THE LaRouche Organization

An Inside View of LaRouche's Philosophy of Science

Class 2 • Johannes Kepler: The Cause of Modern Science

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Lyndon LaRouche, "Re-Animating an Actual Economy" (2006)

My included purpose in the immediate project, on animations, is to demonstrate to intelligent professionals, and to others, the proper methods of approach in use of computerized animations of county-by-county data, that over periods of two or three generations, in showing the determining factors in cause of catastrophe or recovery in the U.S. economy (in particular) today.

This work is premised, at its first stages, on the way in which Johannes Kepler defined cycles within the Solar System, and the way in which Kepler thus defined the need for developing both the infinitesimal calculus uniquely developed by Gottfried Leibniz, and the successive development of elliptical and higher (hypergeometric) functions by Gauss, Abel, Riemann, et al.

The crucial topics treated under that approach, include the functionally determined relationship between the general basic economic infrastructure of whole economies, and the productivity of agriculture, manufacturing, and rates of tangible (physical) growth in the so-called private sector of an economy taken as a unified whole. However, the crucially underlying objective of these studies, is to discover the principal factors which are determining, or might determine either net growth, decline, or stagnation in the rate of the performance of the economic phase-space considered, or a national or larger economy as a whole. The latter task, the uncovering of the principal determining factor, is the functional requirement essentially lacking in the approach to defining animations in the exemplary case represented by Nordhaus's report.

The most suitable pedagogical approach to this crucial feature of the study, is that modeled on the most essential distinctions of Kepler's referenced discovery: the discovery of the principle of the "infinitesimal." This is the distinction which is apparently beyond the comprehension of today's commonly encountered academic classroom and related productions respecting the principles of physical scientific and related investigations.

Kepler and Sphaerics

Knowledge is always essentially subjective, because it exists among mortal beings only as human knowledge; *its primary existence lies consequently only within the human individual, and that individual's functional relationship to the history of the society within which he, or she lives.* Knowledge, in the proper sense of the word, does not exist among lower forms of life. Knowledge is an "attribute" of that principle of the human individual which sets our species absolutely apart from both inanimate objects, and also all lower forms of life. In V.I. Vernadsky's science of Biogeochemistry, this marks the principle which separates the human individual from the animal.

Therefore: subjectively, what has proven itself to be my uniquely successful approach to long-range economic forecasting, dates in its origin with me, in my immediate and persisting, principled rejection of the standard secondary education in classroom geometry at my first encounter with that subject. My adolescent acquaintance with structures had shown me that the function of geometry in society's practice, is physical: only what is functionally a physical geometry, not a formal Euclidean geometry, could be a valid one.

Historically, my standpoint on the subject of geometry, from that moment in secondary education onward, was, already, implicitly an anti-Euclidean geometry, a view of mine which ultimately converged upon what is to be recognized among the Pythagoreans and Plato as *Sphaerics*. *Sphaerics* was known to those ancient Greeks as a method transmitted to them from the practice of Egyptian astronomy, which distinguished the geometry of the motion of development (i.e., *physical* action) as distinct from what convention today recognizes as simple classroom versions of so-called Euclidean geometry. So-called a priori definitions, axioms, and postulates are to be excluded from competent European science; all concepts, including concepts of the form of one's own behavior in this practice, are to be discovered by experimental methods associated, among ancient Greeks, with the tradition of Thales, the Pythagoreans, and Plato. In other words, while we are permitted to take notice of the implied assumptions intrinsic to the practical approach we employ, we can not treat those assumptions as a priori principles, but only as being, themselves, subjects of critical experimental treatment.

This is the standpoint from which to consider the rudiments of the method employed by Kepler. This is the standpoint plausibly attributed to the work in astronomy of Thales of Miletus, and is the standpoint of the Aristarchus of Samos who proved the orbiting of the Earth around the Sun by appropriate experimental methods. Kepler's treatment of the relative positions and motions of Solar bodies considered by him, can be traced from the starting-point referenced by Aristarchus' approach. Also, as Kepler himself emphasized, his own scientific method was derived from the founding of modern physical science as an experimental body of scientific work, by Nicholas of Cusa, and as Cusa's initiatives were complemented by the work of such followers of Cusa, and predecessors of Kepler, as Luca Pacioli and Leonardo da Vinci.

