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SEMINAR ON THE IMPLICATIONS OF NEGATIVE CURVATURE FOR PHYSICS AND BIOLOGY

On January 8, 1989 the German branch of the Fusion Energy Foundation held one of a series of seminars, devoted to the geometrical method in physics and biology. Present at the seminar was Lyndon H. LaRouche, who recently initiated an exciting new line of investigation in this field. LaRouche's recent work centered on the hypothesis, that the so-called "strong forces" of nuclear physics derive from a negative curvature characteristic in the geometry of physical space-time.

Following LaRouche's introduction, in which he traced his own train of thought leading to the new hypothesis, the Italian geometer Dino DiPaoli gave a detailed historical introduction to the topic of negative curvature. DiPaoli led the participants step-by-step to discover the principle of negative curvature underlying Brunelleschi's 15th century design of the Florentine cupola. Next, FEF director Jonathan Tennenbaum discussed the construction of mathematical functions representing physical action in the Universe. He showed how the hypothesis of negative curvature suggests a modification of the constructions originally developed by Bernhard Riemann in the mid-19th century, which remain the best available in mathematical physics to this day. A lengthy discussion followed, in which one seminar participant, a leading German biophysicist, engaged LaRouche in a wide-ranging dialog concerning the principle of evolution.

In the following, the author attempts to convey some of the highlights of the seminar. The reader should bear in mind that the work presented here is ongoing, and leaves many questions still to be answered. Indeed, the seminar's purpose was to stimulate future work!

LaRouche's Introduction

LaRouche began by recounting how he had provoked two American physicists, Professor Robert Moon of the University of Chicago and Daniel Wells of the University of Florida, to make some remarkable discoveries concerning geometrical principles underlying the subatomic domain as well as the macroscopic domain of the solar system.

LaRouche had insisted, in a seminar held in Leesburg, Virginia in 1985, that the Universe is not organized on the basis of pairwise interactions between particles. Instead, the Universe possesses an underlying geometry described by LaRouche as "the curvature of physical space-time", such that apparent interactions between objects in the Universe merely reflect aspects of that geometry. LaRouche emphasized that this had been the methodological standpoint of an entire current of physics, stretching back to Nicolaus of Cues, Brunelleschi and Leonardo, through Johannes Kepler to Gauss, Riemann and Riemann's Italian disciple Eugenio Beltrami in the latter half of the 19th century. Among other things, LaRouche had insisted that the form of the solar system must be derivable from the geometry of electromagnetic action, without reference to Newton's scheme of point-to-point gravitational attraction between the Sun and planets.

Daniel Wells, a plasma physicist knowledgeable in the work of Beltrami concerning so-called "force-free" geometries in electrodynamics, was initially highly irritated at LaRouche's suggestion. [This is incorrect. The general idea that the Wells-Beltrami work could inform the work of Kepler on the Solar System was put forward in the mid-1970s but was suppressed due to the direct intervention of I.I. Rabi, the chief collaborator of J. Robert Oppenheimer and teacher and mentor of Morris Levitt. CBS] But, returning home from the 1985 seminar, he decided to try out the idea. To his own great astonishment, he found that Beltrami's geometry yielded the planetary orbits and velocities with remarkable precision, on the assumption that the solar system originally derived from a "force-free", least action configuration of vortices in a hot plasma. No Newtonian gravitational forces were required! The same sort of structures are routinely generated, on a much smaller scale, in plasma physics laboratories.

When Wells presented his results at a later seminar in Leesburg, it was the turn of senior nuclear physicist Robert Moon to be provoked. For decades Moon had pondered the problem of the physical origin and basis of the periodic table of the elements. Inspired by Wells' confirmation of LaRouche's claim, Moon developed a new theory of nuclear structure. The essential idea is that the properties of the elements of the periodic table derive from the geometry of physical space-time itself. The latter, Moon reasoned, must be "quantized" in a manner reflected by the existence of exactly five regular solids in visual space: the tetrahedron, cube, octahedron, duodecahedron and icosahedron.

In Moon's first, simplified model, the protons in the nucleus are assumed to be singularities distributed on the vertices of nested series of regular solids. The successive "filling" of the vertices of the nested series consisting of the cube (8 vertices), followed by the octahedron (6 vertices), icosahedron (12 vertices) and duodecahedron (20 vertices) yields the series: 8, 8 + 6 = 14, 14 + 12 = 26, 26 + 20 = 46, corresponding to the elements Oxygen, Silicon, Iron and Palladium. These elements coincide closely with the maxima and minima of various functions defining the physical properties of the elements. Furthermore, the first three constitute the most abundant elements to be found in the crust of the Earth. For the heavier elements, up to the last stable element Uranium (92 = 46 + 46), Moon postulated a second nested system adjoined to the first.

A much improved model results, when the regular solids are replaced by the "semiregular" solids named after Archimedes. The Archimedean solids arise by cutting off the corners of regular solids. This work was carried out by Laurence Hecht and Ralf Schauerhammer. (Participants in the seminar remarked, that the relation between the regular and the Archimedean solids already suggests a feature of negative curvature, reflected in the Archimedean series of solids.)

Elaborated along these lines, Moon's hypothesis renders intelligible many features of the periodic table, which are mystified in modern nuclear physics with its various "magic numbers", quarks and other arbitrary constructs. But the most remarkable feature of Moon's geometrical hypothesis, as LaRouche stressed, is that no assumption is made or required concerning attractive or repulsive forces between the nucleons. Nor is nuclear structure viewed as a "packing problem" of fitting hard little spherical balls into a tiny space. Instead, the geometry of the nucleus embodies directly the "curvature of physical space-time". The nucleons are considered not as hard little balls, but as singularities in the space-time manifold.

LaRouche now posed the question: "how did I know what the curvature of subnuclear space was, before this group of very good physicists did their work?" He went on to explain:

"Particularly since the middle to the latter half of the 19th century, when the campaign to discredit Gauss and Riemann was essentially effective in terms of the teaching of science, we have forgotten the work of many centuries on the problem of defining SUBSTANCE. This is a matter which I have dealt with over a great number of years, particularly in my work on creative processes in the human mind and in economics.

“Human society, unlike animal society, is ordered by increase of potential population density. This increase is the result of the action upon society as a whole, of the generation and assimilation of scientific and analogous discoveries by individual human minds. Thus, societies exist not as collections of things or through Cartesian interaction among things, nor do they in any way resemble what the mathematics of animal populations tends to produce. They are based upon something which is elementarily nonlinear: the creative processes of the human mind.

"This being the case, you have a different conception of what we mean by substance. You realize, as did Riemann, that matter, that universal substance, is not composed elementarily of discrete particle-like entities; that mass, as we normally define it in the so-called Newtonian school, does not exist as a self-evident thing, any more than self-evident points exist or self-evident straight lines exist. They may exist as phenomena but they are created by an underlying process in which points are not self-evident. Discrete matter may exist as a phenomenon, but it exists as a determinate product of a process in which discrete matter is not self-evident.

"Therefore, to account for the existence of particularity, the particular organization of discreteness or discrete phenomena in any domain such as the subnuclear one, one must first define a lawful ordering of the Universe in which substance is defined as what mathematicians would call transfinite, rather than finite substance. We must leave the finite manifold for the transfinite.

