater entropy in the targetted process; conversely, to drive a process with a source of negentropy, usually results in less entropy in the targetted process. This observations, too, are valid, although, again, the analysis of the ob-servations is absurd. It is the latter of the set of ob-servations, on which we now focus attention.

Negentropic Ideas

There is a relevant mathematical analogy, which is better than a mere analogy. We referenced this in citing Newton's "confession." The superimposition of an inherently entropic form of mathematics, the finite mathematics of the discrete manifold, produces an analysis of phenomena which always assumes events occurring within a universe which is overall characteristically entropic, whether the phenomena addressed are either entropic or negentropic. Conversely, the employment of non-euclidean geometry always shows the universe to be characteristically negentropic, and recognizes phenomena to be either entropic or negentropic in the fashion this is done by Kepler.

Similarly, the ideas which govern human practice are either entropic or negentropic in tendency of effect. The contrast of non-euclidean (negentropic) ideas, with deductive (entropic) ones, illustrates the point, that ideas are either negentropic or entropic in themselves, not merely in effect.

Turn attention back to our treatment of the kantian

paradox, this time from the vantage-point of a non-euclidean geometry associated with multiply-connected self-similar-spiral forms of physical least action.

The existence of the logical gap between successive Lattices A and B, shows that the creative processes of the individual mind, variously responsible for the generation or efficient assimilation of this transformation, are characteristically non-linear processes. The remaining question is: are those processes not only non-linear, but are they also negentropic, as the results of technological progress suggest? They are negentropic.

Look back to 1948-1952. This reporter had not settled upon the approach to mathematical representation of creative processes, until his 1952 concentration on the work of Georg Cantor, and the decision to focus upon Riemann as the point of reference was not made until near the close of that year. The formal proof that these processes are negentropic depends upon those latter considerations. How did the reporter know that they were negentropic at an earlier point of the project? Something more essential than mathematical formalities was, and is involved.

Simply, what is the nature of <human knowledge>? In the light of the formal treatment of the kantian paradox, as represented earlier here, we are obliged to differentiate between what most persons assume to be <knowledge>, and those products of a higher quality of mental activity, which do in fact represent true <knowledge>.

The fact that the valid progress of scientific knowledge is represented by a succession of scientific revolutions, shows that the best among consistent theorems existing at any temporary level of development of science, are merely conditional knowledge. Each such theorem will be overturned in a significant degree by the next scientific revolution, and the scientific revolution after that one. Does there exist, therefore, a quality of human knowledge which is not conditional in such a sense?

Everything which ordinary opinion, educated or other, represents as a "fact," or an expert judgment of fact, is no better than a proposition, a proposition in the form of a theorem, which has the status, from the standpoint of the best available standards of knowledge, or being merely a con-

jecture, a well-defined hypothesis, or a theorem based upon crucial proof.

Of rigorously defined scientific hypotheses and theorems, it is to be said in their favor, that they are the best current judgments of fact available. Any contrary proposition, unless it reflect the onset of a higher level of science, is a poorer judgment of fact than the scientifically acceptable one. All other forms of judgments are inferior to the scientific ones, as scientific ones are subject to the qualification, respecting the emergence of future science, which we have just indicated.

In a succession of valid scientific revolutions, what remains relatively constant throughout that succession, is the agency of creative-mental processes, by means of which those revolutions are accomplished. Hence, truth must lie within the domain of the creative-mental processes, rather than in scientific propositions as we ordinarily understand those.

This is not sufficient. The creative-mental processes themselves undergo development in the course of successive scientific revolutions. The creative principle is not a constant set of constraints throughout; it is itself undergoing development. Thus, truth must lie in some principle governing that process of self-development of the creative mental processes.

So, truth is transfinite, relative to finite knowledge. It is not located within that first order of transfiniteness, but rather in a higher, second order of transfiniteness.

These observations are not speculative. If we examine the internal history of scientific progress from the vantage-point of the <non-euclidean> method, the first and second order of transfiniteness are demonstrated empirically to have been efficient agencies.

Thus, truth is identified with an ordering-principle
efficiently governing the successful development of the creat-
ive-mental powers through the course of successive, valid
scientific revolutions. Let us detour for a few moments, to
look at what we have just said in a different choice of lang-
uage.

The characteristic of the best scientific knowledge at

any level of development of science, is a form of knowledge
which is <imperfect>, but on which all but fools rely until
<less imperfect> science emerges to become available. The
valid progress of science thus represents <a pathway of dimin-
ishing imperfection>.

Relative to this process, the creative-mental processes,
by means of which this <imperfection> is lessened, are also
<imperfect>. Each valid scientific revolution represents a
lessening of the imperfection of the creative-mental process- es
themselves, relative to the work accomplished by the creat-
ive-mental processes employed at the preceding scientific re-
volution. It is that development of the creative-mental pro-
cesses, along <a pathway of lessening imperfection>, which is
required to generate the next scientific revolution.

It is <the process of lessening imperfection> of the
creative-mental processes which defines a meaningful sense of
truth. The certainty of truth lies only in conceptualizing as
<existence>, efficiently ontological existence, that which
subsumes a sense of direction of <lessening imperfection>.

