Our Combat Against Empiricism: Escaping Tragedy Through Paradox

by Jason Ross

Science and the YOUTH MOVEMENT

We in LaRouche's Youth Movement find ourselves in combat with an old enemy that destroys human beings, kills creativity, and brings entire civilizations to their knees. No, it is not the Terminator and the Rise of the Voting Machines; it is empiricism and the complete destruction of *power,* in Plato's sense of the word, in the minds of those whom it infects. To regain the power of mankind to improve our mastery in and over the world, we will return to the Renaissance, but first to Greece, to the dialogues of Plato.

Plato demonstrates in his "Meno" dialogue, that learning is recollection, and proposes an experiment to illustrate his point. Bringing in one of Meno's slave-boys for the demonstration, Socrates poses a question to him: to double the size of a square that Socrates has drawn in the sand. The first proposal is to double the length of each side of the square, but on trying this, the boy discovers that he has actually made a square four times as large (Figure 1).

Brendon Barnett

Learning is recollection: LYM members Freddie Coronel (right) and Naji Elabed in a dialogue about doubling the square, at a West Coast cadre school, January 2004.

Giving it another go, the boy tries making each side one-and-a-half times as large, resulting in a figure that is still more than twice as large (Figure 2). Eventually, returning to the quadrupled square, the idea of cutting each of the four squares in half leads to a "crooked" square in the center, comprised of four triangles, of which the original square consisted of two—a doubled square! (Figure 3). The boy understands the

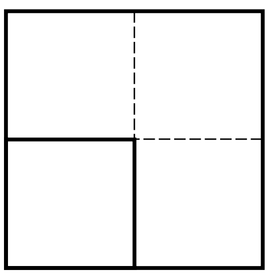

Figure 1
FIRST ATTEMPT TO DOUBLE THE SQUARE
Doubling each side of a square produces a square that is four times the original area.

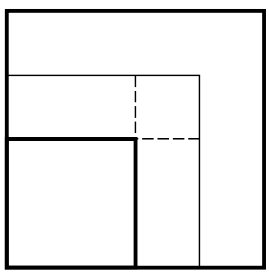

Figure 2
SECOND ATTEMPT TO DOUBLE THE SQUARE
Increasing each side by one-half, produces a square that is more than twice as large.

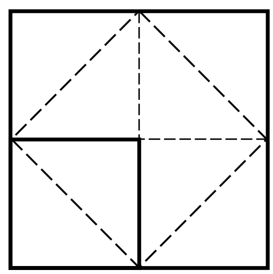

Figure 3
THE DOUBLED SQUARE
By cutting each of the four squares of Figure 6 in half on the diagonal, a new square is produced (dotted lines) which has area of 2.

process and the validity of the discovery, with Socrates merely asking him questions—no declaiming or assertions of fact are made at all.

This discovery is quite remarkable in its demonstration of the inherent cognitive abilities of any human being (try it with strangers—it works!), and in the deeper implications of what we have just discovered. Plato's "Theatetus" dialogue delves into the concept of power in a rich way: The side of the doubled square we have just found is incommensurable with the side of the original square. (See "Burn the Textbooks! Recreate the Original Discoveries," *21st Century,* Fall 2003, p. 8.)

The impossibility of expressing the "square root of 2" as any among the infinite number of fractions between 1 and 2, expresses Plato's notion of power: We have generated something beyond the earlier infinite.

True power is the ability to transform the entire domain of what is possible. Compare this to the simple, infantile notion of power as "more": more horsepower in your engine, more caffeine in your drink, more cup holders, more sex appeal, more choices, more options, *more you!* These consumer notions of power are patently bestial in their implications of human potential. Instead of the immortal power to transform the trajectory of human development to improve our mastery over nature, power is bastardized to mean control over currently existing things.

