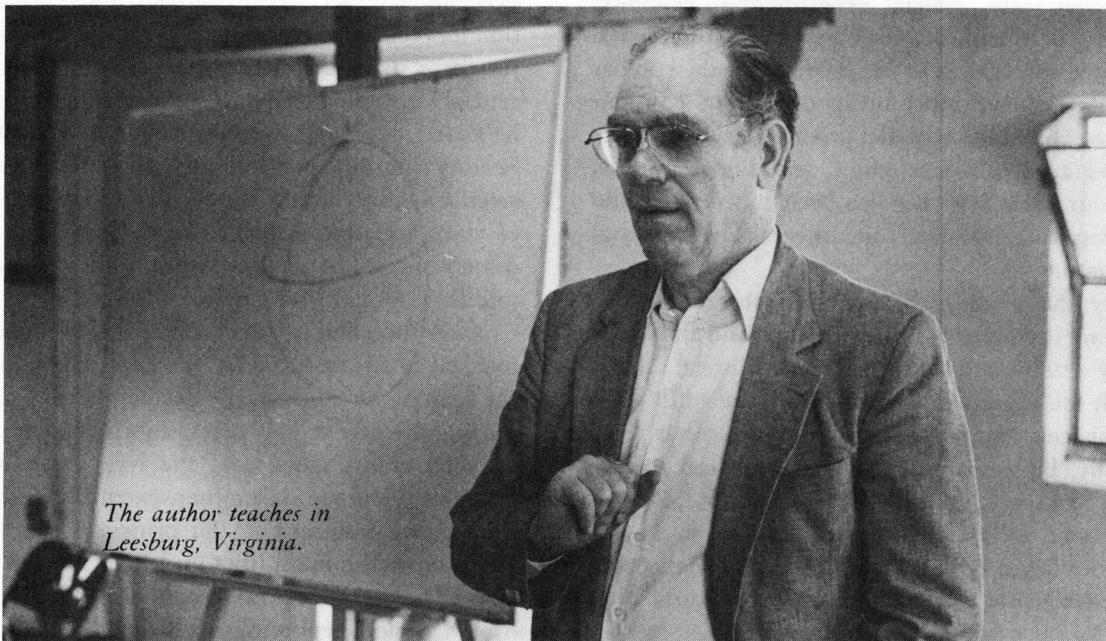


THE SCIENCE OF MUSIC



Solution to Plato's Paradox of 'The One and the Many'

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EIRNS/Stuart Lewis

One of the more striking examples of the lunacy to which a modern positivist's academic mentality may lead sometimes, is the occasional episode, during which a university instructor informs his class that science has been unable to show that life

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(such as that of university instructors) is possible. Lately, since the wider, post-World War II popularization of the Boltzmann dogma, as "information theory," the positivist professor might concede that although the existence of life is contrary to the Second Law of Thermodynamics, it is a remote, chance, statistical possibility.

In that way, we forewarn our readers against such a positivist's misinterpretation of some following observa-

tions on the subject of electromagnetic determinism, respecting the characteristic metrical features of musical science. Man, and life in general, existed long before positivists first appeared on this planet. Such fundamentally characteristic features of *natural music* as *bel canto* vocalization, voice-registration, and a well-tempered scale with middle C set at approximately 256 cycles, are biologically determined, and thus inherent truths of existence predating the first physicist or musicologist. The fact that something exists, is, statistically, necessary and sufficient proof of better than 100% certainty that the laws of the universe have brought about that existence in a necessary and sufficient way. The necessity of *well-tempering*, of *bel canto*, and of middle C set approximately at 256 cycles, was, in each respective instance, discovered centuries, or even, perhaps, millennia ago. These characteristic features of the “musical universe” are, like the existence of mankind, natural phenomena, not something whose existence requires academic midwifery.

The included task of science, is the search for truth, to bring the method by which human opinion is formed into conformity with the Creator’s laws. In that connection, we, as discoverers, depend upon what physical scientists often term “crucial experimental” evidence. The existence of mankind is such a crucial-experimental fact. It is not something to be proven possible; it has occurred. Rather, we must bring prevailing opinion-making into conformity with the proof, that the existence of mankind as a self-developing, and the dominant, species of our solar system—has been a necessary and sufficient result of the most fundamental lawfulness of universal nature.

Similarly, the crucial-experimental facts from which *musical science* is obliged to begin, are each and all facts of biologically determined *vocal polyphony*. Musical science begins with the subject of singing. Since the adult singing-voice species (soprano, mezzosoprano, tenor, etc.) are naturally, biologically determined, musical science starts here, focused upon what is demonstrated, by crucial experiment, to be *well-tempered polyphony*.