The location of truth in such a second-order transfin-
iteness does not render it vague. What are are addressing, is
the domain which classical philosophy associated with the term
<metaphysics>. The paradigm for such a principle of truth is
Plato's socratic dialogues taken as a unified pro- cess.
Rather that considering any one of these dialogues as such,
consider that which is characteristic of them taken as a whole.

Given any proposition. Instead of challenging that
proposition by methods of rhetoric or deductive argument on
behalf of a counter-proposition, adduce the assumptions which
underlie that proposition, as if "hereditarily." This strat-
um of assumptions corresponds to that of a set of axioms and
postulates. Then, consider the assumptions which underlie the
first set of assumptions. This deeper layer of assumpt- ions
corresponds to the level on which the choice between the
deductive and non-euclidean notions is situated.

Respecting the first stratum, immediately underlying any
proposition, the mere alteration of some among the set of
axioms and postulates, no matter how far-reaching this might

be, leaves the disputants stuck on the same level, with no way to escape, unless we reference the deeper stratum, as we have done that in this report.

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L: EDITORIAL, NEC, JEFF STEINBERG
W: EDITORIAL, HELGA ZEPP LA ROUCHE, EEC, JOHNATHAN T.

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This deeper stratum is also illustrated, by considering the conflict in propositions separating Kant from Leibniz. What is at issue in these propositions is no difference among differing notions of sense-certainty and deduction. The issue is a difference in <method>.

This difference in method involves two choices by Kant. Kant adopts the naive notion of sense-certainty as a form of knowledge. He adopts the neo-aristotelean deductive method. Leibniz rejects such notions of sense-certainty, in keeping with the scientific tradition from Brunelleschi and Cusa, through Leonardo da Vinci, and Kepler. Although these, sense-certainty and deduction, might be named as distinct considerations, they are but two aspects of the same matter, for reasons we have elaborated here earlier.

It is useless to debate the contrasted propositions on the level of propositions. To debate them on the level of the axiomatic stratum of underlying assumptions is futile, since this obliges usto choose either the axiomatic basis of Kant, or of Leibniz. We can not choose both simultaneously; we can not resolve the differences between the two on that level. We are obliged to turn our attention to the deeper level: to ex- amine rigorously the considerations underlying the assumption to choose a method akin to either of the two.

Once we have settled the issue on that deeper level, the issues of axiomatics are decided accordingly, and on that basis, in turn, we may determine which proposition, one of the two, or one which is neither, is the proper response.

Once the development of the constructive, non-euclidean geometry of the Gauss-Riemann complex domain was underway, the evidence so developed obliged science to shift attention away from the notions of independent variables associated with finite mathematics, to the transfinite. The characteristic variability of functional representation of real physical processes was located primarily in the harmonic ordering of density of singularities per interval of action.

Not only was this attention to the necessity of transfinite orderings consistent with the method of the socratic dialogue; the origins of the mathematical notion of the transfinite are located proximately in the employment of the socratic method by Cusa et al., to address the questions of method underlying science, thus establishing then the first

approximation of a non-euclidean geometry as the right method of scientific inquiry.

This method, whether in its general form of socratic method, or the methodology of transfinite orderings in mathematical physics, has adducible rules, corresponding to the rules governing the process of lessening of imperfection of the organization of the creative-mental powers.

Up to this point, we have defined only implicit truth. We have shown how and where it is available to be discovered. This leaves yet unsettled, whether or not such truth can be expressed as an intelligible form of proposition, counter to ordinary formal propositions. By "proposition," we refer to the communication of arguments, as the explicit, conscious representation of judgments. The term "conscious" is operative.

The question of truth thus becomes: can truth as we have defined it be made conscious? Obviously, it can be made conscious; we are have supplying a conscious form of representation of such truth here.

Truth is, broadly, consciousness of the activity of one's own creative-mental processes, consciousness of them as an organized process, whose organization is susceptible of intelligible representation, consciously. Adequate truth

requires that the creative-mental processes be consciously
grasped in terms of reference to their process of development.

One of the immediate implications of this, is that we
know only what we know in terms of the creative-mental process-
es. It is only that which is supplied to us through the
agency of development of our creative-mental processes, which
is truly <human knowledge>. Supposed knowledge which depends
upon any different consideration, is merely opinion, not
knowledge, and is untruthful, even when it is not dishonest,
by virtue of lacking the adequate premises of true human know-
ledge.

What man knows from experience, references only that ex-
perience which is historically efficient in the correlation be-
tween implicit willful intent and consequences.

History is most readily understood to this purpose from
the standpoint of economic science. Human existence depends

upon the maintenance and increase of the potential population-
density. This is accomplished through technological prog-
ress, as subject to the constraints of <power-density>. This
causal process is sustained by the manner in which the creat-
ive-mental powers of the individual generate and efficiently
assimilate scientific and technological progress.

The development of those creative-mental powers of the
individual is the essence of mankind's existence for itself,
since it is upon this that continued human existence depends.

