imals, and microorganisms under space conditions. Mentian will focus on research in fluid physics, materials science, combustion science, basic physics, and space technology.

Furthermore, a roadmap for construction of the lunar base by 2035 was presented recently. A guidance document was issued jointly by Chinese and Russian space agencies. According to the document, the physics, chemistry, and geology of the Moon will be studied to the point that resources can be made available for the long-term survival of humans who would form the first human "extra-terrestrial" colony with a lunar economy.

The West, instead of freezing for human rights, should cooperate with this amazing perspective. We have to blow away the fairy dust economy and fugazi science, and get back to the real scientific base which once made possible our industrialization and advances in health care, our food self-sufficiency, and our excitement about the accomplishments of the creative human mind.

This is the genuinely "natural" way of doing things in a human way.

Jason Ross

Vernadsky and LaRouche: The Arrow of Economic Time

This is the edited transcript of the presentation of Jason Ross to Panel 3, "Principles of Science for Durable Economic Progress," of the Schiller Institute's June 18–19 Conference, "There Can Be No Peace Without the Bankruptcy Reorganization of the Dying Trans-Atlantic Financial System." Mr. Ross was a science advisor to the late Lyndon LaRouche, and is currently Secretary-Treasurer of The LaRouche Organization. Subheads have been added.

Schiller Institute

Jason Ross

There exists a profound coherence between the economic and scientific ideas developed by Lyndon LaRouche, and the concepts of the biosphere and noösphere as developed by Vladimir Vernadsky, the great Russian scientist of Ukrainian heritage. This connection is of profound importance today for countering the Malthusian, Green suicide cult, and for charting a course of economic growth to completely eliminate poverty and increase economic output by an order of magnitude. Let's dive in.

Lyndon LaRouche spoke of the source of value in an economy lying not in money, but also not in material production itself. The source of economic value is the ability of human beings to make discoveries of universal principle, and implement those discoveries socially to achieve an increase in our power over nature. This is measured as an increase in what could be called the carrying capacity if we were animals, but is better described as the potential population density of the human species. It is also measured in an increase in the density of the application of energy in human economy, what LaRouche calls "energy-flux density." These specifically human creative powers are the basis of economic progress, and express something about the organization of the universe.

Three Phase Spaces

To see that more clearly, let me bring in the distinctions which Vernadsky made between three phase spaces—the abiotic, the biological, and the cognitive. These are phase spaces that include their own proper principles. The biosphere is not only living matter itself; it extends into the crust of the Earth and to the limits of its atmosphere by virtue of the action of life to change the chemical composition of the lithosphere. The noösphere is the human race and our reshaping of the Earth and beyond. Biology has had an increasingly powerful impact on the lithosphere, and human cognition has grown evermore profoundly to have an increasingly powerful impact.

There is, though, a quasi-religious belief that biology must be nothing more than physics, and that cogni-

tion is at its foundation, a biologic process. But this reductionism does not work. Music is conveyed with notes, but not contained within them. Ideas are conveyed with words, but are not purely the words themselves. The process of discovery is inseparable from knowledge. Biology follows laws of physics, but is not fully explained by them. Cognition occurs in a biological substrate and is affected by that biology, but is not only biological.

The Arrow of Time

To better understand the differences between these phase spaces and the uniqueness of the human one, we'll focus on one particular example—the arrow of time. Why does time flow in one direction and not the other?

Let's start with a similar example in geometry: the difference between left and right. In Euclidean geometry, there is no directly stateable difference between left and right; they're simply opposites. You can't define left in a purely geometric way; that is, without referring to which side of the body the heart is located on, for example. If you stick only with geometry, they're only opposites.

But in biological space, there are many molecules that exist as mirror images of each other, called enantiomers. These are stereo isomers. Amino acids—with one exception—for example, exist as one of these chiral forms, but not the other. Biological processes distinguish between left- and right-handed molecules; even if geometry cannot, and even if abiotic chemical processes make no distinction. Here, left and right most certainly do differ in a biological sense.

Now, let's look at the past and the future, starting in the abiotic. In the abiotic world, the dynamic physical laws that we have, make no direction of time. Time passes, but the formulas work exactly the same when they move to the future or to the past. If you have a differential expression for the evolution of some physical system, does it matter whether DT [direction of time] is positive or negative? We can run our projections forward or back.

But there do exist thermodynamic laws of physics that have a direction in time. That time is related to what is called "entropy," a measure of the amount of energy unable to do work, a measure of disorder. These relate to the flow of heat from higher to lower temperatures.

Let's take an example. If I played in reverse a video of planets orbiting some other star, you wouldn't know if the video was going forward or backward; you wouldn't know it's in reverse. But if I showed you in reverse a video of an ice cube melting in a cup of tea, you'd know that it was backwards if you saw that process in reverse. A cup of tea doesn't get hotter while spontaneously forming an ice cube.