We cannot begin with the phenomena of man-made musical instruments, since these are not natural phenomena.

The proofs of the natural principles of *bel canto vocalization* and *voice-registration*, are directly crucial-experimental reflections of the *biology* of the human species. *Bel canto* is demonstrated to be nothing but the human being’s most natural, relatively least-effort, most efficient method of speaking and singing, by virtue of the biologically determined characteristics of the healthy expression of the human genotype. This was proven experimentally by musicians no later than a half-millennium ago, and

almost certainly much earlier than that.

The vocalization of Classical (e.g., strophic) poetry, according to elementary *bel canto* principles of vocalization, is *song*. The participation of singers representing two or more of the biologically determined species of singing voices (soprano, tenor, etc.), is the essence of *Classical well-tempered polyphony*.

It is determined, in a similar way, that each species of singing voice has, naturally, four *potential* registers, each with a distinct quality (“color”) of voice relative to each and all of the remaining three. It is also determined, that for each such species of singing voice, the places (on the scale) at which the transition from one register to an adjacent one must occur, is biologically determined, and that this place of “register shift” is fixed such that the place itself may not be shifted frequently without possibly irreversible damage to the singer’s voice (see Figure 1).

Similarly, the extreme ranges of the voice, for each species, have certain approximate upper and lower limits, for most of the trained voices in the singing population; by exception, some trained adult singers may command extended ranges. Once we apply these natural, crucial-experimental facts to the canonical-polyphonic vocalization (*bel canto*) of any singable piece of Classical poetry, we force upon the whole body of musical science the crucial-experimental proof, that the musical scale must be based upon the *natural bel canto* characteristics of healthy singing, upon Johann Sebastian Bach’s *well-tempered polyphony*, upon the *naturally* fixed characteristics of voice registration respecting each biologically determined species of singing voice, and upon a value of middle C of approximately 256 cycles.

After that, and no earlier, we consider the man-made musical instruments. As a practical matter, we delimit the span of *our* study to the development of instruments during the recent 500 years, approximately. Although stringed instruments (e.g., the lyre), woodwinds, and horns of one form or another, extend into very ancient history, we lose nothing on principle, if we limit our attention to the main lines of development of keyboard and Classical orchestral chests of instrumental voices over a period beginning with the adulthood of Leonardo da Vinci, and concluding, approximately, at the beginning of the 1814-15 Congress of Vienna. That “chest” of keyboard and orchestral instruments, which emerged as a standard over the period from J.S. Bach’s work at Leipzig up until the Congress of Vienna, is taken as our standard of reference for defining matters posed in respect to the strictly Classical anti-Romantic tradition associated factionally with such names as J.S. Bach, Haydn, Mozart, Beethoven, Schubert, Chopin,

and Brahms (see Figure 2).

These instruments, designed for a well-tempered scale pivoted upon C=256, were developed in imitation of those characteristics of the chest of *bel canto* voice-species which we have identified above. Thus, to the degree both composer and performer grasp, more or less successfully, the practical implications of these connections, everything (bearing on principles) which is to be said of the intent and characteristics of instrumental performance, is subsumed by *natural* voice principles.

Kepler and Music

Through the eyes of the mathematical physicist, what we have noted, as the *natural* characteristics of “musical space-time,” presents us an extremely significant challenge. In brief, the laws of a universe in which these *natural characteristics* might exist could not be the universe of Descartes, Newton, Kelvin, Helmholtz, Maxwell, or Boltzmann-Wiener. However, it could be a different kind of physical universe, that of Cardinal Nicolaus of Cusa, Cusa’s follower Leonardo da Vinci, Cusa and Leonardo’s professed follower Johannes Kepler, Kepler’s professed follower Gottfried Leibniz, France’s Gaspard Monge, or such followers of Leibniz and Carl Gauss as Bernhard Riemann, Georg Cantor,

and Eugenio Beltrami. The case of Kepler’s founding of the first comprehensive mathematical physics, is a very relevant illustration of the point.¹

Take Kepler’s *World Harmony*² as a point of reference. First, for the information of the person who has Alexander Pope’s “a little learning” concerning physical-science matters, we emphasize that Isaac Newton did not “discover universal gravitation.” Newton’s famous Gm_1m_2/r^2 is merely an algebraic manipulation of the algebraic formulas representing Kepler’s famous, universal three laws of motion.³ Newton discovered nothing; rather, by the algebraic oversimplification in Newton’s parody of Kepler’s laws of motion, Newton introduces an apparently insoluble mathematical paradox into physics, the so-called “three-body problem.”

