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EIR Feature

LaRouche in dialogue with Russian science

The lectures and discussion presented here took place on April 28, 1994 in Moscow before an audience of approximately 60 Russian scientists. The occasion was the monthly gathering under the auspices of the "Prezident" *program, initiated by Dr. Pobisk Kuznetsov to explore the application of experience gained in developing life-support systems for spaceships and orbital stations, to the question of the survival of human life on Earth. (See* EIR, *Feb. 11, 1994, p. 8.)*

Pobisk Georgiyevich Kuznetsov is known in Russia as a specialist in engineering and industrial management as well as biology and physics. He is a veteran of space life-support investigations in the Soviet Union. In 1975, he came onto the Scientific Council on Problems of Projecting Large-Scale Systems on the Basis of Physically Measurable Magnitudes, established that year by Soviet government resolution. He is chairman of that Council today. On May 18, 1994, Pobisk Kuznetsov celebrated his 70th birthday.

Dr. Kuznetsov shares with Lyndon LaRouche having had "the opportunity to taste the 'charm' of incarceration 'for convictions' (ten years under Stalin and a year and a half under Brezhnev)," as he put it in his announcement of the "Prezident" *project.*

EIR *thanks Dr. Kuznetsov and Dr. Pyotr Pronin for checking our translation of the parts of this dialogue that were originally in Russian and for technical assistance with the graphics. Rachel Douglas translated into English.*

Kuznetsov: I cannot discuss physical economy with a man who doesn't know physics. This is what troubles me most of all. From your letter, 23 problems have been identified which need to be discussed, due to difficulties in the conception of physical economy, both in science and in the business world.

Here, at the very beginning of your fax, you say that there are many people who do not accept your views, considering them unscientific.

LaRouche: I wouldn't say unscientific.

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Among the participants in the Moscow seminar with Lyndon LaRouche were host Dr. Pobisk Georgiyevich Kuznetsov (second from right) and Dr. Revoli Mikhailovich Suslov (third from right).

Kuznetsov: I think this is the most important situation that we need to solve.

Physical economy requires an armamentarium in physics and mathematics, which goes far beyond the framework of the general theory of relativity and other so-called fundamental scientific findings. I believe that you are right, that the Nobel Prize for quarks should not have been the physics prize, but the economics prize.

Do you understand?

LaRouche: So far I understand. Who knows what may happen next?

Kuznetsov: Physical economy requires a stronger armamentarium in physics and mathematics, of the sort which is provided by university study and graduate work. What is the point? I am now trying, although we should have begun earlier—

LaRouche: This is now the time.

Kuznetsov: First of all, in reading your works, I have read a significant portion of my own biography. But by 1975, a government resolution was passed on establishing a scientific council—and military applications were what was intended—on, in effect, physical economy. This was classified research for two reasons.

LaRouche: By this time, between us there are no secrets.

Kuznetsov: Almost, almost.

LaRouche: We will make them unimportant.

Kuznetsov: Revoli Mikhailovich Suslov served to shield this research from the orthodox Marxists. On the other side, this work was kept secret from the so-called theoretical physicists, who are not engaged in creating technical systems. They were kept out so as not to hinder the work.

We are very surprised at how you managed to arrive at some findings known only to us.

Voice from hall: It took a good intelligence service.

LaRouche: By a different river, by a different method. I have read some of your works. . . .

Kuznetsov: It is now five minutes after six, so I can go to the board with chalk.

LaRouche: The *tabula rasa*.

Kuznetsov: I would like to note that physical economy, to be distinguished from monetary theory, must encompass certain propositions which are not, generally speaking, obvious. These propositions are the following:

There is no work carried out in society, which does not require the expenditure of energy. For any technological process, there always exists a theoretical minimum of energy required for the performance of the given task. The existence of this theoretical minimum is only known to people who have received a scientific-technological education. Therefore, the theoretical magnitude of the necessary expenditures of energy is not and cannot be accessible to a person who has not received a scientific-technological education. The humanitarian disciplines are of no use in this area. This is the distinction between physical economy and monetary theory.