"For a number of reasons, related to the reasoning of Leonardo da Vinci and Kepler and others, it appeared to me, that the existence of substance in discrete forms -- on the subnuclear level as on the astrophysical level -- must necessarily have what we might call a Kepler-Gauss-Riemann ordering. The notion that the nucleus is packed in a gravitational or similar way, that it is somehow attractive-repulsive forces that form this thing called the nucleus, is intrinsically absurd. The nucleus must in itself be a state in

> which the component parts are virtually being created, continuously. That being the case, Moon's particular approach is the only valid one."

LaRouche went on to indicate how the problem of subnuclear structure is intimately related with the most basic questions in biology:

> "Molecular biology is a dead end, as has been clear to me for many years, because -- contrary to Boltzmann -- it would be impossible to construct from a material whose geometry was characteristically linear, processes which were in and of themselves living.
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> "Thus, there must be a characteristic within the subnuclear structure of matter, which lends itself to a geometry corresponding to living processes.... The fact, that subnuclear space must have a Kepler-Gauss-Riemann curvature, signifies that the ordering characteristics of living processes exist at the extreme of the microphysical scale, as they also exist at the opposite extreme, on the astrophysical scale."

LaRouche located the significance of negative curvature within this broad epistemological context:

> "Negative curvature comes up in topology in a very simple way. We know from the standpoint of Riemannian topology, that points as such cannot exist. Insofar as singularities arise in a Riemann surface, these are not points but regions of singularity. The concept of topological hole, popular today, does not really do much to solve the problem. Beltrami is famous for having proposed, that a singularity in a Riemann surface must be a region of negative curvature.
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> "Implicitly this matter had been taken up by Brunelleschi, and implicitly by Alberti in his recording of the work of Brunelleschi during the 15th century. It was a central feature of concern to Leonardo da Vinci, and occurs in the work of Kepler, particular in the irregular tilings (quasicrystals)."
>
> "We have in physical space two conditions in which this matter of negative curvature comes into focus.
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> "Firstly, we have physical least action states, as typified by the relatively stable planetary orbits for example. These involve relatively weak forces. However, when we attempt to change from one least action state to another,

> we run into the problem of negative curvature, which involves what we call strong forces.
>
> "Now it happens that the characteristic of subnuclear space is strong forces, which made me very happy with the Archimedean series, which intrinsically itself reflects negative curvature."

LaRouche ended his remarks by referencing the connection, established by Leibniz and Huygens in the late 17th century but already implicit in the Renaissance masters, between negative curvature and the property of "isochronicity". The simple isochronic curve, Huygens' cycloid, has the characteristic, that a body constrained to move along this curve under the influence of gravity, will reach the lowest point in a fixed time independent of its original height. The broader significance of isochronicity, LaRouche emphasized, is that fact that a law of the Universe, if it is to be a universal law, cannot depend upon the variable propagation times which physical effects appear to have as they are viewed in visual space. True physical laws are framed in terms of absolute time and govern the outcome of processes independently of the point at which action is initiated. [Kairos] Thus, LaRouche concluded:

> "The curvature of action, other than simply least action in stable states, must be isochronic, so that all fundamental laws of physics, if they are truly fundamental, are associated with both the isoperimetric and isochronic conceptions developed in the 15th century. If we, or those of us who are zealous in these matters, bring these points to bear in our work, we might cook up something of use to somebody."

Historical Origins of Negative Curvature

After this challenging introduction, seminar participants were greatly interested to hear the following presentation, by Dino DiPaoli. DiPaoli provided a wealth of examples illustrating the concept of negative curvature in its historical development.

DiPaoli began by pointing out the existence of two different kinds of curved surfaces. First there are surfaces (often called convex-convex or concave-concave) for which the curves, obtained by perpendicular sections of the surface at any location, are all curved in the same direction. In other words, the centers of curvature are located all on one side of the surface (Figure 2). Typical examples are the sphere, and the outward half of a Torus (Figure 2). Such surfaces are said to possess positive curvature.

The second type of surfaces (sometimes called convex-concave or concave-convex) have the property, that at every location two opposite directions of curvature exist, so that in one direction they are curved one way, in the perpendicular direction the other way (Figure 3). The centers of curvature are located on both sides of the surface. These are called surfaces of negative curvature. The clearest example is the shape of a saddle. But DiPaoli pointed out countless others, including the forms of various objects in the seminar room: a hyperboloid-shaped stool, a trumpet, the lower portion of a bell, the shapes of many flowers, and so forth (Figure 4).

In addition to the so-called principle curvatures, which are the extremes of curvature of the curves obtained by cutting the surface by planes perpendicular to the surface (Figure 5), Gauss defined what is called the total curvature of a surface. The total curvature -- which Gauss defines in terms of the internal metric relations of the surface alone, without regard to the surrounding space -- turns out to be equal to the product of the two principle curvatures, with provision made for their orientation relative to one another. If these curvatures go in opposite directions, as they do on the saddle surface, then the product is negative.

Among the curved surfaces, those having CONSTANT positive or negative curvature were studied with particular interest. The typical surface of constant positive curvature is the sphere. Beltrami, in particular, made an exhaustive study of surfaces of constant negative curvature. DiPaoli explained:

> "There are three basic types (Figure 6). The first one (a) is constructed by rotating a curve called a caustic. The second one (b), which is called the pseudosphere, is constructed by rotating the curve called a tractrix. The third type, the most interesting one (b), is obtained by rotating the catenary curve.
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> "The catenary is the form taken by a chain hanging between two points. This is the same curve, and the same minimal surface, that you get if you put two parallel circular hoops into soap water and take them out. The soap-water will form a minimal surface, which is the surface of revolution of the catenoid.

"Whereas in the ordinary sphere, you maximize the volume and minimize the surface, in these cases the tendency is the opposite, namely to minimize volume. So the maximum-minimum relation is reversed.

"Now look at how the ear is constructed. Look at this double surface (Figure 7) with a pseudo-sphere constructed from the tractrix, and the catenoid surface on the outside. The rotation of the two curves forms a double negatively curved surface, which looks like the shape of a loudspeaker, a wave-guide. “

So these surfaces are to be found everywhere, in acoustics, in optics, while sitting, eating, drinking and so forth."

Next, DiPaoli described the construction of the special, non-algebraic curves whose surfaces of rotation give the three basic types of surfaces of constant negative curvature: the caustic, the tractrix and the catenary. These curves were intensively studied by Fermat and Pascal, by Leibniz, Huygens, Bernoulli and their collaborators, and later at the French Ecole Polytechnique under Gaspard Monge. DiPaoli noted:

"There was a fundamental fight between Descartes and Leibniz on this issue. Descartes claimed these curves should not be included in geometry, because they cannot be constructed with a ruler and compass and cannot be described by a simple algebraic equation. But Leibniz said, 'you are a fool, if you don't include these curves, because this is the real Universe.' Descartes didn't want to accept the actual Universe, but only his own. I am simplifying, but this is basically what the big fight was about."

Beginning with the cycloid, DiPaoli proceeded to elaborate an entire family of curves studied by Leibniz et al. The simple cycloid is generated by the motion of a point on the circumference of a circle, when the circle rolls upon a line (Figure 8a). Other types of cycloids are generated when the circle rolls instead on the inside or the outside of another circle (8b). A special case of the latter occurs when the first circle has infinite diameter, so what we have is a straight line rolling on a circle, which generates an Archimedean spiral (8c).