In Newton’s schema, for example, the orbits of the planets and their moons can be situated at any distance from the Sun one might choose for situating a planet. One merely has to choose a mass and orbital velocity whose associated centrifugal force neatly balances the centripetal force, the gravitational “pull.”

In Kepler’s universe, this is not permitted. The number of possible orbits and orbital velocities is precisely determined. No orbits between any two of these determined orbits is permitted. Kepler’s method permits the existence of no planetary orbit between those of Mercury

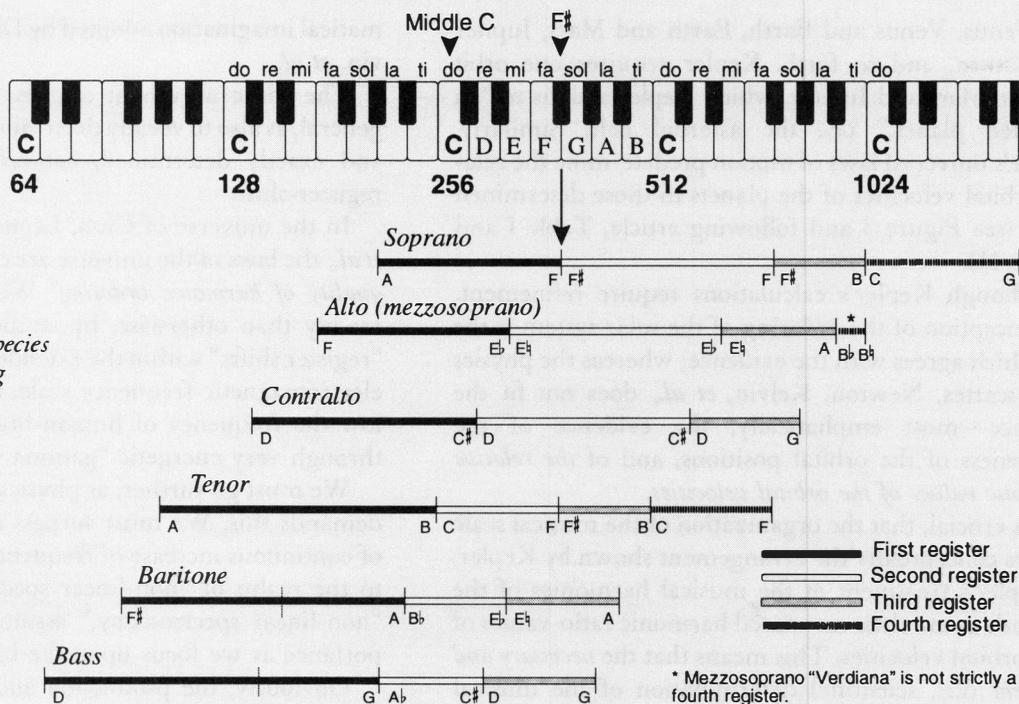
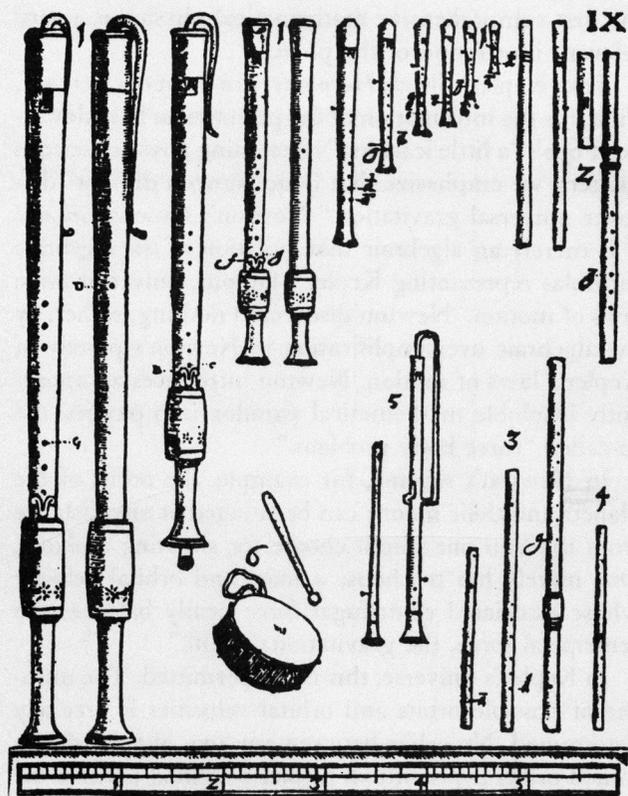
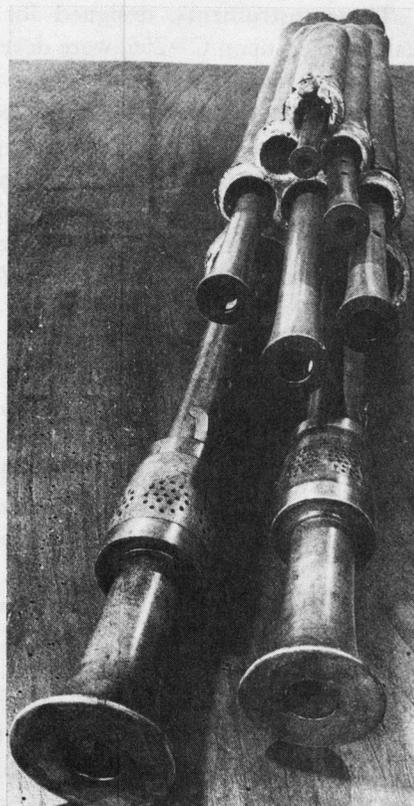