Light and Power

Let us illuminate our true conception of power by exploring the propagation of light. In Classical Greece, the reflection of light was discovered to occur along a pathway of least distance. This can be demonstrated with an experiment you can perform with two assistants, a string, a mirror, and a flashlight.

You and a friend stand across a mirror resting on a table between you, as you shine your flashlight (held at your eye), onto the mirror right into your friend's eye. Now, both of you hold the string against your eyes, and have the third person put his finger down on the mirror at the spot the light is hitting (see photo, at right).

Now the third person can have some fun! With the string beginning reasonably taut, have him slide his fingers in various directions. Does he find it hard to keep it on the mirror? Is it coming off the glass? What your friend is feeling as the pull, when he moves his finger, is that the path the light took was the path of *least distance;* moving your finger elsewhere requires giving slack to the string to still touch the mirror. Incredible!

How does the light "know" to take the shortest path? "Come on!" our surly physics professor interjects: "The light just bounces off at the same angle it came in at. There's no 'least distance'; it's just an effect of equal angles."

Maybe the professor is right; what *is* the big deal? We will continue our progress and come to discover the importance of this principle.

Now, we examine what happens to light going into water. As you have seen when you put things in water, submerged objects bend and break at the threshold between the air and the water. So what is happening here?

Using the water-tank apparatus in the photo (page 8), we can examine how the path of light changes when we shine light at various angles. We have "bent" paths of light. So what is happening? We will try two different approaches to this problem. One of them is what is taught today as Snell's Law. It states that the sines of the angles (the horizontal lines in Figure 4), are in proportion according to the different speeds of light in the air and the water.

This *describes* the result that we see, but does it explain *why* the light moves in a path with this relationship? We examine the question instead from the standpoint of *intention.* In the case of reflection, we saw that the light took the path of least distance. What is the intention now?

Take the example of a lifeguard rescuing a drowning swimmer. Would the lifeguard run directly towards the swimmer, plunge into the water, and swim directly towards the victim? Only if the lifeguard was a physics graduate from a four-year university. A sensible guard would spend more time running along the beach at a good speed before jumping into the water and swimming the rest of the way. Fermat hypothesized that our humble light beam expresses the same good sense: It is taking the path of *least time!*

"Absurd!!" bellows the empiricist: "How could the light possibly *know* a thing like that? I've read Bertrand Russell—'purpose is a concept which is scientifically useless'—this is quackery! People who think things like this proba-

Sylvia Spaniolo

The light from the flashlight "knows" how to take the path of least distance. The author is at left, shining a flashlight from his eye, to the mirror, and into Jonathan Stuart's eye (at right). They each hold a string up to the eye. Jen Yuen holds down the string with her finger, just at the point the light hits the mirror. If she moves her finger from that spot, it will require slack in the string.

