IV. Science

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LaRouche's Principle of the Human Mind: Kepler and Our Harmonic Universe

This is the edited transcript of the presentation by Megan Dobrodt as part of Panel 4, "The Art of Optimism: Using the Classical Principle To Change the World," of the Schiller Institute's Sept. 10–11 Conference, "Inspiring Humanity To Survive the Greatest Crisis in World History." Mrs. Dobrodt is the U.S. President of the Schiller Institute.

The full video of Panel 4 is available here.

Schiller Institute

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The human mind is the most powerful phenomenon in the universe that we're aware of. This fact was Lyndon LaRouche's specialty, and it's what all science and art must learn from him today; it lay at the root of his early discovery in the science of physical economy, and is something which he continued to develop deeper and deeper insight into over the course of his life.

In 2014, Lyn pointed out, in response to recent breakthroughs in fusion and plasma physics, that the human species was beginning to surpass the Sun in levels of energy-flux density and states of matter under our control.

The great miracle at the root of this is that human thoughts, conceptions which originate not from experience, not from observation, not *from the outside*, so to speak, but only as inventions of the imagination of a single human being, correspond so closely to the principles of the universe outside of our skins, that when we act upon those thoughts, we can exert great, new powers in and over that universe. That category of thoughts that are successful, we call scientific discoveries, and they are the root of the distinction of mankind from all other species on Earth, and of our progress away from an animal-like existence, toward one which is capable of leaving this planet and establishing life, and cognitive life, on other planetary bodies.

This fact, this "miracle," challenges what is often believed to be the boundary between the human mind and the universe, a false separation between man and nature, and it raises the issue of what role we as a species has been assigned to play—should we accept the mission—in the continuing self-development of our universe.

This brings before us, as our proper subject, the driver of all progress, human and otherwise: the creative imagination, which moves us out of the domain of logic and mathematics and other such things, and into the domain of art. What I want to address specifically today is the subject of Harmony, not just sensible harmonies, but the *principle* of harmony: the mind's ability to discover—you could say, invent—a higher, unifying *one* that governs and tunes the multiplicity.

Why is this so important today? Among other reasons, human beings have reached the point in our development where we are no longer Earthlings. Not only do we travel physically off of the surface of the planet regularly—to the International Space Station, and hopefully again soon to the Moon—through non-human explorers, like the *Voyager* missions and the *Curiosity* and *Perseverance* Mars rovers on Mars, the Chinese rover, Yutu-2, on the far side of the Moon, we've extended our sensorium and implicitly our power to act, to the surfaces of other worlds.

The most recent example that has captured the imagination of so many is the work of the James Webb Space Telescope, which has given us the deep infrared "eyes" needed to see and map previously unseen phenomena, many of which are already challenging the basic assumptions about the principles behind the larger galactic and intergalactic systems in which our humble little Earth swims.

What is the *principle* running this galaxy, and this intergalactic system *as a system*, as a *one*?

To even begin to answer that question, scientists today must take their orientation from the work of Johannes Kepler, from his discovery of the principle animating our solar system, to which Lyndon LaRouche pointed again and again. It's here that we find a powerful example of the mode of creative thought necessary to make the breakthroughs of *principle* we require today, as opposed to drowning in the kinds of mere modeling of appearances which Kepler overturned hundreds of years ago.

In 1609, Kepler published a revolutionary work, the *New Astronomy*. In this work, he re-founded the science of astronomy, lifting it out of the realm of geometric modeling of appearances, and placing it firmly in the domain of physics. In that work, he walks the reader through each step of his discovery that the planets are moved by the *physical* power of the Sun, the result of that, the outcome of that, is that the orbits traced out by the planets are elliptical, rather than perfectly circular.