Into this development, the diverse labors of many con-
tribute. Parents transmit the cultural potential upon which
depends the potential for development of the inborn creative-
mental potentials of the very young. Those who generate and
maintain the classical fine arts contribute to this process, as
much, and sometimes more than well-ordered educational
institutions. These, and kindred labors are as essential to
technological progress as the work of scientists. Whoever
contributes positively to this result, in some necessary as-
pect, on even the limited scale of a parent, for example, is
doing something which is necessary as an historically effic-
ient personal activity.

Unlike the beasts, whose range of adaptive behavior is
delimited by inheritance, mankind has no fixed range of adapt-
ive behavior of this type. Relative to this, technological
progress represents a succession of willful changes in the
adaptive behavior of the human species. These changes are not
narrowly technological in range of practice directly flow- ing
from them; they are nonetheless coherent with the change in
physical productivity, modes of work, market-basket, and
general potential population-density made feasible through those
changes in behavior which bear directly upon technolog- ical

progress. They all have some necessary sort of bearing upon the effective result of technological progress, or of lack of it.

Insofar as technological progress shows its potential to generate a negentropic form of increase of potential population-density, this shows us the nature of the task submitted to the human mind's creative mental-powers. The fact, that through no other means but those creative powers, man has demonstrated the capacity to choose modifications of behavior consistent with negentropy as the result, shows that the mental-creative powers are inherently negentropic, as much as

non-linear.

"Psychophysical Parallelism"

The nineteenth-century positivists were terrible people, whose contribution to human civilization was chiefly a negative one. Even when they submitted a useful sort of provocative hypothesis, as in the instance of the younger Freud's bungling efforts to define a "psychophysical parallelism," where the question was fruitfully interesting, their suggested answers to the question were not.

It is evident, that the human mental processes, including the creative-mental processes, correlate in some way with the physiological medium in which they exist. The positivist's reaction to that, as in the instance of Wiener's dogma of "information theory," or the kindred speculations of John von Neumann, is a stream of absurd impositions upon both the notions of the mental processes as such, and the biological substrate of such mental activity.

First, on the matter of biology. Leonardo, Kepler, et al., showed that living processes are characterized by negentropy, as we have defined negentropy here. The task of biological science, is to present every aspect of living processes with this characteristic, negentropic function as the hereditary feature of every statement associated with the verb "to live."

What has become predominant as biology is the mortuary pathologists' biology, a biology of things which have ceased to live, or living things considered in light of the process of dying adopted as the characteristic function studied. This unwholesome state of affairs came about in the manner shown by our scrutiny of Newton's "confession." The superimposition of the finite mathematics of the discrete manifold, upon the phenomena of biology, is the pervasive problem.

Thus, with relatively rare exceptions, the putatively scientific view of the physiological sub-strate of mental activity, is premised axiomatically on either one of two errors, or some combination of them both.

From the one side, that of Wiener and von Neumann, the processes of mentation are presumed to represent the brain as a

computing machine, created for the purpose of describing reality in terms of the finite mathematics of a discrete manifold. Such folk tend to seek in physiology of the brain and nervous system only that kind of substrate which fits their fallacious conception of brain-function.

The approach from the side of molecular biology presumes the species of electrochemical reactions associated with prevaling dogmas of molecular biology. In other words, a kind of biology adduced from limitless faith in the unique author- ity of the finite mathematics of the discrete manifold.

Worse than either, is their combination, notably on theose occasions where the two types rally for interdisciplinary proceedings, at which specialists in linguistics adduce a common language ostensibly for combining the two approaches.

Such nonsense aside, until recent developments in high-energy plasma physics, the difficulty in attempting to define a negentropic function, subsuming, ordering living process- es, has been blocked by the supposition that there is no negentropic potential in the atomic elements and isotopes of the periodic table. This assumption respecting atoms brings the assumption of universal entropy into biology, by the back-door of deductive methods in mathematical physics.

As long as physicists cling to the cartesian-newtonian tradition, of viewing so-called elementary particles as either point-masses, or bundles of more elementary sorts of point-masses, only the euclidean method, or a neo-euclidean one can be employed in a consistent physics. This difficulty is axiomatic; therefore, no mere procedures, such as clever manipulation of mathematical functions, can get around the "hereditary" implications of defining sub-atomic physical space-time as a domain of elementary point-masses.

Relative to such assumptions, to construct a coherent negentropic function for the macro-molecular scale of what are treated empirically as the simplest building-blocks of living processes, it were necessary that the curvature of sub-atomic physical space-time be some Gauss-Riemann version of a keplerian curvature. The fact, that the most characteristic biological activity on that scale involves radiation of coherent photons-phonons in discrete quantization, merely underscores this point.

It is now demonstrated that sub-atomic physical space-time is "keplerian," in the qualified sense of the Gauss-Riemann complex domain. From that vantage-point, it is shown that the periodicity of proton and neutron combinations, to conform to the periodic table, fits prediction based upon such sub-atomic curvature. Otherwise, beyond that prelimin- ary showing, such a line of inquiry into the "keplerian" packing of the atomic nucleus is but a preliminary hypothesis, so far. Nonetheless, it indicates the nature of the problems to be investigated in light of the proof that sub-atomic space is so "keplerian."

Effectively, the point-mass has been smoked out of its last hiding-place in the recesses of the sub-atomic domain, and been exposed as nothing more than a singularity. At a minimum, we now know with certainty, that this sub-atomic domain is harmonically ordered in the manner cohering with negentropic living processes.