These cycloids have characteristic optical properties. The special cycloid formed by rolling a circle inside a semicircle of twice its diameter, yields this cusp-shaped form which is known in optics as a CAUSTIC (Figure 9a). If the large semicircle represents a mirror surface, then this cusp is the envelope formed by parallel rays of light striking the mirror from the opposite side (9b).

At the same time, the simple cycloid defined by rolling a circle on a straight line, is the curve used by Huygens in his construction of an "ISOCHRONIC PENDULUM". If we turn one cycle of this curve upside down, then a weight sliding along the curve will reach the bottom at equal times, independently of where it starts on the curve. By a clever mechanical arrangement Huygens built a pendulum whose weight moves on a cycloid. He thereby obtained a clock able to beat at a constant frequency, in spite of variations in the amplitude of the pendulum's motion. Huygens obtained a cycloidal trajectory by installing a cycloid-formed guide at the point of suspension of the pendulum (Figure 10), exploiting the fact that the so-called evolute of a cycloid is again a cycloid (see below).

A related construction yields the catenary curve, the curve defined by a hanging chain. We have only to let a parabola roll on a straight line, and mark the path of the parabola's focal point (Figure 11).

The catenary generates, in turn, the tractrix as its INVOLUTE. The involute of any curve is defined as the LOCUS OF THE CENTERS OF CURVATURE of the curve, which is the same as the envelope formed by the normals to the curve (Figure 12). There is an inverse construction: Attach one end of a piece of string to some fixed point on an arbitrary curve, and "wrap" the string progressively onto the curve in such a way that the free portion of the string remains everywhere tangent to the given curve (Figure 13). The locus of the free end of the string describes a new curve, called an EVOLUTE of the original curve. For example, the evolutes of a circle are Archimedean spirals.

It turns out that the involute and evolutes of a cycloid are also cycloids (Figure 14). The involute of a catenary, however, is a different curve, and this is the tractrix which defines one of the three types of surfaces of constant negative curvature.

The tractrix was actually studied by Leonardo. Any child can make a tractrix. If you take a toy train running on a straight track, and attach to it by a string any object lying off the track, and let the train drag the object along as it moves, then the trajectory of the object will be a tractrix! (Figure 15)

In summary, these three curves -- the caustic, the tractrix and the catenary -- produce as their surfaces of rotation, the three species of surfaces of constant negative curvature. This connection was already implicit in the work of Leibniz and Huygens on physical least action. But the origin of these ideas goes back much further, as Dino DiPaoli demonstrated. The Brunelleschi dome in Florence was constructing according to exactly the same principles!

Firstly, the cycloid and catenoid are crucial to the construction of bridges and other structures (Figure 16). All of the curves discussed so far are "physical" in the same sense, while at the same time being inaccessible to ordinary algebraic methods. Second, they are al related to the conic sections, the circle, ellipse, parabola and hyperbola.

Lyndon LaRouche interjected the comment, that the Renaissance architects constructed all their forms by direct geometrical means, on the drawing board, without calculation.

DiPaoli now challenged his audience, showing them a photograph of the Florentine dome. "After what we just studied, what kind of surface do you see here?" On first examination it appears to have positive curvature. But in fact, as the drawings of Prof. Leandro Bartoli demonstrate, the surfaces between the ribs of the dome curve inward; they are surfaces of negative curvature (Figure 17). What is more, these surfaces were formed out of CATENARIES, by actually suspending chains between the ribs. The lengths of the catenaries were determined by a certain constant angle formed at the points of suspension.

This aspect of Brunelleschi's construction coheres with many other remarkable features of the Florentine Dome. Evidently, Brunelleschi was in possession of a remarkable geometrical method, involving the implications of negative curvature. This, DiPaoli concluded, was the reason for the extraordinary feats of Brunelleschi, Leonardo and the other Renaissance architects. LaRouche emphasized experiments in optics as a key source of Brunelleschi's discoveries leading to the Florentine Dome design in particular

NEGATIVE CURVATURE AND THE GENERATION OF SINGULARITIES

Jonathan Tennenbaum began his presentation by pointing out, that the existence of dimensionless mathematical points and point-masses, as postulated by Newton, is by no means self-evident; in fact, it is an arbitrary assumption imposed upon the physical evidence.

> "Dino DiPaoli referred to the caustic as the image we get when we try to focus a beam of light by a spherical mirror. Actually, it is IMPOSSIBLE to focus a beam of light onto a mathematical point, no matter how good the system of lenses. In the best case -- a laser beam focused by an optimal optical system --, what appears to be the focal point is actually a small hyperboloid-shaped region, approximately the diameter of the wavelength of the light (Figure 18). Again, negative curvature!
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> "What if in the real Universe we have no infinitely small points, but only regions like this? We have to go back to elementary geometry, and wherever we have so-called points we must replace them by regions of negative curvature. What kind of geometry do we get? How are these singularities generated?"

The best approach in mathematical physics so far, Tennenbaum said, was elaborated by Bernhard Riemann in his treatment of electromagnetic potential. Riemann rejected the idea of self-evident point charges mysteriously attracting or repelling each other through empty space. What appears to us as a "force" between charged bodies must reflect a change in the geometry of physical-space time, a change somehow connected with the process by which the singularities called "electrons" came into existence.

There seem to be two phases of such a process: First, a discontinuity is generated by physical action. Second, the Universe responds to the discontinuity by changing its geometry in some way which has the effect of restoring continuity, and integrating the singularity associated with the original action.

A preliminary model of such a process is provided by elementary constructions with Riemann surfaces. Take a circular disk. Now cut a slit in the disk from the circumference to the center. This represents a discontinuity introduced into the system. How do we restore continuity? We take one edge of the slit disk and bend it around to form a second level above the rest of the disk, and arriving after one full rotation over the remaining edge, and paste the two edges together as shown in Figure 19a. (This process occurs in phase space, not in ordinary visual space, where the anomaly of the surface passing through itself does not occur.) Now we again have a continuous, connected surface. The change, from the disk to this spiral-surface, represents the way the Universe "adjusts" its geometry in response to a discontinuity. Tennenbaum presented another example, indicating how the Riemann surface construction generates the configuration of magnetic field associated with the poles of a magnet (Figure 19b). He continued:

"By these and related means, Gauss and Riemann constructed a theory of electromagnetic potential without any assumptions of self-evident point-charges attracting and repelling one another. But, there are two matters left over.

"First, we have to account for the action generating the discontinuity in the first place. Riemann developed an initial approach to this in his paper on acoustical shock waves. There he showed how a continuous process, characterized by negative curvature, leads to formation of a singularity called a shock front. We shall return to this later.

"The second aspect is that, in the real Universe, we do not merely have generation of discontinuities, but the underlying physical action function is manifestly one which subsumes an INCREASING DENSITY OF DISCONTINUITIES GENERATED PER UNIT ACTION. In other words, in every interval of action, transformations of the sort indicated by the elementary Riemann surface construction are occurring, with increasing density.