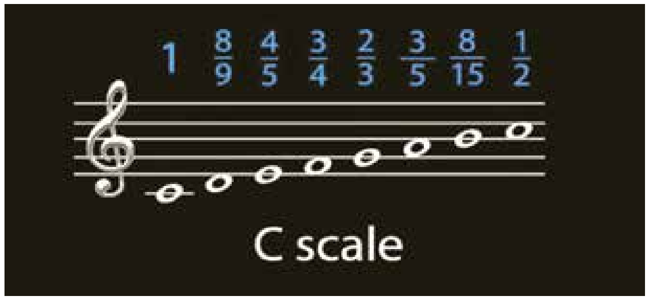
He then returned to the higher question, one which he had tackled preliminarily as a young teacher in his early 20s: What makes the individual planets and the Sun a *system*, a universe, as opposed to a collection of things that happen to inhabit the same part of space? Another way of posing that question is, "Why and how did God shape the Solar system *this* way, and not otherwise?"

It's here that Kepler turns to music, to harmony.

Kepler wasn't the first to look at the nighttime sky with a feeling that there was a harmony to its motions. This was a quite ancient idea which we see signs of in Plato's *Timaeus* dialogue. Kepler's breakthrough was in leaving behind the idea that the sense-perceptible harmony or even the numerical harmony was primary. He leaped to a higher, generating principle, an entity which can only be heard by the ears of the mind.

Let's take a simple illustration.

FIGURE 1

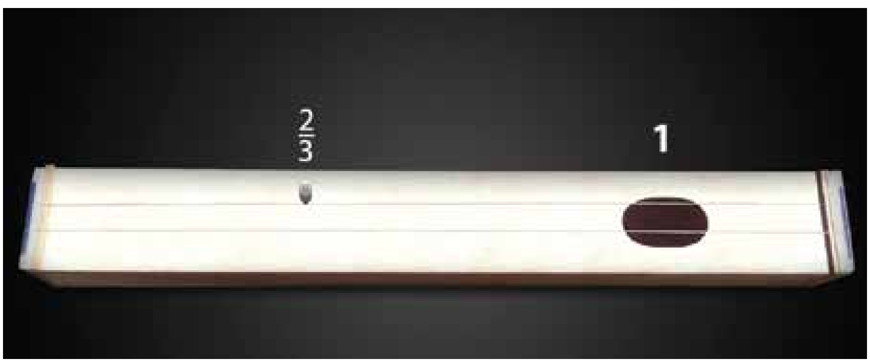


In **Figure 1** you see the notes of a musical scale, the major scale, and above them, you see numbers. Let me show you what those numbers mean. It was known millennia ago that the tones of what we today call the major and minor musical scales can be built from a number of whole-number ratios.

For example, if we have a simple vibrating string—a string stretched across a resonating box (**Figure 2**) like a cello or violin. The string will make a tone when plucked. Let's call the length of the string "1." If I now mark off two-thirds (**Figure 3)** of the string, I have a shorter part which is in a ratio of 2 to 3 with the whole, and the motion of its vibration is in a ratio of 3 to 2 with

FIGURE 2

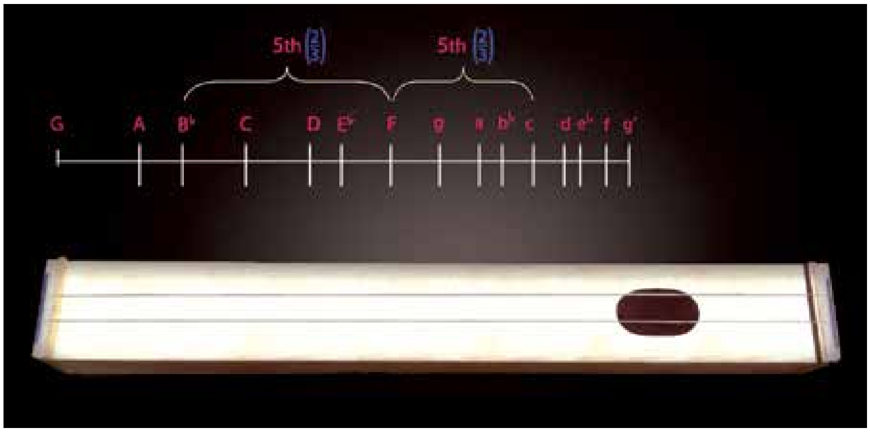
FIGURE 3



the whole. If I pluck that shorter string, we get a higher tone, which, when played simultaneously with the original tone, sounds consonant—beautiful. The two tones are in harmony. The same holds with a division of the string at 3/4, 4/5, 5/6, 5/8, and 3/5 ratios.