Expelled from biology so, is not only the last phant- asm of the point-mass, but with it the malthusian dogma of natural selection. As Nicolaus of Cusa was the first modern to elaborate the reasons for this, evolution is "teleologic- al," at least in the sense Kant denied teleology in his <Critique of Judgment>. Implicitly, the evolutionary trans- formations of the biosphere belong within the Gauss-Riemann complex domain, governed by functions associated with a defin- ition of "potential" cohering with transfinite functions.

The fact of creative-mental processes suffices to de-monstrate that the characteristic feature of the human mind is negentropy, as we have defined it. Hence, whatever we dis-cover to be the physiological correlate of mental processes, that correlate is negentropic. We do not need the evidence of the human mind's creative processes to demonstrate that living processes are characteristically negentropic; our stressing that correlation here is to set the stage for the point immediately to be made.

Mankind is the first species which evolves its behavior in a negentropic way, and that to the effect that this negen-tropy is the subsuming feature of those mental processes which are conscious. In other words, <with man, for the first time, the principle of life, negentropy, becomes an effic-iently conscious controller of itself.> It is that which casts man in the image of God, and which renders all human Notion of

life sacred by virtue of the divine gift of man's potential for creative conscious thought.

Economic Science, Once More

To define the phase-space for the <power-density> constraint of physical-economic development of increased <potential population-density>, we require a coordinate system of the following minimal spefications.

Our first pair of coordinates, for the phase-space upon which we concentrate, is two double-cones, corresponding to a double-conic form of self-similar-spiral action. The coordinates correspond to magnetic and electrical potential, and the spiral in each is scaled to direction of rotation and re- lative (coherent) frequency.

The multiply-connected characteristic of this coordinate system, defines the characteristic event of the phase-space as a harmonically-ordered distribution of hyperbolic singularities. The density of such singularities per interval of action is the definition of "potential" for this phase-space, and all functions devised are referenced to the notion of a potential surface of equal potential defined within that phase-space.

The definition of "potential" is <transfinite>.

This brings us to a problem, whose solution is work in progress. It is referenced here, partly because of the importance of solution, but, more emphatically to identify the problem addressed.

It is unacceptable that we associate with the regions of singularity in the positive surface of a Riemann Surface, the notions of a singularity defined by either a "point" or a "hole." The problem has some similarities to that of the logical gap between successive Lattices A and B. To the degree we conceptualize a singularity as a "point" or "hole," we sustain a crippling difficulty in the effort to define what is occurring during the corresponding intervals of a Riemann Surface Function.

The suggested approach to a solution, a way of ridding ourselves of these troublesome "points" or "holes" of singularity, is to "modulate" a Riemann Surface with Beltramian negat-

ive curvature. Such "modulation" would be an hypothetical option for resolving the problem of conceptualizing continuity.

It will be important to the growing numbers of scientists examining the crucial implications of Beltrami's work, to note his exact relationship to Professor Bernhard Riemann. These biographical matters are so intertwined with the foundations of the subsequent world-leadership of Italy's scientists on topics within the field of electrohydrodynamics and the related field of aerodynamics, that the scientific topics can not be grasped adequately without considering these biographical matters.

During the late 1850s a group of scientists associated with the patriotic circles of Cavour visited Go:ttingen, with the intent of integrating their own efforts with fundamental progress being effected by Gauss's successors there. This was the beginning of the personal collaboration between Riemann and the circles of Betti.

Riemann was fatally crippled with a congenital tuberculosis infection, which killed him young, like many members of the Riemann family. During the early 1860s, the years preceding his death, his hands were so crippled arthritically, that he could scarcely write at all. Nonetheless, some of his most important work was accomplished during that period, in Italy, whence, during most of those years, he retired for his health. With a handful of exceptions, his literary out- put was stopped by these circumstances of health; his contin- uing work is reflected in such locations as the notes of Betti on their conversations, and in the fruit of his collaboration with others of that circle, Beltrami most notably.

Betti notes from his garden-walk conservations with the crippled Riemann, Riemann's emphasis, that the education of scientific workers for work in matters of physics fundamentals must be premised on a thorough training in the synthetic geometry of Professor Jacob Steiner, the basic constructive form of <non-euclidean geometry>. We see this reflected in the work of Riemann's italian collaborators during that period, and later, and in the methodological features of the best work in science from Italy during the twentieth century.

Thus, for example, Italy's electrodynamics was a world leader during the early twentieth century, as the example of Enrico Fermi reflects this. Italy's aerodynamics was the best, and Italy was the first to produce the initial form of a

jet-powered aircraft, and to construct, during the 1930s, the world's first supersonic wind-tunnel.

The two most notable reflections of the collaboration between Riemann and Beltrami, is Riemann's prompting of Beltrami to develop, and to publish the latter's exposure of the hoaxes in Maxwell's electrodynamics, and Beltrami's proposal that Riemann's surface functions be corrected to reflect the negative curvature introduced to Riemannian physical space-time by singularities.