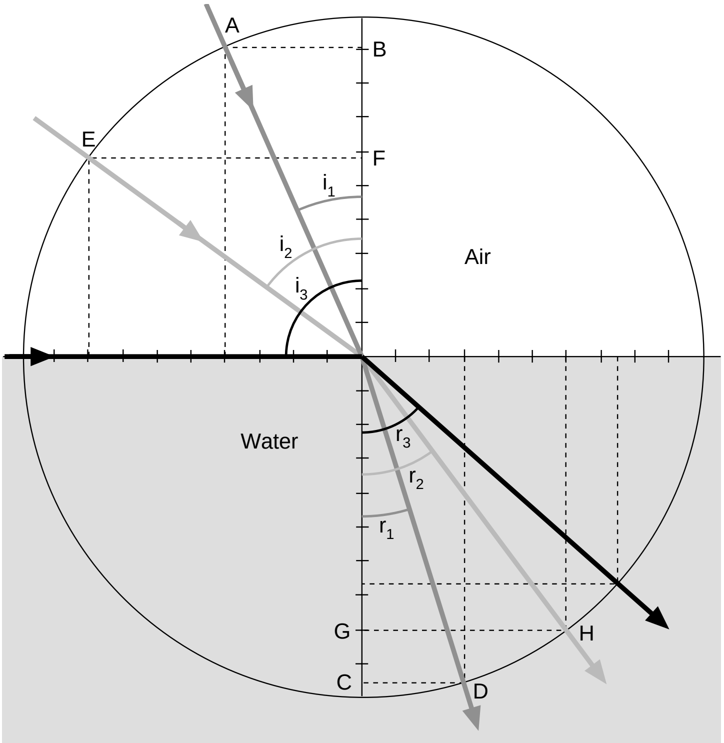

Figure 4
THE LAW OF SINES
The ratio between the sine of the incident angle and the sine of the refracted angle is constant; that is to say, it is independent of the angles of incidence and refraction.

$\sin i_1/\sin r_1$ = AB/CD = 4/3
$\sin i_2/\sin r_2$ = EF/GH = 8/6 = 4/3
$\sin i_3/\sin r_3$ = 10/7.5 = 4/3

bly see value in Kepler's mystical explanation of the planetary orbits. But these 'harmonies' and ideas like 'least time' are the results of the true, deterministic physical laws that govern the universe."

Are we only fantasizing that we have discovered ordering principles in the universe? How can we determine if we have discovered an idea of greater power? Ah, by looking for an expansion of the domain of what we can do, of course!

Bernoulli's Brachistochrone Problem

Shift gears for a moment, as we take up Bernoulli's brachistochrone problem, posed in Leibniz's *Acta Eruditorum* article in 1697: "Mechanical Geometrical Problem on the Curve of Quickest Descent: To determine the curve joining two given points, at different distances from the horizontal and not on the same vertical line, along which a mobile particle acted upon by its own weight and starting its motion from the upper point, descends most rapidly to the lower point."

What is the fastest path for an object to fall from point A down to B? Is it a straight line? A half of a circle? A parabola? Or, what if it chances to be a curve generated in a way that is completely unknown to us? This is a problem that cannot be answered from empiricist mathematics or physics. For, among the infinite possible curves, how can we determine one best curve? What if it is physically created in a way that cannot be expressed (as was the catenary before Leibniz); could it then arise as the solution to a question posed in a mathematics in which it is inexpressible? Of course not.

Rather than assume that the solution must exist in an already expressible way, as do Euler and LaGrange—see Gauss's 1799 "Fundamental Theorem of Algebra" (see http://www.wlym.com/text/gauss fundamental.doc), ask instead: What would generate the solution?

Instead of looking at the properties of falling balls, Bernoulli approached this problem with principle. Using the least-time principle governing light, and the hypothesis of an array of changing densities that the light travels through, Bernoulli developed a differential—the principle generating the curve, that shapes its unfolding—and used this to demonstrate that the brachistochrone (least-time path) is, like Huygens's tautochrone (equal-time path), a cycloid. Incredible—we are using light to determine a pathway for a body falling by gravitation (Figure 5)!

Bernoulli uses the following physical idea: Were we to arrange layers of different media atop each other in sheets, arranging them so that the speed of light going through them will increase in the lower sheets, in the same way that a falling object's speed increases with the distance it has fallen, then light travelling through the sheets would (since it is light) take the path of least time, and the arrangement provides that it is the least time for a fall through gravity.

Bernoulli demonstrated that this curve is the cycloid, generated by drawing the position of a point on the circumference

Jason Ross

A water tank apparatus for demonstrating light refraction into water. The light "knows" how to take the path of least time.

of a circle rolling along a line. Bernoulli writes: "Thus I have with one stroke solved two remarkable problems, one optical, the other mechanical, and have accomplished more than I required of others; I have shown that the two problems which are taken from entirely distinct fields of mathematics are nevertheless of the same nature."[1]

Where Snell's law lets us predict light refracting (a process we were already able to create), least time increased our power (*dynamis* in Plato), expanding the domain of human understanding to solve paradoxes.