That much said, it is sufficient for the purposes of the present report, to focus on a narrow, but crucial feature of Kepler's discoveries: the implications of the observed Mars orbit in terms of reference to the cyclical alignment of relations among the positions of the Sun, Earth, and Mars.

To reduce the matter to essentials, we may say: The generation of an elliptical orbit of Mars was recognized by Kepler's measurements to be the result of what Gottfried Leibniz was to make his unique discovery: his definition of the differential of the infinitesimal calculus. Simply said: the notion of the infinitesimal which Kepler presented to "future mathematicians," was a reflection of the observed consistency of the fact, that the area subtended by the sweep of the orbit of Mars, relative to the Sun, varied in an ordering of "equal areas swept, during equal times." In other words: *the elliptical orbit did not determine the motion of Mars; rather, the relevant, perfectly infinitesimal principle of physical action, generated the elliptical orbit of this specific characteristic, the characteristic of equal areas swept within equal times.*

Notably, precisely that view of the matter by Kepler, prompted him to assign to future mathematicians the development of both an *explicitly infinitesimal* (physical) calculus and of a corollary theory of physical-elliptical functions. The former challenge was solved by the uniquely original discovery of a calculus of the infinitesimal by Gottfried Leibniz, a quality of the calculus which is rejected in the failed attempt to understand gravitation by Isaac Newton and his followers. The second challenge, of discovering the relevant physical principle underlying regular elliptical action, was mastered in essentials by Carl F. Gauss and his followers, most notably by the Bernhard Riemann who followed Gauss in going beyond elliptical functions into higher physical hypergeometries associated with an ontological insight into, the matter of the human species' qualitative progress.

The actual rudimentary development of the mathematics of a competent mode in modern physical science, was derived entirely from the combined effect of these implications of Kepler's discovery with what Gauss was to expose as the implications of what was actually Napier's definition of the *Pentagramma mirificum* and Fermat's experimental demonstration of the existence of physically relative time, the concept of "quickest time" as opposed to primitive superstitious belief in simple (e.g., Euclidean) time." These are the elementary considerations, as treated, most notably, by Leibniz, Gauss, and Riemann, required for the defining of a competent modern science of physical economy.

However, in any competent science of economy, there is another crucial aspect to Kepler's uniquely original discovery of universal gravitation; this is what William Nordhaus's treatment overlooks completely. Kepler's discovery of the principled, *ontological* character of the planetary orbit, provides students the model of reference for study of economic cycles.

Ptolemy, *Syntaxis* (~150)

For us to grant these things [that the Earth rotates on its axis every day], they would have to admit that the earth's turning is the swiftest of absolutely all the movements about it because of its making so great a revolution in a short time, so that all those things that were not at rest on the earth would seem to have a movement contrary to it, and never would a cloud be seen to move toward the east nor anything else that flew or was thrown into the air. For the earth would always outstrip them in its eastward motion, so that all bodies would seem to be left behind and to move towards the west.

Johannes Kepler, *Astronomia Nova* (1609)

Introduction

21: Ptolemy is certainly hooted off the stage first. For who would believe that there are as many theories of the sun (so closely resembling one another that they are in fact equal) as there are planets, when he sees that for Brahe a single solar theory suffices for the same task, and it is the most widely accepted axiom in the natural sciences that Nature makes use of the fewest possible means?

22–23: Upon this most valid conclusion [that the earth-sun motion also includes what looks like an equant], making use of the physical conjecture introduced above, might be based the following theorem of natural philosophy: the sun, and with it the whole huge load (to speak coarsely) of the five eccentrics, is moved by the earth; or, the source of the motion of the sun and the five eccentrics attached to the sun is in the earth.