On this latter topic, we must correct sharply the prevailing ahistorical trends of practice in scrutiny of fundamental physics issues of the present. The importance of negative curvature of physical space-time was already recognized, on a crucial-experimental basis, by Brunelleschi, during the early fifteenth century. Leonardo da Vinci's treatment of <caustics> is also a crucial-experimental treatment of the significance of negative curvature. The work of

Desargues, and Monge's work on construction of envelopes, and the work of Poncelet, typify the continuation of the work of Brunelleschi and Leonardo in France. It is of the utmost importance, if we are to understand Beltrami's negative curvature effectively, that we reexamine the crucial-experimental basis for all of the leading treatments of negative curvature, in physics, back into the early fifteenth century.

This historical approach, as opposed to the hoaxes circulated as glosses on the internal development of modern science by the <History of the Exact Sciences> project, is essential to afford the student, and the working professional, an effective insight into the point that the fifteenth-century development of non-euclidean method was not merely some abstract speculation in formal geometry, but a revolutionary correction in mathematical method triggered by the array of crucial-experimental evidence which required such a revolution.

In the same vein, it is unnecessary to invent simple pedagogical devices, to make the notion of beltramian negative curvature plausible to oneself as a working professional, or to classes of students, textbooks, or audiences for published dissertations. The suitable form of pedagogical examples was provided by the relationship between crucial experiments and treatment of topics of negative curvature during the fifteenth-century, and up through the 1820s, by

the tradition of Desargues and Monge in France.

Beltrami's own work makes clear, that his proposal on negative curvature within the Riemann domain was in no sense an arbitrary idea based merely upon formal considerations. It was grounded on the sort of historical references to crucial-experimental inquiries we have just indicated above.

In a sub-atomic regime congruent with a Gauss-Riemann form of keplerian physical space-time curvature, negative curvature corresponds to what are referenced as strong nuclear forces, and Riemannian curvature to the corresponding weak forces. From this standpoint, in the nucleus, the possi- ible configurations of protons and neutrons appear as arrays of singularities, so representable, in first approximation, by an archimedean series treated as an extension of the platonic series of Kepler's astrophysics. From the standpoint of topology, the archimedean series confronts us with the same considerations which lead us to consider negative curvature.

That, for example, implies topologically, that the neutrino problem of nuclear fission must be treated as a characteristic reflection of such a configuration in sub-atomic physical space-time. It implies, more fundamentally, that the unified field of Riemannian physical space-time is defined in the combined terms of reference associated with modulation of

Riemann space of positive curvature by regions of singular- ity associated with beltramian negative curvature. This lat- ter proposition rests not upon what are regarded as sophistic- ated sorts of reticulations in mathematical physics; the pro- position, or something conceptually-functionally equivalent to it, flows entirely from the simplest sort of axiomatic consid- erations, in the vein of this report.

It is demonstrable, in physical economy, that this same problem arises in the growth and depression cycles of econom- ies. To make this point clear, some qualifying remarks upon the matter of growth/depression cycles are required.

Except in the cause of traumatic calamities externally introduced to political-economies, depressions are never caused by laws of economic science. In economic science, depressions should never occur. Excepting externally intro- duced trauma, they are never caused except by dysfunctions in the political realm. Bad monetary, fiscal, and banking policies are the cause for depressions, which can not be

reversed without changing radically the monetary, fiscal, and banking policies prevailing during the period preceding and ac- companying that depression.

Monetary, fiscal, and credit policies are political decisions imposed upon every detailed feature of economic decision-making within the society. They cause governments, banks, firms, and individuals to make decisions according to a pattern which is entropic in the effects superimposed upon the physical-economic process.

In the case of physical-economic growth, as we have defined the rudiments of that above, the curve of growth is not a simply continuous one. It is marked by singularities, and that in the manner a Riemann Surface Function implies. In the onset and development of an economic depression, the down- ward curve is also not continuous, but is harmonically ordered by singularities in the manner the superimposition of entropy upon a characteristically negentropic process defines such an harmonically-ordered pattern.

In both curves, the negentropic and entropic ones, the regions of singularity are zones of exceptional turbulence, relative to the progress of the curve in regions lying be- tween. From the standpoint of economic science, these reg- ions of singularity, the zones of intensified turbulence, are associated with negative curvature, negative relative to the prevailing trend of the curve as a whole.

In depression-cycles, from the onset to the apparent bottom of the curve, the pattern of developments suggests a roller-coaster ride, or the relaxation patterns shown by a bouncing ball. An accelerating decline, leading into a zone of extreme turbulence, followed by an illusory recovery relative to a more gradual process of general decline over the cycle as a whole.

In the contrasted growth cycle, the zones of turbul- ence are associated with the unleashing of a pent-up potent- ial of technological progress to date. Growth appears to reach a relative limit for a moment, and resumes as invest- ment in accumulated technological progress takes effect. Relatively speaking, that zone of turbulence is also a zone of negative curvature: in this case, an apparent constriction of growth-trends associated with drawing upon the forces of expansion for extensive retooling. Simply, savings and credit

tend to be directed away from simple expansion of per-capita output of final products, into an intensified investment in producers' goods.

The following example, developed by some among the reporter's associates, helps to clarify the point.