"The mathematical representation of such a process requires multiply-connected conical action, which comes out as a hyper-hyperbolic function (Figure 20). A simple conical-spiral function corresponds to a relatively constant rate of increase of Potential, as represented by the increasing circular cross-section. The apex angle of the cone defines the rate of increase per unit spiral action. Now, what happens if conical action acts upon conical action? This must have the effect of increasing the apex angle of the first function, causing it to "flare out" into a hyperbolic horn. In this visual-space representation it appears that the horn "zooms to infinity"; but what we actually have is a discontinuity subsumed within a continuous process, whereby the doubly-connected function resumes "on the other side" of the discontinuity. Thus, doubly-connected conical action generates discontinuities at a certain rate, defined by the apex angle in the second-order conical function. If we now have a THIRD degree of conical action, this results in an increasing density of subsumed hyperbolic discontinuities per unit action! This is the sort of function we actually have in reality."

Tennenbaum next described how the "infinities" of the hyperbolic horns, which are an artifact of the visual-space representation of these functions, can be eliminated by stereographic projection (Figure 21). The result is a hyperspherical function, represented by a harmonically ordered series of concentric spheres.

Action is represented by a spiral winding up from the South to the North pole of any given sphere; the North pole represents a relative limit to the density of discontinuities generated per unit action in that mode. At that point, the process "jumps" to the next sphere, representing a higher mode.

> "There is still something unsatisfactory about this representation. What is happening between the spheres? What is the nature of the jump itself? The very fact, that these jumps are harmonically ordered, demonstrates the lawful nature of the process. But we want to understand this more completely. This is where negative curvature comes in. As I was discussing with Dino, we have to think of a negatively-curved pseudosphere joining the successive positive-curved spheres of the hyperspherical function, or something like that. Already, Riemann provided crucial evidence in his work on shock waves, where he shows that the phase space of the shock-generation process has negative curvature (Figure 22)"

Tennenbaum referred to a document by LaRouche, in which LaRouche remarks that a growing economy -- the paradigm of a negentropic process, and hence of a hyperspherical function -- develops ideally in two phases. In one phase, which Tennenbaum identified as the phase of positive curvature, the economy is expanding in a constant technological mode, improving its productivity by maximum exploitation of the most productive available technologies. In what Tennenbaum called the "negative curvature mode" the economy is undergoing a technological revolution. This phase was described by LaRouche as "turbulent"; the apparent rate of growth slows as free energy is applied to changing the internal geometrical mode of organization of the process.

> "We find a similar alternation of modes in living processes, particularly in the relationship between simple cell division, mitosis, and the more complicated form, meiosis, in which genetic recombination occurs. Mitosis is what happens when an organism grows in size, while maintaining a relatively constant genetic basis. Meiosis mediates the process of sexual reproduction, producing a new individual. The recombination process is the most turbulent phase."

Returning to physical action per se, Tennenbaum pointed out, that what we see in visual space, in each case, is not directly the physical action function, but a kind of hologram of that function. "What we see apparently happening at different locations is really different facets, different phases of one and the same object, the universal action function. That is, spatial extension and passage of ordinary clock-time (as opposed to absolute time) correspond merely to angular rotation in the action-function." Absolute time corresponds to an increase in density of singularities of physical action, a change which appears to occur "simultaneously" everywhere in the hologram, although more clearly visible at certain locations than at others. Thus, Tennenbaum concluded, advance of the universal action function must be representable in the manner of an isochronic curve increasing its curvature: all "local processes" are affected independently of their location on the curve.

> "Exactly this sort of thing governs a living cell. The biophysicist Sidney Webb has shown that the metabolic processes in a living cell are organized as a configuration of soliton waves propagating along the space-filling internal membrane of the cell. In order for the cell to function, these solitons must arrive at certain positions in phase with each other. But, the cell is growing, increasing in density of singularities. In particular, the paths of the solitons are constantly changing. How is the phase coherence insured as the cell grows? Simple! The architecture of the cell must be based on isochronic curvature!"

But, as LaRouche, emphasized, this isochronic curvature is not given in terms of simple visual-morphological characteristics, but is located in the phase-space of the process:

> "The curvature is located in the characteristics of action, which define the coherence of the process, so that you can relate the phase-relationship here to a phase-relationship there. What you actually require is a family of multiply-connected isochronic functions, in a degree of multiple-connectedness corresponding to the level of the changes occurring. The Universe is not constructed in terms of action-at-a-distance Newtonian laws. The Universe functions on the basis of absolute time, which is embodied in transfinite isochronic functions."

NEGENTROPY

In the general discussion, a leading German biophysicist, attending the seminar, struggled to understand the conception of a negentropic universe presented by LaRouche. He asked:

"You have discussed necessary features of physical action. But it seems to me there can be many possible developments. So, is there some aim to evolution, or some goal? Is the goal of evolution to develop to higher nonlinearities? How could the goal be expressed in a law, when no mathematical description could ever define real development?"

LaRouche replied, "In a sense, you can (describe development). But not if you use linear mathematics. The problem is, the mathematics taught in universities today is totally incompetent. For example, Cauchy substituted the tangent line for the normal which is the real characteristic of the curve at the point of differential, and not the tangent. That's linearity!

“The famous case is Newton. Newton wrote a confession in his Principia, where he said: 'My Universe, which I present to you, has a great fallacy. The fallacy is, that the Universe appears to run down, like a mechanical watch.' He admitted this was not due to physics, but to the kind of mathematics he used. But he said, I have no other kind of mathematics which I like. So, therefore, this happens.

"That's all it is. The introduction of the wrong mathematics, superimposing it upon the physical evidence, creates this idea (of universal entropy). If I use a Euclidean or axiomatic algebraic, formal mathematics to analyze any physical phenomenon, that mathematical language will not allow me to represent that phenomenon in any way except in an entropic way.

"So, the idea of universal 'heat death' is simply scientific incompetence and should be so treated. Why should we waste our time, when we are doing serious work, bothering with an agenda of incompetence? Ninety-five percent of the modern scientific literature, at least, is garbage, and maybe five percent is important.

"By eliminating the garbage we get to a very interesting conception. The idea of simple teleology is a mistake. Kepler proved what the Universe is. It is a self-developing Universe. However, self-development is itself a goal. For example, take a human being. What is our purpose is being alive? It is self-development! Why do you create something? Because you as an individual by creating something true and useful have done a universal act: a universal act which expresses itself as a contribution to the self-development of the knowledge of the entire human species. Who needs any other purpose? The Universe needs no other purpose than itself. It IS self-development!

"That is the essential definition which Nicolaus of Cues used, the law of universal self-development. He derived (this law) essentially from discussion of the solution to the Parmenides paradox, the relationship of the particular to the universal. The key problem in mathematics is to realize that processes are not aggregates. The way to define a process is to define the characteristic of the universal, then find the functional relationship of the necessity of the particular with respect to the universal. Cusa put this together in his De Docta Ignorantia, in the form of his maximum-minimum principle. The solution of this problem is to realize, that the particular exists as the necessary ingredient of action for the self- development of the universal. The society produces individuals. Individual human beings create. This creative act is by its nature universal, because it benefits all minds, potentially, and thus raises the level of development of the entire human species. Thus, the human species, through the individual developed member of the human species, creates itself. So for Cusa there was no problem, and his concept of evolution of the species was based on this principle. Self-development comes to critical points, at which something has to become a new species."

The discussion went again to the connection between outstanding problems of biophysics and the problem of the matter- antimatter reaction and structure of the atomic nucleus. LaRouche concluded:

"The point of posing this question (of negative curvature) is to get at these practical matters, and that is the great fun of this Brunelleschi business. Here you have this cupola, and when you know what we know about it, you think about it and laugh! Brunelleschi, using pin-hole and other light experiments, recognized, because of the Platonic principle, that these were demonstrations of the laws of physics. He then turned around and applied these geometric principles, discovered from experiments with light, to the principle of construction of the cathedral. You see this cupola and laugh, and realize, that this is a building stronger than any of the materials in it, because Brunelleschi understood principles that most modern physicists don't recognize. That is excellent, exquisitely delicious!