FIGURE 1. The six species of the human singing voice.



Source: Michael Praetorius, *Syntagma Musicum*, 1619

FIGURE 2.
Instrumental voices were developed, from the period of Leonardo da Vinci to the Congress of Vienna, in imitation of the species of the human singing voice. Left: woodcut diagram of “chest” of recorder voices. Right: “chest” of recorders in case.



and Venus, Venus and Earth, Earth and Mars, Jupiter and Saturn, and so forth. Kepler requires one orbit between Mars and Jupiter, which Kepler assigns to “an exploded planet,” i.e., the asteroid belt. Similarly, Kepler’s universal laws of motion predetermine the relative orbital velocities of the planets in those determined orbits (see Figure 3 and following article, Table I and Figure 11).

Although Kepler’s calculations require refinement, his conception of the ordering of the solar system is the one which agrees with the evidence; whereas the physics of Descartes, Newton, Kelvin, *et al.*, does not fit the evidence—most emphatically, the evidence of the uniqueness of the orbital positions, and of *the relative harmonic values of the orbital velocities*.

It is crucial, that the organization of the musical scale follows conceptually the arrangement shown by Kepler, in Kepler’s treatment of the musical harmonies of the solar orbits and their associated harmonic ratio-values of their orbital velocities. This means that the *necessary and sufficient* (i.e., scientific) determination of the musical scale, is consistent with the physical universe of Cusa, Kepler, Leibniz, *et al.*, but not with the schema of mathe-

matical imagination adopted by Descartes, Newton, Kelvin, *et al.*

The same argument applies to *vocal polyphony* in general, as also to vocally determined, *natural registration*, and exactly determined, *natural* singing-voice-species register-shift.

In the universe of Cusa, Leonardo, Kepler, Leibniz, *et al.*, the laws of the universe are coherent with a *musical quality of harmonic ordering*. We can show this more readily than otherwise, by studies of the existence of “register shifts” within the extended span of the complete electromagnetic-frequency scale, for a scale starting below the frequency of human-brain “alpha waves,” up through very energetic “gamma waves.”⁴

We must go further, as physics, including biophysics, demands this. We must surpass a simply linear notion of continuous increase of frequency (from “2” onwards), to the realm of “non-linear spectroscopy.” This latter, “non-linear spectroscopy,” assumes overwhelming importance as we focus upon the biophysical domain.

Obviously, the production and hearing of music by the human species involves living biophysical processes in what proves to be the “non-linear spectroscopic” do-

main of generating and absorbing, discriminating efficiently musical tone-sequences. Thus, we locate the *bio-physics* to be considered respecting a *science of music*.

Since the three cited, principal, natural features of vocal polyphony—*well-tempered scale*, *registration of singing-voice species*, and determined *register shift*—require a Keplerian universe, excluding the Newtonian, the kind of physics to which a science of music must refer, must be along the Keplerian track leading through Leibniz and Riemann.

Kepler and Life

Another way of presenting what is ultimately the same point just made, is to say that Kepler's mathematical physics was based explicitly, "axiomatically," upon the evidence, that our universe is characterized as one in which life is the highest form of existence, and man is *lawfully* the highest form of life known.

To attempt to quell riotous protests of indignation from among some holders of doctoral degrees in physical science, we must interpolate here an identification of the following unpleasant truth respecting modern university (and secondary school) education. Only after we have cleared the air so, can Kepler be discussed rationally.