Now let us consider the bodies of the sun and the earth, and decide which is better suited to being the source of motion for the other body. Does the sun, which moves the rest of the planets, move the earth, or does the earth move the sun, which moves the rest, and which is so many times greater? Unless we are to be forced to admit the absurd conclusion that the sun is moved by the earth, we must allow the sun to be fixed and the earth to move.

What shall I say of the motion's periodic time of 365 days, intermediate in quantity between the periodic time of Mars of 687 days and that of Venus of 225 days? Does not the nature of things cry out with a great voice that the circuit in which these 365 days are used up also occupied a place intermediate between those of Mars and Venus about the sun, and thus itself also encircles the sun, and hence, that this circuit is a circuit of the earth about the sun, and not of the sun about the earth?

23–24: A mathematical point, whether or not it is the center of the world, can neither effect the motion of heavenly bodies nor act as an object towards which they tend. Let the physicists prove that this force is in a point which neither is a body nor is grasped otherwise than through mere relation.

It is impossible that, in moving its body, the form of a stone seek out a mathematical point (in this instance, the center of the world), without respect to the body in which this point is located. Let the physicists prove that natural things have a sympathy for that which is nothing.

Nor again, do heavy bodies tend towards the center of the world simply because they are seeking to avoid its spherical extremities. For, compared with the with their distance from the extremities of the world, the proportional part by which they are removed from the world's center is imperceptible and of no effect. Also, what would be the cause of such antipathy? With how much force and wisdom would heavy bodies have to be endowed in order to be able to flee so precisely an enemy surrounding them on all sides? Or what ingenuity would the extremities of the world have to possess in order to pursue their enemy with such exactitude?

24-25: The true theory of gravity rests upon the following axioms.

Every corporeal substance, to the extent that it is corporeal, has been so made as to be suited to rest in every place in which it is put by itself, outside the orb of a power of a kindred body.

Gravity is a mutual corporeal disposition among kindred bodies to unite or join together; thus, the earth attracts a stone much more than the stone seeks the earth. (The magnetic faculty belongs to this order of things.)

Heavy bodies (most of all if we establish the earth in the center of the world) are not drawn towards the center of the world because it is the center of the world, but because it is the center of a kindred spherical body, namely, the earth. Consequently, wherever the earth be established, or whithersoever it be carried by its animate faculty, heavy bodies are drawn towards it.

If the earth were not round, heavy bodies would not everywhere be drawn in straight lines towards the middle point of the earth, but would be drawn towards different points from different sides.

If two stones were set near one another in some place in the world outside the sphere of influence of a third kindred body, these stones, like two magnetic bodies, would come together in an intermediate place, each approaching the other by an interval proportion to the bulk [moles] of the other.

If the moon and the earth were not each held back in its own circuit by an animate force or something else equally potent, the earth would ascend towards the moon by one fifty-fourth part of the interval, and the moon would descend towards the earth about fifty-three parts of the interval, and there they would be joined together; provided, that is, that the substance of each is of one and the same density.

If the earth should cease to attract its waters to itself, all the sea water would be lifted up, and would flow onto the body of the moon.

The orb of the attractive power in the moon is extended all the way to the earth, and calls the waters forth beneath the torrid zone, in that it calls them forth into its path wherever the path is directly above a place. …

But the moon passes the zenith swiftly, and the waters are unable to follow so swiftly. Therefore, a westward current of the ocean arises…

For it follows that if the moon's power of attraction extends to the earth, the earth's power of attraction all the more extends to the moon and far beyond, and accordingly, that nothing that consists to any extent whatever of terrestrial material, carried up on high, ever escapes the mightiest grasp of this power of attraction.