"What is delicious is to realize that this circle of people in the 15th century, working with very limited means by modern scientific standards, were able to construct, directly, an experiment which the modern physicists wouldn't even be capable of approximating. It seems that these greatest scientific minds of the fifteenth and sixteenth centuries were much more powerful, on a higher cultural level, than the so-called high priests of science today. Defy the legends and recognize, that in the development of the Renaissance something was occurring which is very precious, which has been lost. Don't mistake the details of science for the spirit, the spirit of inquiry. We have the detail, we don't have the spirit. Therefore we must concentrate on those kinds of ideas. We must think like Renaissance scientists. Take all we know, and look at it from a Renaissance standpoint. Recreate among other people the spirit of science, in order to realize, relative to our own time, the same approach as Brunelleschi with his cupola and Leonardo and Kepler. This is not an academic or formal question. It is a practical one."

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TEXT

Wiesbaden, February 14, 1989

Dear Dino,

Reading once more through Leibniz's writings on physics and the calculus (translated from Acta Eruditorum by Jean Peyroux), I began to realize that Leibniz already had solved much of the difficulty I have been banging my head into, concerning a mathematics of negentropic processes. Lyn's remarks on the damaging effects of Cauchy and Cartesian analytical geometry were absolutely to the point. Although the epistemological fallacy of Descartes-Newton-Cauchy has long been clear, it is something more to rediscover Leibniz's actual approach and realize how much we have been missing! Especially his piece on "A line produced by lines" opened my eyes on this. In Leibniz's mathematics we can BREATHE, because it is completely free and has unlimited potential for development. The Descartes-Newton-Cauchy form kills all possibility of creative thinking, with its lifeless points, lines and self-evident parameters. The crucial difference is Leibniz's treatment of singularity, in which (for example) a trajectory is not a finite entity, but a transfinite envelope. You already brought out some of this in the 1979-1980 work on the Ecole Polytechnique; but the idea becomes much more POWERFUL when we address it anew in light of absolute time.

[Moon Kairos. CBS]

In brief, consider the meaning of an "event". In the Newtonian, kinematic conception, past events are totally fixed, self-evident "facts" recorded on a giant video tape called "history". Change is restricted to a point-like "present" tracing a world-line by its motion. This is the epistemology of Newton's fluxion theory. But this is absurd. In and of itself, an event has no meaning whatsoever. It is only in the context of the totality of reality that we can define what "actually happened" at a particular historic juncture; practically, any given definition can at most be a partial one, to be constantly reworked as knowledge and history progress. "The event" is nothing other than the envelope of that process. As Lyn pointed out in his paper on absolute time, present events can "potentiate" the past, for example when I discover something new in Leibniz and in this way Leibniz grows and works in the present. Hence, Leibniz's life is not a finite entity, but a transfinite.

Therefore, an event is a locus of continuing potential development of the Universe. And so I think of an event as an ENVELOPE OR CAUSTIC OF WORLD-LINES. The continuing action generally increases in density of singularities, which I imagine in such a way, that the caustic has variable curvature signifying the potentiation of the corresponding event as the Universe develops.

This has fascinating implications for such supposedly "static" art forms as architecture and painting. [See Alba Madonna of Raphael. Versus the third leg principle of ancient roman sculpture. CBS]

We must distinguish between two multiply-connected moments of action in the Universe. First, we have the action which appears as wave-like propagation of effects, as we speak of chain-reaction effects radiating from some action, like the concentric waves produced when a stone is dropped into a pond. This propagation process does not define EXACTLY WHAT HAPPENED at the original discontinuity, nor WHAT IT IS that is being propagated; it merely establishes one sort of lawful relationship between events. In particular, all events on the circumference of the circular wave are isochronically coherent with one another in terms of the initial discontinuity.

The second moment of action I describe by the term, POTENTIATION. To the extent I now actualize some hitherto hidden or new implications of Leibniz, I have implicitly transformed everything associated with the radiated influence of Leibniz, and this in an isochronic fashion! The actualization of that increased GLOBAL potential may again take the form of propagating retarded potential. Thus, the two moments of action are mutually connected within a function of increasing potential for the Universe as a whole. The event is conjointly the envelope of both degrees of action.

There is an evident congruence with processes of scientific thought, where simple hypothesis corresponds to "least path" propagation and the effect of successive higher hypotheses corresponds to "isochronic potentiation".

Riemann's construction of a phase space for the formation of an acoustical shock wave, already contains some indication of the required geometry. Evidently, the "later" portion of the pulse potentiates the "earlier", which appears as an increase in the rate of propagation of the later portion of the wave; the isochronic potential function appears here in the guise of a function relating density and velocity of propagation. (This is just an initial thought, which I shall develop further if it proves fruitful.)

Coming back now to Leibniz's calculus: another crucial feature is Leibniz's implicit rejection of all scalar parameters. All he permits are ORDINATES, which means something different. Leibniz's ordinates are themselves envelopes. As I think of it, we may use displacement along an envelope as a LOCAL parameter of a process, but only within certain limits (for example on a continuous portion of an envelope). However, such a parameter has no self-evident ontological significance; nor could the process ever be exhaustively defined by any array of such parameters, since a location on an envelop signifies only a LOCUS OF TRANSFORMATION, but not the transformation itself, which is transfinite in character.

For example, the climate models used to justify the "Greenhouse effect" hoax, contain a parameter of "CO2 concentration". It is therein assumed, without this assumption being acknowledged, that CO2 EXISTS as a definable entity. But this is false: CO2 has no self-evident properties within the biosphere, but is associated with many and changing characteristics of action as the biosphere developes. A scalar parameter is only applicable within a range of action in which only "weak forces" apply. The sort of violent changes associated with "strong forces" cannot be described by continuous functions of scalar parameters. In the course of a strong change, we discover that "CO2 is not CO2": We have landed on another branch of the envelope.

This brings out another fallacy of the systems analysis models, which is relevant to our discussion of negative curvature. The systems analysts cannot distinguish between "strong" and "weak" forces, between least path and least time. They absurdly imagine that a catastrophic shift comes about as the result of an accumulation of small perturbations. To the extent such effects appear to occur, however, it is not the ACCUMULATION PER SE which is the cause, but a shift in the GEOMETRICAL CHARACTERISTICS OF ACTION associated with the perturbations. Another typical myth of this sort is perpetrated by Boltzmann disciples who claim, that if by chance all the molecules in my cup of coffee might happen for a moment to all be moving in the same direction, then the cup would fly up to the ceiling! They are asserting, thus, that a "strong force" is just a statistically improbable combination of weak forces. We see what disastrous effects flow from illiteracy in the elements of Leibniz's calculus!

I am in the process of preparing a set of translations from Leibniz and Fermat on the minimum-maximum principle and the calculus, which will shed further light on these matters. I am also working on an article entitled, "What was it Newton and Cauchy couldn't stand about Leibniz's calculus?". If you have any ideas, let me know.

Best wishes,

Jonathan

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See also

Quantization effects in the plasma universe

Wells, Daniel R. ; Dept. of Phys., Miami Univ., Coral Gables, FL, USA ; Bourouis, M.