[At this point the speaker plays a musical example of the harmonies produced as a bow is drawn across the two strings at the different ratios mentioned.]

FIGURE 4



From these proportions and proportions of these proportions, we can generate all of the tones of the major and minor scales. But here, already, a problem arises, which I'll illustrate in the following way:

Take an instrument like a piano. The strings of a piano must be tuned to specific, fixed pitches. Let's say we're tuning the piano centered on the scale note of G, as Kepler did. A minor third up from G in the scale is the note B-flat, a 5/6 ratio. A fifth up from that, a 2/3 ratio, bringing us to the note F. Great. So, 2/3 of 5/6 is 5/9 of the original string, so we tune the F to 5/9. (See **Figure 4)**

Say I want the tuner to check his or her work. I know the same note, F, is a fifth or 2/3 ratio *down* from the note C above. That C is a 3/8 ratio to the original G. However, 2/3 *down* from 3/8 is *not* 5/9—it's 9/16. That's a small but *audible* difference! (See **Figure 5**)

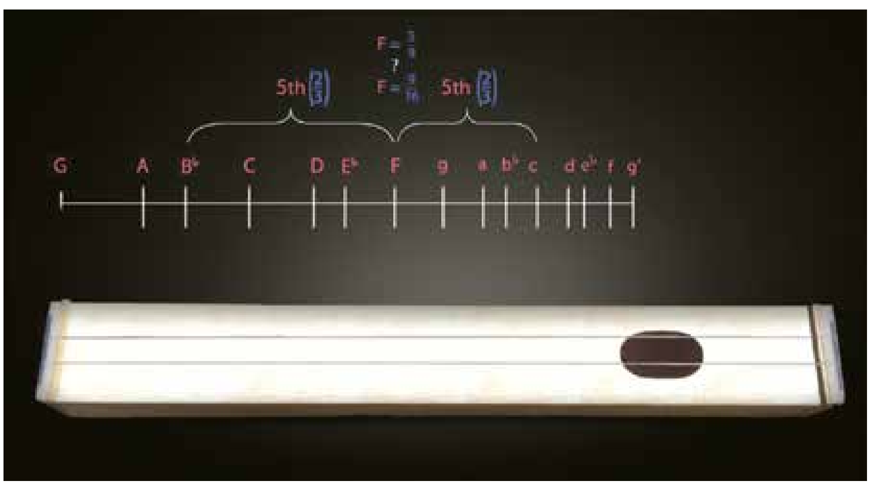
So which value for F is correct? 5/9? 9/16? Should we choose something in between, in which case we lose the perfect harmonic quality of the 2/3 ratio?

The issue, here, is that this example is not an isolated case: The harmonic system, the musical system, is riddled with such disagreements, and there is no possible mathematical calculation which can resolve these disagreements and keep the pure whole-number intervals. It's impossible. What that means practically is that, depending on which note, or which scale you choose to start your melody on, you could get a real unpleasant of "out-of-tuneness"!

This problem, an issue called *musical tempering*, is something Kepler was intensely interested in, and one which he spent a good amount of time studying. Why is this significant? Because of where its solution lies.

Kepler lived at a time when the discovery of musical *polyphony* was beginning to emerge. As opposed to a single principal melody line with other voices or instruments merely accompanying, supporting or in service of that line, in polyphony, we have many, independent voices, each singing a different melody, and yet coming together into a unified, beautiful *one*: into a harmony which is a higher type of harmony than the simple one of two consonant tones. The most advanced modern expressions of this can be heard, for example, in the fugues of J.S. Bach, the symphonies of Mozart, and the late string quartets of Beethoven.