During the post-war U.S. period, until 1970, at each point, the rate of growth of physical productivity of operatives conforms to the rate of expansion of investment in basic economic infrastructure reached twelve to eighteen months earlier. This is the most exact statistical correlation in all economic statistics. The physical reason for the existence of that lagged correlation, is the period of time required, on the average, to realize the benefits of overcoming a physical <power-density> constraint upon the technology-driven increase of physical productivity.

Within this period, there is located a zone of turbulence in the economic-growth pattern. Since, in the real economy, many infrastructure-development programs are occurring in an overlapping way, the economy as a whole shows only the average effect of all of these, as the statistical correlation tends to imply.

In this example, the emphasis is not upon technological growth as such, but upon the <power-density> constraint acting upon a different phase-space of the general function, taking the technological impulse for growth as relatively a constant rate.

As should be implicit in our earlier examination of the kantian paradox, a zone of singularity in a function is a region of such turbulence. In this region, the turbulence as such requires representation as negative curvature of physical space-time.

The characteristic of atomic nuclei, from this standpoint, is the enormous instability they represent. On this account, their existence represents relatively very strong forces relative to the forces associated with the positive curvature of the region of physical space-time in which they occur. Thus, to the degree these intrinsically, strongly unstable configurations viewed as atomic nuclei, are stable, there must be something which, ordinarily, matches the strength of the instability; hence, we attribute to this

stability the action of "strong forces."

Insofar as we consider protons, neutrons, electrons, and photons as "holographic," non-linear regions of electro-magnetic harmonics, we have a similar result.

In non-euclidean physical least action, we have only two general possibilities. Either the phase-space is of positive curvature, in Riemann's sense, or negative curvature of the sort represented by Beltrami. These are the principal two minimal surfaces of physical least action possible in a non-euclidean space. Elliptic curvature is feasible as a combination of both, generated by the addition of a singularity of negative curvature to a manifold otherwise of positive curvature.

In non-euclidean topology, the result of the combination of the two as an elliptic sort of relative minimal surface, is a new dimension of action relative to elementary physical least action associated with a simple notion of a steady continuous state.

On this account, what Riemann references as Dirichlet's Principle of topology must be rexamined, as indicating the potential solution to the problem of singularities considered, rather than that actual solution.

This problem may be situated in reference to Riemann's 1859 <On The Propagation of Plane Air Waves of Finite Magnitude>. The geometrical construction of the function elaborated in that dissertation, is hereditarily a derivative of the Monge envelope, of the crucial problem of the <caustic> in the work of Leonardo, and of the crucial considerations which led Brunelleschi to define a surface of constant negative curvature. Both the work of Brunelleschi and Leonardo, are directly relevant to Beltrami's work on negative curvature.

This Riemann dissertation has a powerful place in the internal history of modern physics. It was roundly attacked by Lord Rayleigh, among others, who warned that statistical dynamics would collapse entirely if Riemann's implicit proof of the possibility of transsonic powered flight were accepted. This empirical proof was supplied, and massively, in aero-dynamics. The same function is shown to be characteristic of what is termed <isentropic compression>, in such included instances as the possibility of construction of a thermonuclear explosion. It is, as far as it goes, a characteristic function in physical space-time.

Yet, in the form it is given, it halts at a certain point, the generation of the singularity. At that point, Riemann references the general solution toward which he announced he was working, in his 1854 published dissertation <On The Hypotheses Which Underlie Geometry>. The Dirichlet Principle, viewed from that standpoint, identifies what next occurs after that singularity is reached. It is the crucial region of the transition from the state immediately preceding the singularity, to the post-transonic regime, which is left uncompleted by the function elaborated. Riemann supplies the correct, dirichletian solution to this discontinuity, as most supersonic jet-pilots know that fact implicitly today (otherwise, if they relied upon Rayleigh's dogmas, some terrible accidents would recur).

The exemplary feature of the function, on which we concentrate attention here, is that envelope-function defines the singularity as a region of negative curvature. The point is, that that region of negative curvature defines the form of continuous action which bridges the two successive states.

Extending this in the manner more general evidence suggests, including non-euclidean topology as such, every such zone of singularity in the Gauss-Riemann domain, by the nature of the function appropriate to define its generation, is defined as an hyperbolic singularity, a zone of negative curvature, by the manner in which the generation of the singularity is thus defined.

The same result is presented by the mapping of the creative-mental processes. Creativity, as located within the zone of "turbulence" within a creative-mental process, has the topological characteristics of a socratic method, whose crucial feature is negative curvature.

We may represent that function as Riemann does in the cited reference. The comparison of the potential with the actual result, referenced to the "point" of singularity, leads to the correct result. From this standpoint, we may define cantorian functions, or the like, treating the characteristic of continuous creative (negentropic) processes as the increase of potential defined as increase of the density of singularities per interval of action. However, the internal

character of the existence of the point itself must be resolved, to eliminate the disabling notion that such zones of singularity can be adequately represented by the images of points or holes.

Once we have resolved such topological issues respecting the atomic nucleus and so-called elementary particles other than what is implicit in positron-electron interactions, the issues we have referenced are the frontier of physical science. As soon as we conquer that frontier, we are then confronted immediately by the array of problems associated with the matter/anti-matter actions. How we resolve the questions posed by beltramian negative curvature in the first of these two instances, will define the apparatus on hand for beginning the attack upon the second.