If quantity of energy *A* is required for the performance of a given task, the time required for the performance of this work will decline in relationship to the increase in the power at the disposal of the person performing the work. But not all the power supplied to the process accomplishes work. Part of it is lost, according to the efficiency ratio of the machines and mechanisms.

$$A = tN\eta \tag{1}$$

This is a notation used by engineers and physicists, and would seem to have no relation to economics. This is work in the sense we mean "work" in physics. In order for this work to be deemed labor, there has to exist someone who needs the results of the given work. Therefore we have to introduce another coefficient which characterizes the connection of this process with the system of social life as a whole.

$$A = tN\eta\varepsilon \tag{2}$$

If there is a consumer, this coefficient is 1. If there is no consumer, then this linkage coefficient is zero.

Dr. Revoli Suslov: And the work has been done in vain.

Kuznetsov: The work has been performed physically, but society does not recognize this work as labor.

We will now write the expression for the productivity of labor.

$$\pi\left(\frac{A}{t}\right) = N(t)\eta(t)\varepsilon(t) \tag{3}$$

The productivity of labor grows, if the time required for the performance of the given task declines. This reduction of the time required for the performance of the same task, occurs as a result of scientific and technological ideas.

Ideas exist in the heads of people. There are three types of such ideas: ideas about new, more efficient sources of power; ideas about improved machines and mechanisms; and ideas about more efficient systems for the management of social production, with the exception of forcing people to perform work nobody needs.

The propagandists of the market economy, basing themselves on monetary theory, forget that even in business, a business plan must be drawn up. The business plan is a document which should serve to avert anybody's being required to perform useless work.

We will now move from a single operation in some finite time, to the concept of the velocity of the output of production.

Let us consider the velocity of performance of task A_i, which can be expressed this way, in the form of a differential equation:

$$\frac{\Delta A}{\Delta t} = \frac{dA_i}{dt} = N_i(t)\eta_i(t)\varepsilon_i(t) \tag{4}$$

This is the ordinary notation for a differential equation describing an economic system, but expressed in the language of physics. This is nothing here but physics. The velocity of output of production nationwide is not only the output of products, but the output of those products for which there is a consumer.

FIGURE 1

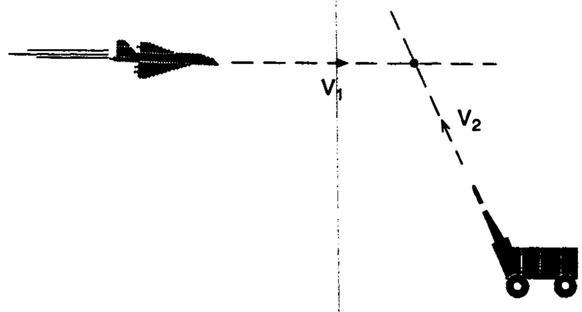


Diagram of anti-aircraft gun firing on an aircraft, showing the point of intersection of their trajectories.

Suslov: This is called demand.

Kuznetsov: Our old Soviet Gosplan was not a planning body, but a futures contract market which provided money to those for whose products there was a demand. On the recommendation of Mr. Sachs, Mr. Soros, and others, this organization was liquidated, on the grounds that things would be better without it.

LaRouche: So they could steal better.

Kuznetsov: You have this [last] term in the notation. In physics, this term characterizes a system whose linkages are determined not by the coordinates, but by velocity. This is a type of dynamic system with velocity linkages. Such systems are called nonholonomic systems. This a little-known division of theoretical physics, in which there are only a handful of specialists. This is why physical economy fails to find understanding among people who do not know the physics of nonholonomic systems. There are more linkages in this cigarette lighter than in any economic system. But these are holonomic linkages, which are easily removed; and all that remains are the general Lagrange coordinates.

A nonholonomic linkage has grabbed people by the throat in the case of anti-aircraft guns firing on an aircraft [**Figure 1**].

The airplane is flying with velocity V_1 and the anti-aircraft gun fires a projectile with velocity V_2. They are supposed to meet. This point is linked with both the plane and the shell, although there is no physical linkage between them.

Suslov: It is a time linkage.

Kuznetsov: It is a velocity linkage.