FIGURE 5



As with a living process, in complex polyphonic music, the intervals and the notes are not fixed. The musicians, string players or singers, for example, will make slight adjustments to the tuning of the notes in the moment such that each note of his or her independent line is very slightly altered to tune to the changing and developing harmonies of the whole composition. The individual intervals are no longer pure, because their values are adjusted, tempered to the higher *one*.

FIGURE 6

a/d $\frac{1}{3}$	b/c $\frac{1}{2}$
c/f $\frac{1}{8}$	d/e $\frac{5}{24}$
e/h $\frac{5}{12}$	f/g $\frac{2}{3}$
g/k $\frac{3}{5}$	h/i $\frac{5}{8}$
i/m $\frac{1}{4}$	k/l $\frac{3}{5}$

Planet						
Saturn	at Aphelion at Perihelion	1.46 a 2.15 b	Between and	1.48 2.15	is $\frac{4}{5}$	a major third
Jupiter	at Aphelion at Perihelion	4.30 c 5.30 d	Between and	4.35 5.30	is $\frac{5}{6}$	a minor third
Mars	at Aphelion at Perihelion	26.14 e 38.01 f	Between and	25.21 38.10	is $\frac{2}{3}$	a diapente
Earth	at Aphelion at Perihelion	57.03 g 61.18 h	Between and	57.28 61.18	is $\frac{15}{16}$	a semitone
Venus	at Aphelion at Perihelion	94.50 i 97.37 k	Between and	94.50 98.47	is $\frac{24}{25}$	a diesis
Mercury	at Aphelion at Perihelion	147.0 l 384.0 m	Between and	164.0 394.0	is $\frac{5}{12}$	a diapason and minor third

Polyphony fascinated Kepler; it truly gripped him as a modern discovery, beyond the capability of the ancients, which had given us more advanced harmonics than those of simple numbers. With polyphonic music perhaps filling his mind, he was convinced that a higher, much more complex kind of harmony could be applied to the issue, not of the motions of musical instruments but of the planets of the Solar system.

In considering why the planets of our Solar system move in the particular orbits that they do, at the specific distances at which they lie, and not otherwise, Kepler's work brought him to a point at which he could say, he knew, that to an observer standing on the Sun, or, if you will, to the Sun itself, looking out at the moving planets, the fastest and slowest motions of each planet, in other words those that bound the orbit, had ratios to one another and to each other across planets, that correspond to the notes of the major and minor musical scales.

In **Figure 6** you can see the names of the planets highlighted in pink, and to the left are the harmonic proportions between the motions of different planets, and on the right are the harmonic intervals between the fastest and slowest motions of each planet, to itself.

The problem is, these harmonies of the planets are not perfect; there are small—and sometimes not so small—errors, discrepancies between the perfect whole-number ratios and the data from the planets. A mathematician might say, and many have, "See! Kepler was wrong! It was a nice, sweet idea, but it's not true!"

What Kepler knew is that the discrepancies of the planetary harmonies from the perfect whole-number ratios were not "errors," but instead were reflective of the tempered harmonies of a polyphonic system. He put the data to the side, and in his imagination, as if he were composing the Solar system, conceived of a tuning, a tempering, in which each planet's motion would be in harmony, not just with itself, not just with its immediate neighbors, but with the greatest number of other motions, at once, as if each planet were a member of a multi-voiced cosmic chorus. In this way the perfect harmony of each individual ratio is sacrificed for the higher perfection of the unity of the whole, of the motions of all.

Here's Kepler, from his *Harmony of the World*:

> It is the universal harmony of all which chiefly makes the world perfect, rather than the individual twinnings of neighboring pairs. For harmony is a certain relationship of unity: therefore, they are united if they are all at one at the same time rather than if each pair separately agree in pairs of harmonies. So that in a conflict between the two, one or other of pairs of harmonies of the pairs of planets must have yielded so that the universal harmonies of all could stand.