Bernoulli's solution to the brachistochrone problem made use of the infinitesimal calculus developed by Leibniz, and this too came from light. From Fermat's principle of least-time, Leibniz developed the general principle of universal least action, a conception that completely shook up everything, including physical mathematics.

If all processes in the Universe occur according to a universal principle of least-action, what does this imply about geometry and physics? Well, it means that everything occurs only by principles, along which least *action* can even exist. This means no abstract geometrical considerations can be allowed (for example, shapes *qua* shapes), only actions determined by the governing principles of the universe.

Aha! One hears in the mind, the

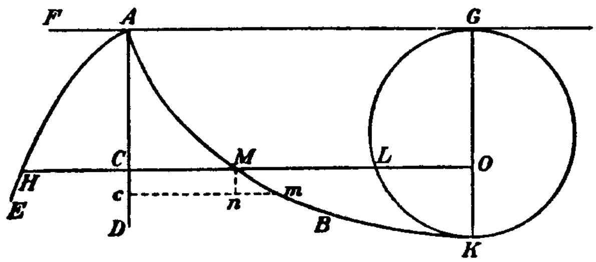

Figure 5
BERNOULLI'S CYCLOID: THE LEAST-TIME PATHWAY OF DESCENT

Bernoulli writes of his demonstration that the least-time pathway of descent is a cycloid:

"In this way we can solve our problem generally, whatever we assume to be the law of acceleration. For it is reduced to finding the curved path of a ray of light in a medium varying in rarity arbitrarily. Let therefore FGD be the medium, bounded by the horizontal FG in which the radiating point A [is situated]. Let the vertical AD be the axis of the given curve AHE, whose associate HC determines the rarities of the medium at the heights AC, or the velocities of the ray, or corpuscle, at the points M.

"Let the curved ray itself which is sought be AMB. Call AC, x; CH, t; CM, y; the differential Cc, dx; differential nm, dy; differential Mm, dz; and let a be an arbitrary constant. Take Mm for the whole sine, mn for the sine of the angle of refraction or of inclination of the curve to the vertical, and then by what we have just said, mn is to HC in constant ratio, that is, $dy : t = dz : a$. This gives the equation $ady = t\,dz$, or $aady^2 = ttdz^2 + ttdy^2$; which, when reduced, gives the general differential equation $dy = tdx : \sqrt{(aa-tt)}$, for the required curve AMB."

Source: Johann Bernoulli, "On the Brachistochrone Problem," in David Eugene Smith, *A Sourcebook in Mathematics* (New York: Dover Publications, 1959), p. 652.

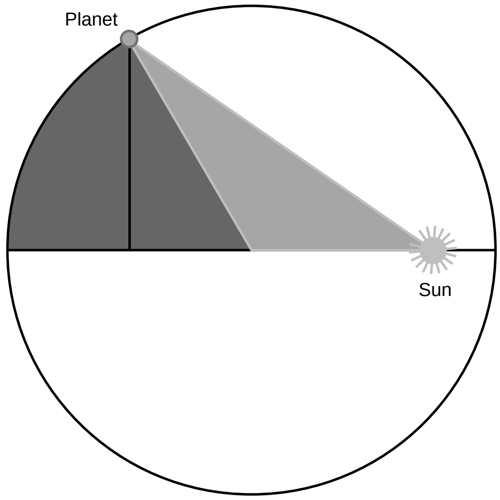

Figure 6
KEPLER'S PARADOX: LOCATING THE EXACT POSITION OF A PLANET AT A GIVEN TIME

Kepler understood that the time of the motion of the planets corresponds to the area created by their motion—equal area is swept out in equal time. Therefore, the position of a planet at a certain time in the future requires finding the position that will sweep out the desired time-area.