Physical science, and scientific thought more broadly, must now proceed to shuck the axiomatic notions of ontology convenient to the assumptions underlying the <finite mathematics> of a <discrete manifold>. It is now approximately four centuries after Kepler implicitly proved conclusively: <1) That the laws of physics are to be adduced from nothing more than the curvature, and possibly changes in curvature, of physical space-time;> and <2) The the fundamental law of the universe is the reign of universal negentropy>. We have reached the point that progress in physical science dies of stagnation, unless it abandons every assumption contrary to these implications of Kepler's work, for astrophysics, for biophysics, and sub-atomic microphysics.

The result of this shift in the definition of the elementary features of <ontology>, is typified by the proper definition of "potential" in the setting of the non-euclidean synthetic geometry specific to the construction of the Gauss-Riemann complex domain. All well-defined functions are those which treat as the principal variable of characteristic physical functions the harmonic enumerability of density of singularities per interval of action.

To make this the basis for an effective physical science, it is indispensable that we free the notion of topological singularities in the Gauss-Riemann domain, and otherwise, from the status of "points" or "holes" in an otherwise continuous, positive surface. We know that these "points" or "holes" correspond to what conventional utterance today describes as the "strongest forces" in physical science's empirics. Thus,

the intelligible representation of that which occurs, characteristically, inside these "points" or "holes," is defined, for a future potential theory, as the central question facing physical science today.

We must, therefore, save the precious energy of the scientific workers and others available for such work, by declaring it to be a diversionary waste of time to continue to discuss matters bearing upon this within the frames of reference preferred by the fanatical adherents of deductive method. All mental effort available, ought to be freed from such tiresome, and useless diversions of reliving the intellectual failures of a wasteful past, that the creative potential of professional minds must be concentrated upon solving the challenges implicit in our identification of the matter of negative curvature.

IV. PLATO'S CAVE

When we stand here, as far as human knowledge has progressed during a span of approximately 2,500 years, and look back to the level of conceptual knowledge represented in such locations as Plato's socratic dialogues, we enjoy a humbling sense that, respecting fundamentals, science has progressed very little during the course of the past hundred and fifty generations.

As we have stressed here, it is a humbling experience to trace the most profound ideas of today's science, back to three, four, and approximately five hundred years, to Leibniz, to Kepler, to Leonardo, and to Cusa and Brunelleschi. Then, from the fifteenth-century Italian renaissance, we leap back in the mind approximately two thousand years, to the work of Plato's Academy at Athens, and to the Golden Age of Athens before that.

Take, for example, the topic often referenced by the academic's labelling "Plato's Cave." Virtually everything written on that topic, by most British classical scholars and philosophers, and by virtually all U.S. specialists, is contemptible illiteracy. Yet, the conception buried under such an accretion of gossipy commentators' glosses, is among the most profound in the history of civilization.

Plato employed the simile, that the images presented to

us by naive sense-perception, may be likened to the distorted shadows which the firelight casts upon the irregular walls of a dimly-illuminated cave. There was no mystical sort of armchair philosopher's speculation in this; Plato had a crucial experimental proof of that point, the proof that only five regular polyhedra can be constructed in visible space by means of multiple circular action.

There are three aspects to this fable of "Plato's Cave," three conceptions which have repeatedly, insistently reasserted themselves in physical science, over the millenia since. First, the notions associated with naive sense-certainty depend upon overlooking crucial evidence proving that the images associated with perception are not simple mirror-images of the sensory experience which prompts them. Second, that although sense-perception yields us only distorted images of reality, sense-perceptions, although distorted images of reality, are nonetheless shadows of that which is real; in modern language, they are <conformal projections> of that which is real upon our senses. Third, that because of the fallacies of sense-perception, on the first count, but also because of the <conformal projective> character of them, on the second count, our sensory apparatus is a magnificent scientific instrument, if we but learn to read its dials competently.

The failure, and also the refusal of so many to observe that simple lesson, is the chief cause of the irrational mysticism which even most scientific professionals superimpose upon the subject of mathematical physics' complex domain. This common difficulty would not exist, if those befuffled professional ladies and gentlemen would acknowledge that the transfinite asserts no more than the following.

Physics shows us that ontological actuality is located in that transfinite-functional realm of the complex domain, not the discrete manifold of naive sense-certainty. It is demonstrated that the constructable representations of ontological actuality, in terms of transfinite functions are, by their very construction, the objects, singularities, whose conformal projection is the images of sense-perception.

Yet, so far, most professionals reject that evidence. They do so for two reasons. First, for childish reasons, they have never relinquished that infantile notion of naive sense-certainty, and accompanying intimidation by the count-

ing numbers, which is the "common sense" premise for cling- ing to the asserted self-evidence of the discrete manifold. Second, as they have progressed through secondary and university education, they have been drilled and grilled to pass examinations, and to pass as card-carrying members of the relevant peer-ingroups, by reciting every idea referenced to the name of "science" in nothing but the deductive reticulation of the finite mathematics of the discrete manifold.