In completing his notion of the physical power of the Sun, Kepler writes:

> Not only does light go out to the whole world from the Sun, as from the focus or eye of the world, as all life and heat does from the heart, all motion from the ruler and mover; but in return there are collected at the Sun from the whole cosmic province, by royal right, these, so to speak, repayments of the most desirable harmony, or rather images of the pairs of motions flowing to it are linked together into a single harmony by the working out of some mind….

Just as a great conductor takes control, you might say, over the members of an orchestra, animating them, unifying their individual motions into a single, harmonic entity, so does the Sun guide and animate the motions of the planets into a higher *one*.

With that thought, come back to our galaxy and beyond. For Kepler, his principle was universal. It held through the extent of the known universe, to the planets up through Saturn. As a side note, Kepler knew there was more to it. Not only did he forecast the existence of the asteroid belt as a result of a particular harmony between Mars and Jupiter, but he was also interested in working on the problem of the secular changes of the orbits. In other words, he was aware that the eccentricities of the orbits were not fixed, that they—and therefore the planets' motions—changed over long periods of time. He planned to dig into those causes: How were those harmonies changing over time? Unfortunately, he died before he could do that work.

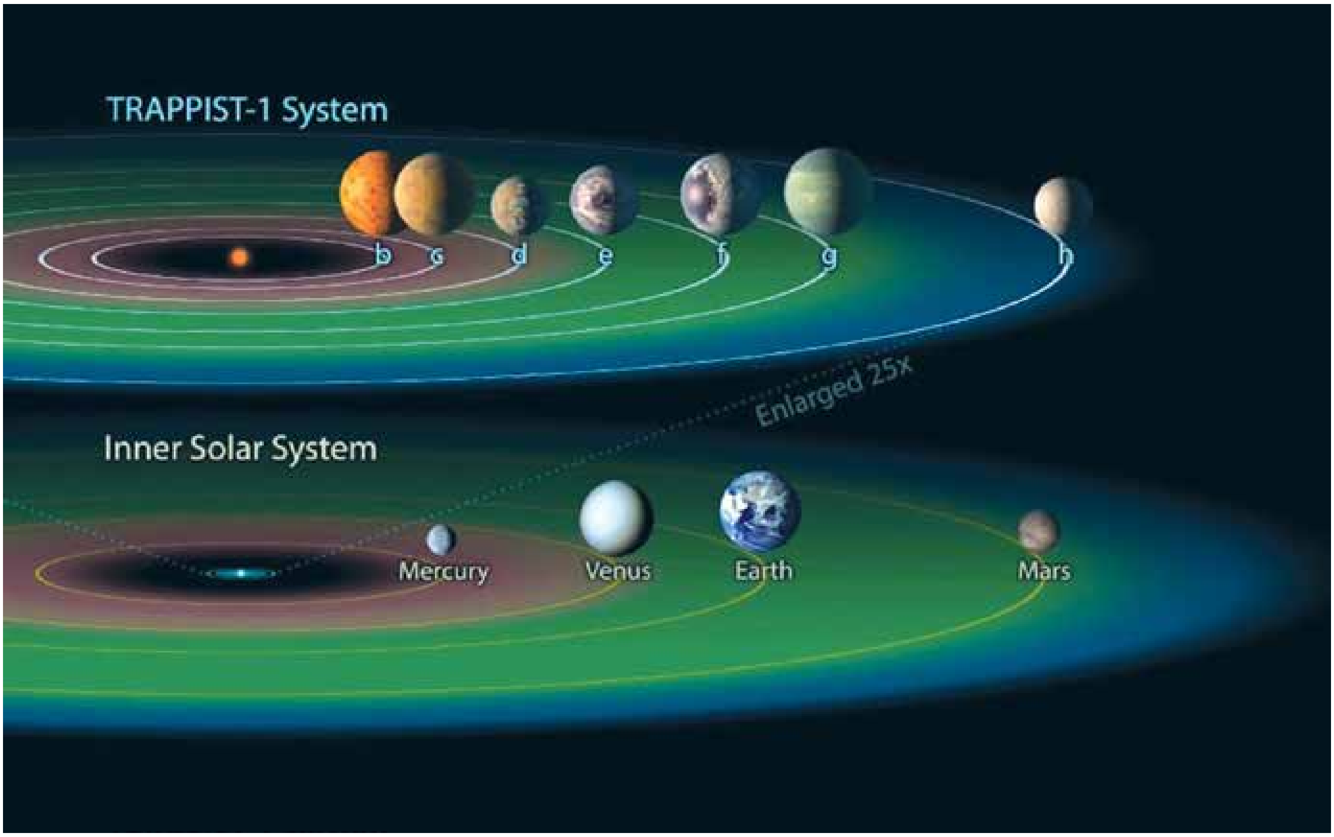
At Kepler's time, the planets beyond Saturn were unknown; the asteroid and Kuiper belts were unknown; the fact that our star is just one within a galaxy of billions of stars, all orbiting a galactic center, was unknown; that our galaxy is one of trillions, each with billions of stars, most with planetary systems around them, was not an available field for Kepler to think upon. That is left to us.