Briefly, under these thermodynamic, entropic laws the direction is toward states which have more ways of being. There are more ways to have a warm cup of tea than a hot cup with an ice cube. There are more ways to have air spread around a room than there are ways of having it all condensed in a bottle in a corner of the room. If you open the tank, air would come out; it wouldn't go into the bottle. This is the direction of time in the abiotic in a very brief nutshell.

Types of Time

Now in biology, there are several types of time. There is metabolic time—think of just a few hours: you eat food, you move your body, you excrete waste, you breathe in oxygen, you breathe out CO_2. There is generational time, which is the time of reproduction, and there's evolutionary time, when we think about tens of millions of years. The direction is clear.

As one example, over generational time, trees can move across a landscape, even though an individual tree doesn't walk during metabolic time. But as it reproduces, it spreads. Over evolutionary time, life doesn't just change; it's not just different. It advances. This can be measured, for example, in the number of elements used by life. This can be measured by the flow of material and of energy. The energy-flux density of life increases.

As an example, mammals use more energy than reptiles per unit of body mass, and especially per generational time. And mammals can have more specialized biological processes, due to the fact that we have a controlled temperature. We're warm-blooded, unlike a reptile whose temperature varies much more.

Another biological example over evolutionary time—a process called cephalization, which really just means the formation of a head, has drawn life towards a concentration of nervous processes in one place. We have senses, we have a brain, etc.

These advances—these are just a few examples—have overall allowed life to exert an increasingly

powerful effect on the chemistry of our planet.

If we look at the arrow of evolutionary time, the tendency is not toward states of greater probability as it was in the abiotic, but towards states of absolute impossibility. This is the opposite of entropy. We're giving a direction to the arrow of time in biology.

So, evolution has drawn life towards new, let's call them biological technologies. The chemotrophs living off of sulfur emitted by hot vents in the ocean floor, very early life, are hypothesized as having existed for quite some time. These creatures cannot photosynthesize; they don't use light.

But now, with the advent of photosynthesis, we have an atmosphere that is one-fifth oxygen. Life's development of photosynthesis isn't in the direction of the greater probability of these deep-sea chemotrophs, but is the creation of a new technology; a new way of generating energy that was impossible for the previous level of life, the previous platform. With photosynthesis, the potential population density of life on the planet soared.

In life, past and future are not just opposites, like left and right in Euclidean space, or a positive or negative DT in dynamical processes and dynamical physics. For life, the future reaches states that the past never could have.

Let's apply this to cognitive time. For us, think through the difference in your experience of past and future and now. Can you remember the future? Can you change the past? What is "now" in your experience? Do rocks have a "now"? If there weren't people here expressing our free will, how would some "then" in physics differ from "now"? What makes this moment different from another? Does a rock know the difference between "now" and ten minutes ago? A new aspect of time in this phase space.

Anti-Entropic Growth Is Our Mission

A few other parallels. Life has become increasingly independent of its surroundings. Life has increasingly shaped its surroundings—the biosphere. We bring into being new synthetic environments through the infrastructure platforms that we create. This is how Lyndon LaRouche saw economic infrastructure. Not as a collection of pieces of rail or roadway or power lines, but as representing as a whole a certain level of technological understanding and of social direction in implementing it. An economic platform changes the physical economic space in which economic processes unfold.

A difference between us and life over evolutionary time would be that unlike all other life, we create these seismic shifts, these epochal changes in a moment, in the twinkling of an eye, when a fundamental discovery is born or communicated. We embody in our minds a process that takes the mere biosphere millions of years, and we are endowed with a "now" that allows us to willfully change the future, and also the past by drawing meaning from it. That process of change, that is the truest substance of the universe. We start with what we see in our cognition, not from the abiotic.

So, in improving our economic abilities, by increasing our power over nature, we use more energy, more resources per person, and that is good. We also create more resources per person; we create energy. The laws of thermodynamics do not apply to the human economy as a whole. The Malthusian Green cult believes in an entropic world in which fixed resources are consumed. They say that progress and development must be stopped. But this is unnatural! This goes against the development of the arrow of evolutionary time, and of cognitive time.

I conclude: We have a role as the only known form of cognitive life in this universe, to expand the process of development initiated by the abiotic universe, the formation of the Solar System, then the development of the biosphere: We have an obligation to create a more prosperous, joyful, beautiful, and purpose-filled human society. Such efforts will bring a measure of justice to the past and the future of the lives of Lyndon LaRouche and Vladimir Vernadsky, among the billions of people who have lived, and who are yet to be born. Anti-entropy, growth, is our mission as the human species.

Thank you.