It is suggested that a unification of the morphology of the solar system, anomalous intrinsic red shifts of quasars and galaxies, the structure of the hydrogen atom, the Einstein equations of general relativity, and Maxwell's equations can be accomplished by a basic consideration of the minimum-action states of cosmic and/or virtual vacuum field plasmas. A formalism of planetary formation theory leads naturally to a generalization which describes relativistic gravitational field theory in terms of a `pregeometry'. A virtual plasma associated with the vacuum state is postulated. It is demonstrated that the relaxed state of the virtual plasma underlies Einstein's field equation and predicts the proper form for the effective gravitational potential generated by the Schwarzschild solution of those equations. A further extension of the theory demonstrates that it also predicts the structure of the hydrogen atom described in terms of the Schrodinger equation of quantum mechanics. These concepts are applied in an attempt to explain the quantized anomalous red shifts in related galaxies as observed by H. Arp and J.H. Sulentic (1985). A possible unified field theory is suggested based on the above-mentioned concepts

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Unification of gravitational, electrical, and strong forces by a virtual plasma theory

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It was demonstrated in previous papers that a virtual plasma theory of physical forces unifies all forces as `fluid' or `Magnus' forces generated by vortex structures (particles) in the virtual plasma gas. The theory generates gravitational fields. It generates the electrostatic field in the atom, explains the form and action of the Schrodinger equation, and generates the appropriate Bohr orbits in the hydrogen atom. It is demonstrated that the general form of the strong nuclear forces is also generated by the theory. An extension of the concept of planetary formation to this virtual plasma also predicts the mass spectrum for the leptons and hadrons

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PRIVATE INFORMATION CONCERNING THE COMING REPORT ON "KEPLERIAN ORBITS" IN LOCAL PLASMA AND RELATED EVENTS

By Lyndon H. LaRouche, Jr.
April 11, 1986

During an FEF seminar, Dr. Dan Wells was perturbed by my fresh reference then to my "hobby-horse" theme, that the Keplerian orbits are essentially "force-free fields" of the same principled character as "force-free" states occurring in nuclear-fusion plasma experiments. Dr. Wells has reported, that he has made the relevant calculations (for the approximation of Keplerian values given by (Titus-Bode), and sees my observation as empirically confirmed for so-called "force-free" plasma states. For reasons which ought to be obvious enough, it is important that I provide some cautionary observations, as background information for those associated with our efforts in this and related matters.

1. Dr. Wells has contributed a discovery, which, for reasons I shall indicate below, will tend to revolutionize all theoretical physics, including biophysics.

2. Although it might first appear, that Dr. Wells simply worked through proof of my hypothesis, he did so in a way I am by no Although it might first appear, that Dr. Wells simply worked through proof of my hypothesis, he did so in a way I am by no means qualified to do.

He is a leading figure in study of so-called "force-free" fusion configurations, very strong in qualifications as an experimental physicist in this field, and in the relevant implications of the work of Riemann's collaborator, Beltrami. Partly because of his additional background, in aerodynamics, the outstanding features of his earlier work reflect the relative ease with which he brings the hydrodynamic standpoint to bear on conceptualization of experimental results. He has acted in the tradition of creative scientists who, by rigorously working through provocative hypotheses presented, transform such hypotheses into important new discoveries of their own. All scientists live in a sea of ideas, a sea swarming with both old and fresh hypotheses, and also shrewd conjectures which fall somewhat short of the qualifications of a true hypothesis. Most of these are the hypotheses, or conjectures contributed by others, some their own. In practice, fruitful scientific workers pick out certain among these swarming propositions as either worthwhile ventures, or as notions of sufficient significance to be worked through rigorously. The fortunate such scientist, is one so skilled in the design and construction of scientific instruments that he can correlate abstract ideas with definite experimental actions in the easiest, most immediate way.

3. What Dr. Wells has done, belongs to the class of the most important contributions to advancement of physics fundamentals. For reasons indicated by Riemann in his "On The Hypotheses Which Underlie Geometry," improved insight into the general lawfulness of the universe centers upon correlating what appear to be anomalous phenomena occurring on the scale of the very large (i.e. astrophysics) with seemingly anomalous events in the very small (i.e., microphysics, or a scale slightly greater than that of microphysics proper). If a new discovery in physics resolves such apparent anomalies, where previously prevailing analyses can not, the discovery effected is proven to be of a universal validity, and is thus usefully classed as a fundamental discovery.

4. Dr. Wells' work, while relatively conclusive in respect to the limited proposition it asserts and proves, is otherwise of a preliminary character. Rather than relying upon the Titus-Bode construction for making Kepler's values more precise, we must accomplish the long-overdue reconstruction of Kepler's proofs from the standpoint provided by Gauss, Riemann, et al.; the lack of sufficient modern emphasis upon elaborating a Gauss-Riemann constructive geometry, has caused this important reworking of Kepler to be neglected. Dr. Wells' work, by proving a principle of physics, thus supplies a sense of urgency and practical importance for completing the long overdue recasting of Kepler's work.

Kepler's three laws of physics are entirely accurate in respect to the hypotheses for which Kepler sought empirical verification. However, for the same reason that Kepler was influenced by an erroneous interpretation of musical harmonics, his physical hypotheses are not the most correct ones. Hence, during 1981, I proposed that we work through the physics of well-tempered polyphony, as an indispensable pedagogical step for education in principles of plasma physics and coherent radiation. This proof for musical composition, couched in the same terms of Gauss-Riemann physics employed for the LaRouche-Riemann "model," is key to the next fundamental stage in refinement of Dr. Wells' work.

5. The implication of this discovery, is that it destroys the last pretext for continued toleration of Newtonian physics, and, implicitly, destroys the foundations of the more popular varieties of statistical thermodynamics and quantum theory. The demonstration, that the most fundamental laws of astrophysics and microphysics are defined in terms of what Newtonian physics must view as "force-free" configurations, destroys the axiomatic basis of popularized instruction in "classical physics," statistical thermodynamics, and interpretations of quantum physics today.

The implication of Newtonian physics in particular, and currently popularized physics more generally, is that the solar orbits are defined by functions of forces among bodies acting at a distance upon one another. Kepler showed, that "force" has nothing to do with determining these orbits, but, rather, that these orbits represent available "force-free" pathways.

Up to now, the typical objection to this, including the objection supplied by President Reagan's science advisor, George Keyworth, in 1981, is that our "Keplerian" argument is irrelevant, since, according to Keyworth, all practical progress in science has been based upon our ability to interpret physical phenomena from the methodological standpoint of Newton and Maxwell.

Factually, Keyworth shows astonishing ignorance of the history of science; most of the fundamental contributions to physical science were originally contributed by Italian, French, and German scientists working from the same methodological standpoint as Kepler and Leibniz. Keyworth has been enabled to deceive himself to the degree that the results of scientific work lend themselves to the form of algebraic statements, statements which may be interpreted either from the standpoint of constructive geometry, or from the alternative, opposing standpoint, of axiomatic arithmetic. To the degree that followers of Newton and Maxwell are able to conduct experiments associated with such algebraic formulations successfully, without recognizing the geometric basis of such formulations, they deceive themselves that all physics can be adequately explained from the vantage point of an axiomatic arithmetic, explained in terms of either percussion or "forces" acting at a distance.