The twentieth-century trend in U.S. education has been away from the rigorous standards of classical and scientific education preferred by nineteenth-century Harvard University, for example, toward a rote education of the poor quality which German speakers associate with the conventional word of contempt, *Brotgelehrten*. More and more, scientific education has aimed pragmatically, away from rigorous attention to scientific fundamentals, toward, and below the editorial standard of, say, *Popular Science* magazine.

In brief, even most contemporary university products with four-plus averages and terminal degrees, are primitively uneducated in a field which happens to be this writer's specialty: *a Socratic method of approach to axiomatics*. This latter method is the most characteristic feature of the leading work contributed by the greatest scientific minds of the past six hundred years, such as Cusa, Leonardo, Kepler, Leibniz, *et al.*

What the *Brotgelehrten* among science students and graduates know, is virtually no geometry, but merely a variety of arithmetic-algebra based upon, and limited to, a formalist deductive method. Such is the passively accepted classroom mathematics, at all levels of the pecking-order, today. What only a handful of such professionals do know, is that the scientific competence of a deductive mathematics is very much in doubt experimentally. The popular defense of the *Brotgelehrten*, is to

put out of sight and mind any physical evidence, no matter how devastatingly true, which calls the "generally accepted," deductive form of mathematics into question.

The evidence which proves Kepler's mathematical physics competent and Newton's opposing mathematics as crucially incompetent by comparison, is the kind of crucial evidence showing the outer limits of physical application of a merely deductive mathematical schema.

That brings us to our concluding points on the science of music. There are three points to be made.

Despite the progress in interpretative performance of Classical musical works by some postwar-period musicians, the principles of Classical musical composition themselves have been virtually lost. The chief obvious reason for this general decay of musical education's quality is the attempt of established musicologists to superimpose the Hegelian metaphysical schema, in which the Romantic school is portrayed as the logical successor of the Classical, and the twelve-tone modernist rubbish the logical successor of the Romantic. The effort to adduce for the teaching of music, a "principle" which coheres with such Hegelian mystical irrationalism, is the core of the musical-theoretical problem of today.

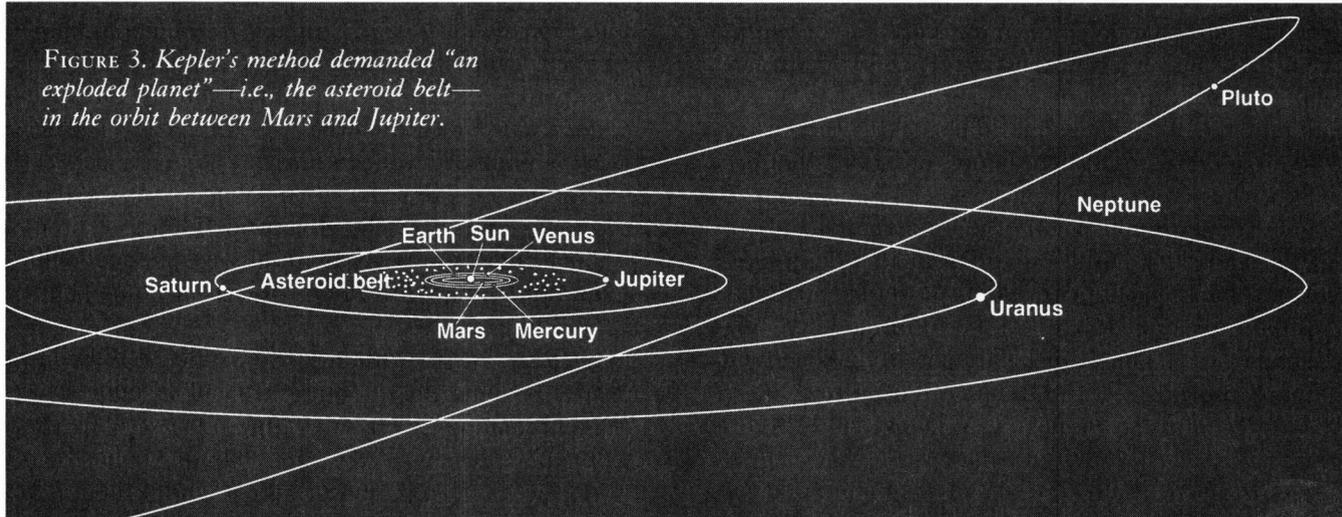
Continuing with the first of our three points here, there is a second aspect of the same problem to be noted. The popularization of anti-scientific rubbish of Helmholtz's *Sensations of Tone*, and the popularized hoaxes of Helmholtz's devotee Ellis, if believed, destroy utterly the ability of the music student to understand rationally the three *natural characteristics of music* we have identified above.