The linkages in economics are of this type, and these linkages are described by the Boltzmann-Hammel equations from 1902. Until then, humanity did not possess anything like this. The dynamics of nonholonomic systems and non-Riemannian dynamics became known to humanity in 1934.

I am referring to "Non-Riemannian Dynamics of Rotating Machines," by Gabriel Kron of General Electric.

LaRouche: This is Kron, on the rotating machines—

Kuznetsov: That's it. Only there do we find a hint of the descriptive approach necessary for physical economy. Because of this, I believe that American scientists understand you poorly, just as I was poorly understood. That's an answer to the first question [raised in your letter].

The lack of understanding is not a function of a lack of desire to understand.

LaRouche: Sometimes.

Kuznetsov: It is a function of the lack of scientific training.

LaRouche: Sometimes.

Kuznetsov: Insofar as all development in the framework of the growth of productivity of labor occurs because of ideas, and only scientifically and technically educated people can come up with ideas—

Suslov: And geniuses.

Kuznetsov: —when we come to your charges against the finance oligarchy, this area is not accessible for them.

LaRouche: No, they're stupid.

Kuznetsov: But the scientists of the entire world need to say this, because physical economy can only find allies among scientists. There are no other forces in the world.

I would like to write this expression in a somewhat generalized form and to introduce the concept of the magnitude of labor productivity, which can be written as follows:

$$\pi(t) = \frac{\sum_{i=1}^{k} N_i(t)\eta_i(t)\varepsilon_i(t)}{M(t)} \tag{5}$$

where you have here the number of people employed in production. This magnitude does not decrease over time.

Let us test whether this law functions in observable phenomena.

The existence of crises is known. In crisis periods, the linkage coefficient falls and excess inventory appears. The size of the numerator declines, but the magnitude on the left cannot decline; therefore, the number of workers must also be reduced. Thus physical economy describes an economic crisis in accord with this law.

Another example: the rise in the oil price in 1973.

LaRouche: It was artificial.

Kuznetsov: Yes, yes. As a result of it, there was a reduction in oil consumption. This meant, again, that the numerator was reduced. As a result of the increased oil price, there was an increase in unemployment.

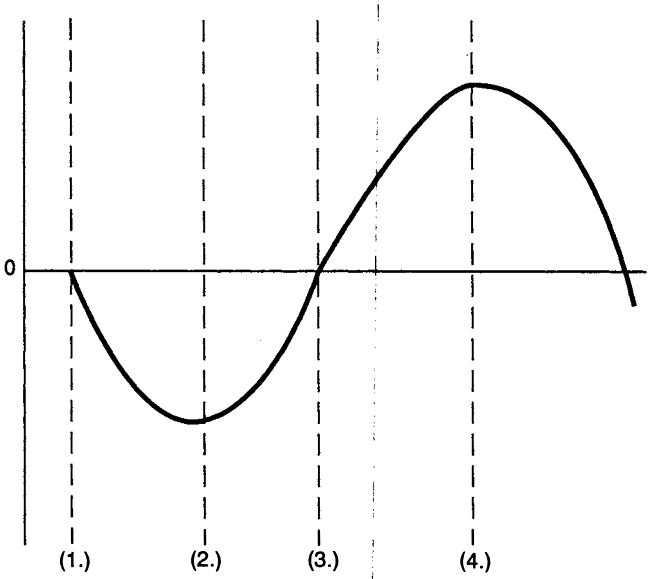
I don't know how far your researches have proceeded in the area of such laws. Although you will not find this law in a physics textbook, I am talking about a law of physics.

Dr. Kuchkarov: This is Pobisk Kuznetsov's law.

LaRouche: It comes to an approximately good result.

Kuznetsov: In physical economy, we have to speak in various languages. When we discuss with physicists, we write such formulae and we discuss the dynamics of nonholonomic systems. When we discuss with people from the humanities, we talk about the economy of time, a magnitude they have mastered.

FIGURE 2



Dr. Kuznetsov's sketch of the return on capital curve. It shows the sum of sales minus the sum of expenditures, over the sum of expenditures (×100%). The initial capital investment occurs at (1.); the process of production is launched at (2.); the amortization period ends at (3.), where the curve comes up to zero. Breakdowns accelerate beginning at (4.).