Part 1: The Comparison of Hypotheses

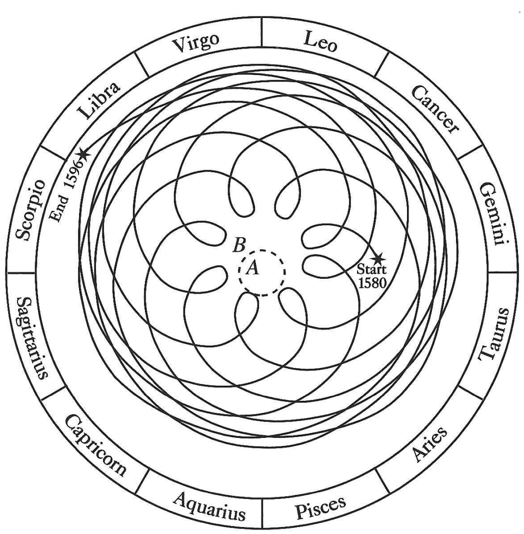
page 75: The testimony of the ages confirms that the motions of the planets are orbicular. Reason, having borrowed from experience, immediately presumes this: that their gyrations are perfect circles. For among figures it is circles, and among bodies the heavens, that are considered the most perfect. However, when experience seems to teach something different to those who pay careful attention, namely, that the planets deviate from a simple circular path, *it gives rise to a powerful sense of wonder, which at length drives people to look into causes.*

77–78: Now that the first and diurnal motion had thus been set aside, and only those motions that are apprehended by comparison over a period of days, and which belong to the planets individually were considered, there appeared in these motions a much more complicated mingling than before, when the diurnal and common motion was still mixed in with them.… [A]ll the proper motions of the stars, as many as there are, and all the confusion of this multitude shone forth more obviously.

First, it was apparent that the three superior planets, Saturn, Jupiter, and Mars, attune their motions to their proximity to the sun. For if the sun would approach them they moved forward and were swifter than usual; where the sun would come to the signs opposite the planets, they retraced with crablike steps the road they had just covered; between these two times they became stationary; and these things always used to occur, no matter what the signs of the zodiac in which the planets might have been seen.

At the same time, it was clear to the eye that the planets appeared large when retrograde, and small when anticipating the coming of the sun with a direct and swift motion. From this, the conclusion was easily reached that when the sun approaches they are raised up and recede from the lands, and when the sun departs towards the opposite signs, they descend again towards the lands. And finally, it was observed that these phenomenon of retrogression and increase of luminosity, just described, was moved through the signs of the zodiac in the order that tended from west through the meridian eastward, so that whatever has happened at one time in Pisces would soon come to pass similarly in Aries, then in Taurus, and so on and consequence.

If one were to bundle all this together, and were at the same time to believe that the sun really moves through the zodiac in the space of a year, as Ptolemy and Tycho Brahe believed, he would then have to grant that the circuits of the three superior planets through the ethereal space, composed as they are of several motions, are real spirals … like the shape of a pretzel, as in the following diagram.



80: From these observations it came to be understood that for any planet there are two inequalities mixed together into one, the first of which completes its cycle with the planet's return to the same sign of the zodiac, the other with the sun's return to the planet.

Now the causes and measures of these inequalities could not be investigated without separating the mixed inequalities and looking into each one by itself. They therefore thought they should begin with the first inequality, it being more nearly constant and simple, since they saw an example of it in the sun's motion, without the interference of the other inequality.

But in order to separate the second inequality from this first one, they could not do anything but consider the planets on those nights at whose beginning they rise while the sun is setting, which thence were called ἄκρονυχιους [acronychal, or "night rising"]. For since the presence and conjunction of the sun makes them go faster than usual, and the opposition of the sun has the opposite effect, before and after these points they are surely much removed from the positions they were going to occupy through the action of the first inequality. Therefore, at the very moments of conjunctions with and opposition to the sun they are traversing those very positions that are their own. But since they cannot be seen when in conjunction with the sun, only the opposition to the sun remains as suitable for this purpose.