The example of Newton's "confession," treated above, illustrates the unnecessary complexity and associated confusion of attempted representation of even the simplest phenomena, when the axiomatically false apparatus of deductive mathematics is superimposed upon the evidence.

Take as illustration of this point, the case of the so-called "three-body problem" of newtonian schemas. Newton et al. fail to solve an elementary problem which was adequate- ly solved earlier by Kepler. That demonstration ought to be sufficient to have warned the newtonians, that if such a difficulty exists in the way it does, there is something crucially fallacious in the entirety of the choice of mathematical physics so represented.

Even when the complexities of representation of phenomena arise from no methodological error, as in the best work of non-euclidean physics since the early fifteenth century, many problems acquire a great complexity of representation until a better solution is found. Exemplary is the comparison of Kepler's construction of estimates for the elliptic orbits, with the beautifully simple solution developed chiefly by Gauss.

The complexities occurring in connection with the latter, superior choice of method are the best illustration of the general observation we wish to make at this immediate juncture. The achievement of relative simplicity respecting the fundamental and related problems of scientific thought, occurs when we have applied the "hereditary principle" in the distinct form it occurs within a non-euclidean physics, to trace our way to those problematics of the deeper stratum of underlying assumptions, where the root of the difficulty is to be seen directly.

It is on the level of that stratum, that we are able to compare the development of fundamental notions in terms of the sundry examples taken from a number of hundred, or even thous-

ands of years before our time. Conversely, by examining the elementary conceptions of scientific thought in terms of the address to them thousands, or hundreds of years earlier, our attention is focussed upon the simplest mode of comparison, and our thoughts thus directed to the deeper stratum of under- lying assumptions where present and past conceptions of that sort may be compared properly.

Relative to the Christian humanist mode of secondary education typified by that Groote's Brothers of the Common Life which educated Thomas A Kempis, Nicolas of Cusa, and Erasmus, for example, modern textbook education, in and of itself is much to blame for the poor scientific literacy commonplace among entrants to and graduates of university science programs -- and other studies -- today.

The kinds of Christian humanist secondary education which the Brothers of the Common Life typified, and which Prussia's Wilhelm von Humboldt, like his earlier mentor Friedrich Schiller, sought to revive in a modern form, emphasized the student's re-experiencing the history of development of scientific and other subject-matters, by reliving that experience in terms of primary sources and reconstructed experiments and observations, over a span of more than 2,000 years since classical Greece.

The students in such programs acquired two related kinds of distinctive benefits.

First, the student, by reliving the history of important ideas, acquired an historical perspective respecting capricious fads of mere popularized opinion during his lifetime. Looking at the present, by reliving the vantage-point of the past as a view of the present, and viewing the past from the present by aid of this, affords the student a sense of being an efficient individual within the span of past, present, and future history. The student thinks of the outcome of ideas, and situates the notion of such outcome in an historical perspective respecting the present's causal connection to past and future over spans of centuries and millenia. This is to be seen as a moral sensing of ideas, the which almost totally lacking in the present generation.

Second, by reliving the experience of relatively successful discovery of valid fundamental ideas, in science and otherwise, the student referencing primary sources together

with reconstructed experiments and observations, is causing his or her creative-mental processes to resonate with the greatest minds of centuries and millenia of preceding hist- ory. The student completes such a secondary program with something far more valuable, to the student and to society, than mere learning of approved sentiments and procedures. The intellectual and moral potentialities of the student's character are developed to the highest relative potentiality which education can inspire.

The matured mind, so enriched, has the inclination to think simply, axiomatically, on the most profound topics, and has developed, and continues to perfect the habits of doing so effectively.

This sense of the simplicity of every fundamental conception, must be the standpoint from which every fundamental matter is approached. Once the proper sense of the axiomat- ic simplicity of the matter is grasped, the best result is to be expected from the crucial-experimental pursuit of the array of topics so addressed.

In this report, we have presented everything from a specific standpoint, economic science. In concluding this report now, we do not wish to leave the reader with the implied suggestion, that the same method we have employed here differs from the method we might have employed in addressing other topics, theology not excluded.

The division of labor in society prompts each to pres- ent knowledge from the vantage-point of but one facet of the endeavor of the society's division of labor as a whole, and but one facet of the life's activity of even that reporter. If the reporter so engaged is one of the philosophical temper presented here, variously explicitly and implicitly, there is no important topic respecting the life of society, or the wholeness of his own life, which is not implicitly addressed even when only one facet of knowledge is the immediate reference of communication.

Knowledge is a unity, as the universe is a coherent sort of unity such that every true law in any facet of the universe's activity is also a law of equal efficiency in every other facet. True knowledge is thus a most precious gem of many facets, such that, looking into the heart of that gem through any one of these facets, we are afforded a view of the deeper

interior, which is the same interior seen from the vantage-point of each and every other facet.

For this reason, it is not permissible to represent any facet as truth, except as we show implicitly that it is a true projection of the interior common to, and thus subsuming the many facets. When that has been the approach to representation of the fruit of work of polishing any one of the facets, the reader is thus enabled to look deeply into the soul of the author, and to infer what the same author's approach would be to the peculiar subject-matter of any other facet.

That becomes, thus, the reader's implied responsibility: not to impute to such an author anything contrary to that implication.

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