We are all very important and very necessary. But in these expressions, you have pure physics.

Now I would like, in concluding this section of scientific arguments for a scientific audience, to show arguments for business. I think that I have now finished the physics part. Now we're going to discuss business.

LaRouche: How terrible.

Kuznetsov: The task in discussing business is the ability to calculate the cost of scientific and technical ideas. I do not think that there is even a hint of interest in this question among financial circles.

LaRouche: No. If you steal for a living, you don't have to worry about production.

Kuznetsov: [We have] the velocity of sales in dollars per year, and the velocity of expenses in dollars per year. We have to be able to calculate the annual percentage on capital invested [**Figure 2**]. Capital investment is considered more efficient if it yields a higher percentage per year.

Any project starts with a certain capital investment. Then the process of production is launched, and here you have the operational expenditures. This is the construction time. And then comes the moment when the integral quantity of sales equals the integral quantity of expenditures—the amortization period.

Usually, the analysis ends here. There are some more literate individuals who go farther.

Let us write the expression for return on capital:

$$\frac{\text{capital}}{\text{year}} = \frac{\sum \text{sales} - \sum \text{expenditures}}{\sum \text{expenditures}} 100 \qquad (6)$$

It is the sum of the sales minus the sum of the expenditures, over the sum of expenditures, multiplied by 100%. And since we're interested in the *annual* return on capital, we have an additional term:

$$\frac{\text{capital}}{\text{year}} = \frac{\sum \text{sales} - \sum \text{expenditures}}{(1+p)^{(t-t_0)} \sum \text{expenditures}} 100 \qquad (7)$$

which is an ordinary business formula.

But physics says that there is no such thing as a perpetual motion machine. Engineers have developed the theory of reliability. If we have a growth in the velocity of breakdowns, it leads to additional expenditures on repair and spare parts. The return on capital curve comes to zero, rises, and then again begins to decline. Consequently, the return on capital function is a third-order curve. You have the three points of intersection.

But as is well known, non-linear systems are very unpopular in mathematics. At this point here [in Figure 2, the curve's third intersection with the horizontal axis—ed.] things should come to a halt. That is a normal, ordinary business plan, and I think that literate businessmen plot something looking like it.

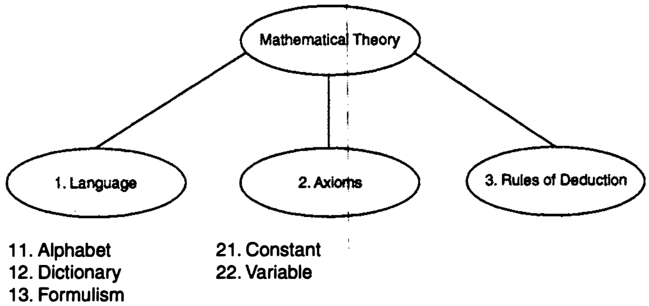
But I would not be talking about trivialities, if I did not need to demonstrate the cost of an idea.

Let us take the case of a producer of nylon thread who has invested $10 million and is earning 5% per annum. Incidentally, I am a chemist. I invented a new synthetic material and put it on the test apparatus. It was ten times stronger than nylon. At the point that I did this, the nylon industry bit the dust.

Let us call the new material navikon. The expenditures for its production are approximately the same as for nylon. Thus for the same strength of material produced, I could obtain a 50% per annum return on my investment. But in order to defeat the nylon producers, I will undersell them by 10%. This 10% discount on the price which will bring me an annual 45% profit. If I need shares for $10 million, I can issue $90 million worth of shares and pay shareholders a 5% dividend per year.

But since I only need $10 million for capital investment, and 90 minus 10 is 80, I'm going to get $80 million foundation income and foundation profit. I pay $1 million to the inventor, who is ecstatic. I have $79 million which I have earned with my own head.

FIGURE 3



The Bourbaki group's standard for a mathematical theory.