The mere existence of "force-free" states in plasma physics, already well established, constitutes what Riemann identified as evidence of a "unique experiment," that special sort of experiment which suffices to prove that one entire theoretical-physics doctrine is mistaken, and a different doctrine required. The followers of Newton and Maxwell might attempt to interpret algebraic formulations in a manner consistent with the "force" assumptions of Newtonian physics; but this is possible only up to the point, that it is shown that events independent of Newtonian "forces" exist. Once the role of "force free" configurations is demonstrated, the authority of the Newton-Maxwell school collapses entirely.

Implications

"Force free" is a misleading term. The term, "force free," is used only to emphasize that the fundamental assumptions of Newton-Maxwell physics are violated by the mere existence of such phenomena. In other words, if Newton had not based a proposed physics on the premises of Descartes, we would have never heard of Newtonian "forces," and would never have thought of describing such configurations as "force free."

As for myself, there is nothing fundamentally original to me in the hypothesis which Dr. Wells has explored. I learned the rudiments of the hypothesis before I was sixteen years of age, from Leibniz. Leibniz would not have used the term, "force free;" he would have said, instead, "least action."

Although we owe much to Leibniz for understanding the notion of a Principle of Least Action today, the idea was not exactly original to him. Kepler's hypotheses, on which his three famous laws of physics are based, were already based on the principle of ("force-free") least action. Kepler's orbits are "force free" (least action) pathways, which is why they are stable orbits, in which the planet (for example) must remain, unless tremendous work ("force") were applied to move it from that least-action pathway [even if this could be done, the planet would probably disintegrate as a result of being moved from its least-action-pathway orbit]. Much of Leibniz's work in physics, like his 1676 establishment of a differential calculus, was based directly on working-through Kepler's writings.

Nor was the idea original to Kepler. Kepler's work was based, most prominently, on the direct influence of Leonardo da Vinci, and the direct influence of the scientific writings of Cardinal Nicolaus of Cusa. What Leibniz terms the Principle of Least Action, was described by Cusa as his "Maximum Minimum Principle"(De Docta Ignorantia, 1440). The only "axiomatically self-evident" form of existence in the universe, is the generation of a maximum cross-section of work, by a minimum amount of perimetric action: the "Maximum Minimum Principle," or, in other words, the "Principle of Least Action."

The fact that the refraction of light corresponds directly and exactly to least action, rather than as a statistical optimum of variable action, is the simplest sort of direct empirical proof of least action in experimental physics. [Although one aspect of Heisenberg's "uncertainty principle" has conditional experimental validity, the attempt to project such uncertainty upon the laws of cause-effect action in nature, is a wildly fallacious one. As Einstein said, most aptly, "God does not play dice" with the universe.]

The ideas we associate with the notion of "forces," arise as we attempt to account for the possibility of action outside of least-action ("force-free") pathways. Kepler's laws of physics are based, "axiomatically," on the demonstration that the most fundamental laws of physics exclude all notions of "forces." The fundamental laws of physics, properly conceived, are stated entirely in terms of least action, in which no notion of "force" need be considered; only the constructive geometry of physical space-time need be considered. The fundamental opposition of Galileo and Newton to the physics of Kepler, is the simplest case in point, by aid of which we might show how the notion of "forces" was introduced to teaching of physics.

Cusa founded modern science, by elaborating general principles of scientific method coherent with Cusa's discovery of the Maximum-Minimum (Least Action) Principle. The collaborators, Luca Pacioli and Leonardo da Vinci, founded applied physics, by showing that the application of Cusa's Maximum-Minimum Principle to crucial experimental evidence sufficed to identify and prove the specific kind of geometry of universal physical space-time. By showing that Golden-Section harmonics coincided with both the most general laws of physics, and also living processes, whereas non-living processes do not so coincide, Pacioli and Leonardo proved implicitly that the geometry of our physical space-time is that of a Gauss-Riemann multiply-connected (hyperspherical) manifold. The proof of the work of Cusa, Pacioli, and Leonardo, on this specific point, was the basis for the hypotheses employed by Kepler to establish a comprehensive mathematical physics.

In a constructive geometry centered around the isoperimetric theorem, lines, points, surfaces, solids, hypersolids, and the implicit innumerability of countable topological harmonic relations, have the character of singularities which are derived, created, by purely constructive methods, from elementary, multiply-connected circular action. The physical space-time cohering with such an elementary, constructive geometry, requires that the notion of time-based action be incorporated, thus superseding physical space by physical space-time. Uniform, least-action forms of time-extension, require that we supersede simply circular action by extended circular action, which can be only, either cylindrical or conical extension. The proof that the highest orders of action in physical space-time are coherent with the Golden Section's harmonics, suffices to prove conclusively, that the geometry of physical space-time is multiply-connected [conical, self-similar-spiral] action.

Physical space-time is not the time-extension of physical space. "Instantaneous" physical space has no existence; only transformations in physical space-time exist; there is no existence but that of an harmonically-ordered transformation in physical space-time, and this exists only in the Gauss-Riemann space of conic forms of multiply-connected, self-similar-spiral action.

The central feature of a Riemannian space so defined, is that, only in such a Riemannian space does there occur, the necessary generation of those higher-order singularities we associate with the generation of existences such as electrons. The lower-order singularities, such as those of the famous Eulerian topological functions, are not truly existences, but merely forms associated with existences. The generation of an electron, or of a definite quantum of action by coherent electro(hydro)dynamic radiation, is exemplary of the simplest sort of those higher forms of singularities we call "true singularities," "true" because they correspond to efficient physical existences.

The foregoing background observations, are indispensable for understanding how the fallacious assumptions of Galileo, Descartes, Newton, et al., led to the reductionists' notions of "forces."

In the relatively more practicable features of Newtonian mechanics, Newtonian mechanics' best features are simply the work of Kepler turned inside-out. The essential difference, is that Kepler shows the existence of objects, to be created by continuous hydrodynamic action, and Kepler defines his discovery of a principle of universal gravitation from this standpoint. Gravity is an effect of the geometry of physical space-time, a way of measuring the work required to deviate from a least-action pathway, and this in a manner consistent with the principle of least action. The reductionists treat the existence of the discrete particle in empty, shapeless space, as axiomatic, and attempt to reinterpret Kepler's physics, "delphically," by interpreting Kepler's algebraic formulations in terms of Cartesian space's absurd assumptions. This "Delphic" hoax is accomplished, by turning Kepler's definition of gravitation inside-out, to define it as a prime force, rather than a reflection of the physical geometry of spacetime. So, "action at a distance" among discrete particles, is introduced, and Kepler's algebraic formulations "delphically" misinterpreted from that reductionist standpoint.

For directly related reasons, Leibniz discovered the differential calculus, whereas Newton's attempt of the 1680s, to plagiarize Leibniz's 1676 paper from the standpoint of "infinite series," contained nothing original that was not useless. Thus, Augustin Cauchy found himself obliged to attempt to revive the discredited Newton, by embedding Newton's assumptions within a mere parody of Leibniz's differential calculus, concocting the fraud which is ritually taught in textbook versions of undergraduate "differential calculus" today.