But since the sun's mean and apparent motions are two different things, for the sun, too, is subjected to the first inequality, the question is raised which of these releases the planets from the second inequality, and whether the planets should be considered when it opposition to the sun's apparent position or its mean position. (The sun's apparent position is that which it is perceived to occupy through its inequality. The mean position is that which it would have occupied if it had not had its inequality.) Ptolemy chose the mean motion, thinking that the difference (if any) between taking the mean sun and the apparent sun could not be perceived in the observations, but that the form of computation and of the proofs would become free from difficulty if the sun's mean motion were taken. Copernicus and Tycho followed Ptolemy, carrying over his assumptions. I, as you see in chapter 15 of my *Mysterium Cosmographicum*, instead established the apparent position, the true body of the sun, as my reference point, and will vindicate that position with proof and parts four and five of this work.

But before that, I shall prove in this first part that one who substitutes the sun's apparent for its mean motion establishes a completely different orbit for the planet in the aether, whichever of the more celebrated opinions of the world he follows. Since this proof depends upon the equivalence of hypotheses, we shall begin with this equivalence.

Part 2: The First Inequality, in Imitation of the Ancients

184–185: Ptolemy, in Book 9 chapter 4 of the Great Work [Almagest / Syntaxis] , where he is about to take up the first inequality, made by way of preface a somewhat cursory declaration of the suppositions of which he wished to make use. It is, in summary, as follows: We see that a planet spends unequal times on opposite semicircles. As, although from 2 2/3° Cancer through Leo to 26 3/4° Sagittarius is less than a semicircle, and from 26° Sagittarius through Aquarius to Cancer is more than a semicircle, nonetheless the planet is found to spend longer on the former than on the latter, although a law of uniformity would require the contrary. For from a mean longitude of 2S 23° 18' to 9S 5° 44' is 6S 12° 26', more than a semicircle, that is, more than half of the planet's periodic time. So from 12° 16' Pisces through Leo to 12° 27' Virgo is about a semicircle and 11 minutes. But if the mean longitude of the former position (11S 9° 55') be subtracted from the longitude of the latter (5S 14° 59'), the difference is seen to be 6S 5° 5', which is 5° 5' more than half. The planet consequently takes a proportionally shorter time from Virgo through Aquarius to Pisces. Now if you examine adjacent positions one at a time and compare the intervening arcs with the times or with the arcs of mean longitude, you will see that the planet is slowest at one fixed point on the zodiac, and swiftest at the opposite point, and that at the intermediate points its motion gradually increases or decreases, according to its proximity to one or the other.

These things reveal first of all that the motion of a planet (however irregular it may appear) is governed according to cycles, and that the present cycle is the successive modification of motion and a return to its same state. For if the planet moved in straight lines joined by angles (such as if it should move around a pentangle—I was once engaged in such ideas, its motion would sometimes suddenly change from swifter to slower in an evident manner, according to the relationship of the lines, and this would happen not in one but in many places on the zodiac, according to the number of lines. However, since so great an inequality still remains in the planet's motion, after the removal of the inequality that depends upon the sun, it therefore will be incapable of being either governed or demonstrated by the supposition of a simple circle (one set up at the center of observation). This can, however, be done by composition of several circles, or the equivalent (as Ptolemy said in his preliminaries to Book 3). The simplest ways of doing this are two: by using either an eccentric circle or a concentric with an epicycle.

Thus Ptolemy chooses an eccentric for the first inequality, for the sake of distinguishing between the two and providing an aid to comprehension, since an epicycle would be required for the second inequality. Then, thinking over this general description, he denies that a mere eccentric suffices the planets. For he first considered closely what would duly follow from the simultaneous revolution of an epicycle (to account for the second inequality) and an eccentric (for the first inequality), and it was then evident, by comparing observations, that the center of the epicycle approaches much nearer to the earth at apogee, and flees farther from it at perigee, than the simple eccentric that accounts for the first inequality allows. From this discovery, by a continuous train of thought, he alights on the measure of this approach, and relates that he discovered that the center of the eccentric that carries the center of the epicycle is exactly at the midpoint between the center of observation, the earth, and the center of uniformity or of the eccentric accounting for the first inequality. And, without a single demonstration, he nevertheless relies upon this principle for the three superior planets.