Summing up the first of our three concluding points, the nineteenth-century rise of the quasi-dionysiac dogma of Romanticism, decreed through the mouth of proto-fascist positivist Professor Friedrich Karl von Savigny, that an absolute separatism must be enforced, between natural sciences (*Naturwissenschaft*) and the arts (*Geisteswissenschaft*). Thus, did establishment support for Savigny's doctrine of separatism lead both to the rise of Adolf Hitler and to the triumph of the irrationalist sundry dogmas of "art for art's sake," in music, poetry, and so forth.

Hence, the proper unification of science and art, as embodying, as an integral wholeness, these pervasively coherent qualities of individual mind setting man apart from, and superior to, the beasts, is indispensable for the vigorous revival of music in our time. To this purpose, the current of scientific view of music exemplified by Kepler and his successors, is indispensable.

The second of our three concluding points coheres with the first. Although musical history has proven conclusively, empirically, the three cited *natural characteris-*

FIGURE 3. Kepler's method demanded "an exploded planet"—i.e., the asteroid belt—in the orbit between Mars and Jupiter.



tics of vocal polyphony, questions of practical significance arise which music demands be examined from the standpoint of biophysics. We shall turn to that after identifying the third of our three concluding points.

Our third, cohering point is this. It is not sufficient, that musicological questions be settled from the vantage point of biophysics' nonlinear spectroscopy, or from what might be termed a "simply musical" standpoint. The irrationalist myths of "absolute music" must not be left unchallenged. The human function of music, must be ultimately the basis on which musical activity is to be judged.

We subsume the three topics, as ultimately one, under the rubric *Kepler and Life*.

Sovereignty of the Creative Processes of the Individual Human Mind

Every genuinely new conception, as knowledge, which you, or any other person acquires, comes into existence in the individual human mind, in a way which can in no way be described by deductive methods, but rather in an entirely different way, in a way which solves the central paradox of Plato's *Parmenides* dialogue. This is the true key to understanding, first, the human purpose of Classical forms of music: This understanding shows us how the *biophysics of vocal polyphony* play their part in defining how such should be performed and composed.

The generation of a new idea, as a unified, *indivisible* conception, in the mind of an individual person, presents this following echo of the *Parmenides* paradox.

Many pieces, each individual, indivisible ideas, enter the mind, and are transformed from a *many* into a new, valid, combined but single and non-divisible new conception. There is nothing of the new idea in any part

of those many ideas which appear to have stimulated its generation. They are the *Many*; the new conception is *the indivisible One*. There is no deductive pathway leading from any or all of the *Many*, to this *One*. The transformation of the *Many* into this new *One*, is the work of *the creative processes of the individual human mind*.

By *creative processes*, we mean the same kind of mental processes which generate, transmit, and assimilate new, valid discoveries of fundamental principle in physical science. This occurs as a *Many-into-One* transformation, typifying so the required solution to the *Parmenides* paradox. Since this process is unique and indivisible, every individual mind engaged in generating concepts which are valid, and new to it, to this effect, is an *axiomatically sovereign quality of individuality*.

The case of physical science, the uplifting of man's existence through scientific and technological progress, shows that the self-development of individual mental creative processes, to produce valid changes for the better in man's comprehension of universal physical laws, puts such individual mental-creative processes in a special kind of direct, correspondence with the Will of the Creator.

Thus, in valid scientific progress, the primary relationship to knowledge of the individual's creative-mental processes, is to the *Mind (Will) of the Creator*, and only by derivation to objects in the universe.

Classical music, is the use of the natural characteristics of vocal polyphony, to replicate in music what the developed creative-mental powers of the individual human mind accomplishes otherwise in the "synthesis" of a valid discovery of improved, fundamental scientific principle.

This signifies, that the process of generating a *Many* (a mathematical-physics *manifold*) from a starting-point,

and then developing the manifold to generate a *One*, establishes a single conception—the *One*—as the identity of the composition, rather than as a divisible aggregation of parts. This requires what may be described fairly as a “problem-solving” dynamic to the process of composition; this implies, in turn, that the *problem* and its *solution* are defined as *problem* and *solution*, respectively, by some notion of lawfulness.

Hence, the *arbitrariness, irrationality* intrinsic to the principle of artistic Romanticism, shows Romanticism to be on principle a *dionysiac* defiance against reason, and the twelve-tone system more radically so.