The specifications for a differential calculus were supplied by Kepler. The attempt to solve this assignment was undertaken by Blaise Pascal, in work on differential number series, parallelling work independently undertaken by the young Leibniz. This approach to differential number-series, was based on geometry, not arithmetic, anticipating the work of Euler on topological functions. Essentially, a true calculus is a branch of constructive geometry, "differential geometry," a study of projective correspondences between relative higher and relatively lower orders of a multiply-connected manifold. The numerical values of the algebraic transformations are directly reflections of this sort of projective correspondence: in one direction, we call this integration, and in the other direction, differentiation.

The popularized, conceptually fraudulent version of the calculus, especially after Cauchy, is an attempt to explain the algebraic aspect of the transformations from the standpoint of the axiomatic assumptions of both axiomatic arithmetic (cabbalism) and Cartesianism. For "hereditary" reasons embedded in such axiomatic assumptions, such a calculus is intrinsically linear, and reflects non-linear processes only by aid of wild mystifications of interpretation. Lagrange attempted to correct Cartesian geometry, to seem to eliminate such obvious fallacies, as did Cauchy's sponsor, La Place. The assumption that universal laws portray an intrinsically entropic universe, is not a product of the physical evidence, but of the effort to interpret the physical evidence in a manner consistent with the axiomatic assumptions of Cartesian, linear mathematics. The evidence of "entropy," comes not from the experimental evidence, but is a delusion imposed upon interpretation of the evidence, by the mathematician's obsessive "brainwashing" in linear mathematics' axiomatic assumptions.

Gauss-Riemann physics "returns" mathematical physics to the (geometrical) methodological standpoint of Cusa, Leonardo, Kepler, and Leibniz, to the standpoint of a differential (constructive) geometry, of a multiply-connected (conic, self-similar-spiral) manifold. The physics of a complex function is properly so interpreted. Unfortunately, beginning with La Place and Cauchy in post-Vienna Congress France, and with the post-1850 collaborations among Clausius, Kelvin, Helmholtz, Maxwell, Boltzmann, et al., a radically neo-Cartesian misinterpretation of physics was introduced, leading into the ineptitude of modern statistical doctrines. This neo-Cartesian faction launched a hideous witch-hunt against the work of Gauss et al., and with backing for this effort by the Saxe-Cobourg-Gotha and Venetian families, the statistical, anti-Gaussian doctrine was made hegemonic in the teaching of mathematical physics today.

Physics has become ironical, paradoxical, in this way. On the one side, the popularized view of physics' mathematical side, physics is absurd in the main. Yet, since scientific progress depends upon respecting the experimental evidence, experimental progress has the form of contributing seeming anomalies which repeatedly throw the formal side of physics, the mathematical explanations, into crisis. For that reason, the only truly interesting aspect of physics work, is exploration of expanding repertoires of those classes of phenomena which are nature's way of insulting the teachers of mathematical physics.

This interesting side of physics produces two classes of response. More commonly, physicists attempt to patch up the previously respectable mathematical physics, to seem to explain the existence of the anomalous phenomena. Less commonly, the best mavericks of the physics community open their minds to the fact that the experimental evidence has cast grave doubts upon the most precious of the axiomatic assumptions of currently taught physics. Illustrative of the latter activity, is the work of Bostick, Wells, et al., in reviving the physics of Riemann's collaborator, Beltrami, and an associated openness among such and kindred circles of physicists to deeper exploration of the Gauss-Riemann standpoint.

Recently, we have seen more emphatically demonstrated the importance of ending that anomalous fragmentation of scientific work which separates microphysics, astrophysics, and biophysics from one another. When the crucial "anomalies" of the three aspects are placed in conjunction, and a correlation of the evidence sought, the most fruitfully stimulating results are obtained: implicitly, a return to the unity of physics under Leonardo da Vinci. Conversely, it is to the degree that the three specialties are hermetically separated from one another, that the wildest absurdities in each are more readily made to appear plausible. As Kepler emphasized, the laws of astrophysics, and physics generally, must be defined by imposing the initial and persisting requirement, that our universe is one in which living processes are the highest state of organization of the universe as a whole. The attempt to explain life by a physics which axiomatically excluded the principle of life from the laws of astrophysics, leads to a biology in which life is axiomatically impossible by adopted delusions. Obviously, such a physics does not correspond to the real universe.

Living processes, including healthy economies, can be defined only in terms of a multi-connected manifold, as defined in terms of a conic self-similar-spiral action as elementary. Such relevant matters, as the Weierstrass function, the Riemann Surface, and so forth, must be understood from this vantage-point. For this reason, there is a reciprocal and interdependent relationship, among my own discoveries in economic science, the principles of biophysics, and physics fundamentals generally.

Since no later than Plato, this method of scientific work has been rather consistently associated with the development of that well-tempered polyphony best typified by the work of Bach, Mozart, and Beethoven. During the Spring of 1981, I was forced to recognize, that no general understanding of my own discoveries in economic science were likely, unless the student was first grounded in study of the application of constructive geometry to the principles of well-tempered composition. The errors of interpretation of my work, up to that point, reflected either the student's acceptance of the axiomatic fallacies embedded in popular teaching of advanced mathematics, or, similarly, deeply held axiomatic prejudices of the form of belief in naive sense-certainty. One had to consider, not only the emphasis which Plato. St. Augustine, and Kepler had placed upon musical harmonics, but also that without following this pedagogical example, little understanding of the physics of a Gauss-Riemann domain were likely.

In music, it has been said, occasionally but notably, that the comprehension of musical composition can not be obtained, except by focussing attention "between the notes." Bad singing, for example, will result whenever the singer attempts to associate a syllable in one-for-one correspondence with an associated musical note, rather than locating the syllables in respect to an harmonic progression. Similarly, if musicians believe in arbitrary "melodies" selected by no criteria but more or less accidentally "pleasing effects," such musicians are incapable either of composing decent music, or of understanding the nature of musical ideas properly governing interpretation. Such pathological aberrations among musicians, involve deep-seated, ignorant prejudices of an axiomatic quality, axiomatic fallacies precisely identical with those commonplace in a linear misinterpretation of physics.

For reason of the fact, that Dr. Wells' contribution depends significantly on advanced and rather fundamental work in plasma physics, it will tend to be the case, that the student imagines that the significance of this contribution can not be understood, except from an advanced-physics standpoint. The importance of the contribution is that, in and of itself, is pertains to the most elementary of the conceptions which ought to be mastered at the beginning of a study of mathematics, even on the secondary-school level. The contribution bears upon very advanced physics-theorems, as all axioms of physics do, but it is essentially an elementary, axiomatic conception, rather than being peculiar to advanced theorems.

Summary

At first glance, Dr. Wells' contribution illuminates and demonstrates the hypothesis, that a refined version of Kepler's universal laws of astrophysics, is equally efficient in the microphysical domain. However, since the immediate connection exists only in respect to so-called "force free" configurations of physics in the small and relatively small, the proof of the connection, is proof that astrophysics is based fundamentally, not on forces, but on "force free" states of physical space-time. Thus, is demonstrates that the existence of "force" in physical processes is not self-evident, but determined. Forces do not govern universal processes, but, rather, universal, "force free" processes produce the by-product phenomena we associate with the phenomena of "forces."

That proposition, thus, emphasizes that Gauss-Riemann physics is not merely a matter of choice of formal mathematical apparatus. It demonstrates that the fallacy of anti-Riemannian mathematical physics, is an ontological fallacy, rather than merely a formal error. This point is, properly, the most fundamental principle governing a successful revolution in the contemporary and future practice of physics.

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