For example, to find the position of a planet after a quarter of the planet's year, would require finding the position that would cover a quarter of the entire orbit's area. This area consists of two components: a circular section, and a triangle. The size of the triangle is measured by the distance from the center of the orbit to the Sun, and by the height of the triangle.

The size of the circular section can be measured proportionally to the circular arc of the planet. (The planets move in ellipses, but this paradox can be understood with circles.) But the circular section and the straight-line height are incommensurable: One cannot measure curvedness with straightness, or vice versa. This made it impossible for Kepler to definitively determine a future position of a planet, although he could estimate as closely as desired by breaking the orbit into a number of small pieces and making tables of areas.

beginning of the theme of Riemann's habilitation dissertation: "Space constitutes a particular case of a triply extended magnitude. A necessary sequel of this is that propositions of geometry are not derivable from general concepts of quantity, but that those properties by which space is distinguished from other conceivable triply extended magnitudes can be gathered only from experience."

The necessity for Riemann's polemical dissertation came from the millennia-old separation of geometry, as an abstraction, existing independent of the physical universe. The paradox that prompted Leibniz's development of his calculus arose when abstract, dead geometry was imposed on Kepler's active physical principle of gravitation—giving rise to the so-called Kepler paradox.

When a higher-order idea is projected or expressed in a lower domain in which it is inexpressible, it appears paradoxically. Think of the problems of artificial intelligence—the paradox, of trying to program an artificial mechanical mind, is that the fundamental product of the mind, the hypothesis, cannot be derived from anything that has come before and cannot be generated mechanically.

The paradox was that with Kepler's determination of time being measured by area, it became possible, given two positions of a planet, to measure the area, and thus the time, between the positions. But it was impossible to do the reverse—the exact location of a planet at a given time in the future was impossible to determine. The area involves both a circular arc (the measure for the portion of the circular section) and a straight line (the sine that is the measure for the triangle), two magnitudes that Cusa demonstrates are incommensurable (Figure 6).

The paradox that Kepler arrived at indicates that he did not get an answer, although he did. The unanswered incommensurability one arrives at when trying to determine position at a given time, is the answer. It is the only way that the universe, speaking through that mathematical system (Sensorium), could answer your question. A poet, passionately conveying a profound idea, cannot do so directly, but only through metaphor. When LaRouche answers your question in a way that seems to not answer it at all, it is precisely those questions in your mind that spring up that are the real substance of the answer.

Here, the substance of the universe's response to Kepler was a challenge, to which Leibniz responded with a higher-power mathematics based on principle: his calculus. His conception was to determine the principle of the unfolding of the differential (gravitation) to determine the integral (orbit) in a way that could generate, knowably, the desired location.

Leibniz's response, to the universe's response to Kepler, was another question; Leibniz was not successful in solving the Kepler problem, but his work laid the foundations for, and posed the questions to be answered by, the later developments of Gauss, et al. on the complex domain.

Invisible Principles

The development of the conceptions of universal least action and the infinitesimal calculus indicate much higher, metaphysical, principles than can be expressed as subjects of the language of geometry or physics. The hypothesis-of-the-higher-hypothesis implication of a principle of universal least action is the complete comprehensibility of the universe, as existing as the unfolding of physical principles, rather than a collection of sensory data.

You must look for invisible principles, not effects. Principle does not exist in properties of matter: ". . .always in its relationship to other objects, the primary, unmediated relationship between the particular and the universal subsumes and is the substance, of all relations to other objects."[2]

It's your universe: Take responsibility for it. The economy is bankrupt, your campus is losing money, popular entertainment is cruel, and a fascist beast-man is running your President. What do you think the universe is trying to tell you?

Notes

1. Johann Bernoulli, "On the Brachistochrone Problem," in David Eugene Smith, *A Sourcebook in Mathematics* (New York: Dover Publications, 1959), p. 652.
2. Lyndon H. LaRouche, Jr., "Project A," in *The Science of Christian Economy* (Washington, D.C.: Schiller Institute, 1991).