Notably, *the principle of musical composition cannot be deductive* (e.g., *Aristotelian, neo-Aristotelian*) in form.⁵ It cannot fit within a “universe” (a mathematical physics) according to Descartes, Newton, Kelvin, *et al.* This brings us to relevant work by Leonardo da Vinci and Kepler, successively.

The central feature of the work of Kepler was his elaboration of a principle central to the scientific accomplishments of Leonardo da Vinci. Leonardo *et al.* had shown that all living processes were characterized as to form, and form of functional motion, by harmonic orderings congruent with the Golden Section. This work of Leonardo *et al.*, had the following significances for the later work of Kepler, and for our topic here today.

First, as to constructive geometry (e.g., mathematics). The Golden Section is the characteristic feature of generation (*determination*) of those five “Platonic” regular solids (polyhedra) which are the limit of such constructability within visible physical space-time (see following article, Figures 2 and 4).

Second, as the convergence of Fibonacci’s series upon Golden Section harmonics illustrates, these latter harmonic orderings are not only characteristic of all living processes, but express a characteristic of negentropic processes.

Third, Kepler’s choice of this geometrical mathematics for his construction of an astrophysics (and of universal laws of motion) defines his universe (as an integral whole) as negentropic (e.g., directly opposite to the universe of Newton, Kelvin, *et al.*). Subsequent evidence (e.g., Gauss’ work on asteroid orbits) proved Kepler to have been right in his choice of a universal *negentropic* principle, and Newton’s physics, based mathematically and ontologically upon axiomatically entropic assumptions, to have been flatly in error.

Modern crucial-experimental evidence shows: 1) that all living processes are harmoniously ordered negentropically as indicated above; 2) that Kepler’s negentropically ordered physical space-time was proven as to astrophysics by Gauss’ work on asteroid orbits; and 3) that in the

very small, the quantum-domain of Schrödinger and de Broglie functions, physical space-time is negentropically “Keplerian.”

For reasons supplied in such published locations as *In Defense of Common Sense*, creative-mental processes are implicitly *nonlinear negentropic* processes. Consider the argument for each, summarized very briefly.

Any consistent system of deductive argument, such as present-day conventional classroom mathematics, can be represented as an extensible form of deductive theorem-lattices. Such a lattice is generated from the starting-point of a set of unproven, arbitrary theorems, called *axioms* and postulates. All theorems are derived from that starting basis; no consistent theorem so derived contains any claim not originally implied by the original set of axioms and postulates.

A creative discovery in physical science is of the following type (at least, this is so, as long as we examine the matter from the standpoint of deductive method in general):

First, represent an existing physics (for example) by a choice of deductive mathematics, thus depicting that physics, in more or less close approximation, as a deductive theorem-lattice. Now, consider a single crucial experiment whose evidence refutes a consistent and necessary theorem of that theorem-lattice. All other practical considerations assumed taken into account, this single experiment demands a revolutionary overturn of that entire physics.

A fallacy in a single, consistent, and necessary theorem of a deductive system refutes fatally one or more features of the set of axioms and postulates underlying the entire lattice. The required correction of that proven margin of error in the deductive-axiomatic basis, requires a new axiomatic basis, to such effect that no theorem of the old theorem-lattice, e.g., *A*, is consistent with any theorem of the revised theorem-lattice *B*, and *vice versa*.

Thus, from the standpoint of deductive, or linear method (all deductive systems are linear, and *vice versa*), the two successive theorem-lattices are absolutely separated by a deductively unbridgeable logical gulf of *formal (logical) inconsistency*. Another name for this is *mathematical discontinuity*.

Nonetheless, the creative processes of the individual mind, in effecting the leap from *A* to *B*, bridge the discontinuity. Thus, we have as a representation of a creative-mental action (informing practice), a function linking successive theorem-lattices *A, B, C, D, . . .*, which is a function of successive, *nonlinear* discontinuities in one and all possible deductive domains. That is a true *nonlinear* function, of a higher Cantorian order. Thus, we have emphasized *non-linear*.

The fact that the error-correcting aspect inherent in scientific progress directs revolutionary scientific practice (*progress*) of a society toward ever-higher per capita and per hectare reproductive processes, defines this creative function as a *negentropic* function, in the same sense, respecting our illustration, a Fibonacci series converges upon a harmonic ordering congruent with the Golden Section.

This is not merely the case for such creative thinking in physical science, it is the characteristic feature of creative activity in the medium of classical art.