Copernicus, as he frequently did on other occasions, here too followed his master religiously, his form of hypothesis being accommodated to this measure.

208: Who would have thought it possible? This hypothesis, so closely in agreement with the acronychal observations, is nonetheless false, whether the observations be considered in relation to the sun's mean position or to its apparent position. Ptolemy indicated this to us when he teaches that the eccentricity of the equalizing point is to be bisected by the center of the eccentric bearing the planet. For here neither Tycho Brahe nor I have bisected the eccentricity of the equalizing point. Now for Copernicus it was a matter of religion not to neglect this anywhere. For he made very little use of observations, perhaps thinking that Ptolemy used no more than are referred to in his Great Work. Tycho Brahe balked at this. For in imitating Copernicus, he set up his ratio of the eccentricities, which the acronychal observations required. But when this was gainsaid not only by the acronychal latitudes (for these still underwent some increase arising from the second inequality) but also, and much more forcefully, by observations of other positions with respect to the sun which are affected by the second inequality, he stopped here and turned to the lunar theory, and I meanwhile stepped in.

Now the method by which the whole theory of Mars … is demonstrated to be incorrect, is this.

211: And from this difference of eight minutes, so small as it is, the reason is clear why Ptolemy, when he made use of bisection, was satisfied with a fixed equalizing point. For if the eccentricity of the equant, whose magnitude the very large equations in the middle longitudes fix indubitably, be bisected, you see that the very greatest error from the observations reaches 8', and this in Mars, which has the greatest eccentricity; it is therefore less for the rest. Now Ptolemy professes not to go below 10', or the sixth part of a degree, in his observation. The uncertainty or (as they say) the "latitude" of the observations therefore exceeds the error in this Ptolemaic computation.

211: Since the divine benevolence has vouchsafed us Tycho Brahe, a most diligent observer, from whose observations the 8' error of this Ptolemaic computation is shown in Mars, it is fitting that we with thankful mind both acknowledge and honor this favor of God. … For if I had thought I could ignore eight minutes of longitude, in bisecting the eccentricity I would already have made enough of a correction in the hypothesis found in Ch. 16. *Now, because they could not be ignored, these eight minutes alone will have led the way to the reformation of all of astronomy*, and have become the material for a great part of the present work.

Part 3: The Motions of the Sun or Earth

275: Now in my *Mysterium Cosmographicum*, published eight years ago, I postponed arguing the case of the Ptolemaic equant for the sole reason that it could not be said on the basis of ordinary astronomy whether the sun or earth uses an equalizing point and has its eccentricity bisected. However, now that we have the confirmation of a sounder astronomy, it should be transparently clear that there is indeed an equant in the theory of the sun or earth. And, I say, now that this is demonstrated, it is proper to accept as true and legitimate the cause to which I assigned the Ptolemaic equant in the *Mysterium Cosmographicum*, since it is universal and common to all the planets. So in this part of the work I shall make a further declaration of that cause.—

The power that moves the planet in a circle diminishes with removal from the source.

278–284: *Magnificent and worth reading! But too long to include here.*

307–308: You see, my thoughtful and intelligent reader, that the opinion of a perfect eccentric circle for the path of a planet drags many incredible things into physical theories. This is … because it ascribes incredible faculties to the mover, both mental and animate.

Part 4: The First Inequality, from Physical Causes

450: I exhort the geometers … to solve me this problem: Given the area of a part of a semicircle and a point on the diameter, to find the arc and the angle at that point, the sides of which angle, and which arc, enclose the given area. Or, to cut the area of a semicircle in a given ratio from any given point on the diameter.

It is enough for me to believe that I could not solve this a priori, owing to the heterogeneity of the arc and the sine. Anyone who shows me my error and points the way will be for me the great Apollonius.