If we simply extend Kepler's harmonic system even to the outer planets of our own Solar system, it doesn't work—not in terms of simple harmonies, or even simple tempered harmonies: there are dissonances. What is the cause of those dissonances?

With NASA's telescope, fittingly, I think, named Kepler, along with Hubble, Spitzer, and other telescopes, we've managed to detect 5,157 confirmed exoplanets, or planets orbiting stars outside of our solar system, spread across 3,804 planetary systems. This is just scratching the surface and is mind-blowing. With the James Webb Space Telescope, we've recently demonstrated a greatly improved capability to study exoplanets. Webb has directly imaged one about 385 light years from Earth, a feat that's been compared to imaging a firefly against the background of a searchlight. With Webb, we can not only detect the periodicity of its orbit—how often it circles its star—but also the temperature of its atmosphere.

There's another interesting solar system which Webb will study over the course of the next year: The Trappist-1 system (**Figure 7**), a relatively close solar system about 40 light years from us, which has seven Earth-sized planets orbiting its star, three or four of which are believed to be at distances which would allow liquid water to exist there. One of the fascinating things about this system is that the period of each planet's orbit—how long it takes to orbit its star—is in a harmonic ratio with those of its immediate neighbors. So, the length of one planet's year is in a 5/8 ratio with that of the next, which is in a 3/5 ratio with that of the next, and so on. Very preliminary observations,

FIGURE 7



but completely fascinating in what further study of star systems and planetary systems like this could show us!

Perhaps, one element of solving the larger galactic question will be to study the tempering, not just of one set of planets' motions, but a galaxy full of them. What discrepancies, or commas, will we discover that might allow us, as a musician does, to begin to imagine the larger, galactic *one* which is responsible for tuning this multiplicity.

All discovery occurs from the top down, not from the bottom up. Another way to say that is that you cannot build this universe up from a point, but you can only derive it from an *idea*. The painstaking and technologically incredible observations of the phenomena out there, as with the Webb telescope, the thousands of hours of processing and reworking of data into a meaningful form, are the great and necessary work in service of the scientific imagination, the only power capable of taking those unveiled paradoxes in the data and inventing the higher, unseeable *one*, the creative, God-like thought that generated them.

That is science, as I've learned it from Lyndon LaRouche, as science has been educated by great art, and as it must be taken up by those looking toward the heavens today.

Let's end with Lyndon LaRouche:

> Man's development and the whole social process of man's development, is a creative process. Mankind is intrinsically, by nature, a creative entity, a *self*-creative entity.
>
> Now, man dies, but that doesn't end the process, because, actually, the existence of the human being is implicitly universal. The human individual is a universal thing, which lives in history, and only realizes itself, when it's living in history, and history lies always in a higher power, which we call the future. It's the higher development of the higher process, the self-development of the universe. And man is a participant, by resonance, with that progress in the universe. And therein lies the source of the power of mankind as a species.