We can illustrate this principle in Classical musical composition in many ways. We can consider, for example, the famous Goethe's misguided preferences for Reichardt, over settings of the same poems by Ludwig van Beethoven and Franz Schubert. Goethe failed to grasp the essential principle of musical creativity, even in so elementary a medium as the simple strophic song.

One of the most obvious illustrations of the point, is the treatment of J.S. Bach's *A Musical Offering* by Wolfgang Mozart, Beethoven, Schubert, and others. Here is an excellent showing of what ought to be understood as the seamless union of scientific methods of musical composition and beauty. A proposition is presented, yet once again, for a yet-more-ingenuous solution. The solution is bounded by strict Classical rigor; the rigor pertains to the way in which a creative modification of the rules is permitted, on behalf of a solution.

There are three most essential things which a Classical musical composition must satisfy.

1) The medium must never depart from the domain of *natural beauty*. Beauty is life; ugliness is death. Life is rooted in those negentropic harmonic orderings which are congruent with the Golden Section. This has not changed since Plato.

2) Nothing can be art which is merely arbitrary whim, or which departs from the strict confines of natural beauty. Yet, the mere imitation of natural beauty is not art. Art is that which employs, and never departs from, the medium of natural beauty, but which uses that uncorrupted medium as the domain of the same kind of strictly rigorous and valid creative-mental activity, applied to the medium of (in this case) vocal polyphony, which we associate otherwise with valid fundamental discoveries of principle in physical science.

3) The work of art, after meeting in a general way these first two requirements, must also master the challenge outlined in Plato's *Parmenides* dialogue: The *Many* in the composition must be transformed into the continuous substance of the indivisible *One*.

Hark back to Nicolaus of Cusa's work: the *microcosm* (Minimum) and the *macrocosm* (Maximum). We,

through efficient development of that *divine spark* which is our individual potential for creative-mental acts, show ourselves, in working for the *isochronically* universal good, to be truly in the living image of our Creator. We participate so, in that which is greater than we are.

It is this quality of doing which marks us out, more than in any other way, as truly, perfectly sovereign individual reflections of our perfectly sovereign Creator. A true work of art brings *Many* into the perfect indivisibility of a *sovereign Oneness*, which latter is the indivisible Oneness of that work of art taken as a whole. Such a work of art thus reflects upon the direct form of relationship between the sovereign individuality of the creative intellect and that in whose likeness that sovereignty is cast. Unless a work of art achieves that specific sort of *sovereignty* itself, and the other conditions also fulfilled, it is no true work of Classical art.

The last quartets of Beethoven, beginning with the Opus 127, epitomize the opening into a new dimension of Classical musical composition. Since then, the Opus 135, the best Classical composers through Brahms, enriched the use of Beethoven's heritage; but they budged music as a whole not an inch further ahead, to this day.

Once, by the aid of insights contributed to young musical masters by a science of music, there will be a more adequate assimilation of what the late quartets represent; once the first truly *sovereign* musical composition reflecting the principle of those quartets has been heard, we shall know by that sign that the lesson has been mastered, and then music shall, at last, move ahead once more.

NOTES

1. See Carol White, "Johannes Kepler: Voyager in Space," *21st Century Science & Technology*, Vol. 1, No. 1, March-April 1988; Lyndon H. LaRouche, Jr., "Designing Cities in the Age of Mars Colonization," *21st Century Science & Technology*, Vol. 1, No. 5-6, November-December 1988; and *LaRouche: Will This Man Become President?* by the Editors of *Executive Intelligence Review* (New York: Executive Intelligence Review, 1983), pp. 161ff.
2. Johannes Kepler, *Harmonici Mundi (The Harmonies of the Spheres)* (1619); see also *Mysterium Cosmographicum (The Secret of the Universe)* (1596), *Commentaries on Mars* (1609), *On the Six-Cornered Snowflake* (1619), and *Epitome of Astronomy* (1620).
3. Kepler's laws can be summarily stated as follows: 1) The planets move around the sun in ellipses, at one focus of which the sun is situated. 2) As each planet moves around the sun, the vector extending from the planet to the sun sweeps out equal areas in equal times. 3) The ratio of the square of the planet's year to the cube of the planet's mean distance from the sun is the same for all planets.
4. For a full development of this material, see Warren J. Hamerman, "The Musicality of Living Processes," *21st Century Science & Technology*, Vol. 2, No. 2, March-April 1989.
5. Lyndon H. LaRouche, Jr., *In Defense of Common Sense and Project A*, in *The Science of Christian Economy and Other Prison Writings* (Washington, D.C.: Schiller Institute, 1992).