There is nobody in this hall who needs to be organized to support a physical approach to economic phenomena. But the dynamics of nonholonomic systems, which is a little-known branch of physics, gives rise to dozens of effects, which do not obey existing theories.

I do not know which of my writings you have had the opportunity to read.

LaRouche: I would not come unprepared.

Kuznetsov: In 1967, many of those who are here today were studying the question of applied mathematical theory. Today, we believe that a given phenomenon has a theory, if that theory can be represented on a computer, that is, if your interlocutor becomes convinced not by words, but in front of a computer. But in order for a theory to be entered into a machine, it must meet the standard proposed by the Bourbaki group of mathematicians.

LaRouche: I know them.

Kuznetsov: Any mathematical theory is comprised of three parts: the language of the theory, the axioms, and the rules of deduction [**Figure 3**].

The language in turn consists of three parts: first, letters and symbols, called the alphabet. But we distinguish the letters from the symbols. Some ordering principle for the letters forms words, or the terms of the mathematical theory are formed. And if the words fixed in our dictionary are combined with symbols, we obtain formulae or statements.

There is no term for this in modern science. Since formalism means something different, we are calling this *formulism*.

The axioms are divided into two types: constant and variable. The latter we usually call conditions. Initial curves, boundaries, constraints—it's different in different branches of mathematics.

And then we have the rules by which one formula may be transformed into another, without the loss of sense. This is all mathematics. How do we compile a dictionary for physical theory?

No points, lines or planes exist in the world. There are only instruments which measure physical magnitudes.

The dictionary of physical magnitudes, it turned out, could be represented by factors of length and time: (L, T). It turned out that the table comprised of length and time to various degrees, gives us all the known laws of conservation and has empty cells for unknowns. The existing terms are inadequate for description in physical economy. There are not enough words, there are no terms.

Simple hypothesis is when a given phenomenon is described by a known theory. The higher hypothesis: In the framework of given axioms, an area of phenomena is not described by theory.

LaRouche: Not by the formal theory, no.

Kuznetsov: But the hypothesis of the higher hypothesis makes it possible to sort out a multiplicity of possible theories.

LaRouche: Right. Or alternatives.

Kuznetsov: And to cultivate the missing physical theories for one or another area of study.

For this reason, the first tenet of physical economy is that there exists no process which does not demand the expenditure of energy. The second tenet of physical economy is that the known theories in physics are appreciably inadequate to describe new classes of phenomena.

But there are very few people who are interested in discussing new theories. This audience is comprised of people who are capable of discussing any new theory. Each of them has substantial accomplishments in one subject area or another.

Therefore, we have been looking forward to meeting you so much. And I expect that this will be a scientific discussion.

LaRouche: It will be *my* kind of scientific discussion, which you may like.

I shall use the blackboard very little. And I shall try to be kind to my dear friend [and translator] Dmitri Glinsky, who's a very good philologist whose background is not in physics, and therefore, we shall try to minimize the problem of technical terminology; and I shall speak slowly also.

Let me just first of all indicate one historic problem of reference, which will be good to bear in mind as we go through an outline of the material here.

When I speak of mathematics, I refer to four historical categories of mathematics. The first, of course, is the so-called rational numbers, which the Classical Greeks found to be insufficient, and defined *incommensurables* as purely geometric magnitudes, which could only be approximated by rational constructions. The most famous of these, of course, is the quadrature of the circle by Archimedes. I'll return to this in a moment and indicate its significance for tonight.

The third level of mathematics was discovered approximately 1440 A.D. in Florence, Italy, by Cardinal Nicolaus of Cusa. This discovery forms a central descriptive feature of his famous *De Docta Ignorantia,* and was then described in some more detail formally in 1453, in a second paper called *De Circuli Quadratura*. In *De Circuli Quadratura,* Cusa says, "I have discovered a *higher species* of mathematics." Today we call that the mathematics of transcendental functions.

The fourth level of mathematics was probably discovered first by Leibniz. It is the subject of his famous *Monadology*. This level of mathematics was later expanded during the nineteenth century by the successive work of Gauss, Dirichlet, Riemann, Weierstrass, and so forth, and then was finally represented, systematically, in a series of papers concluding in 1897 with the *Contributions to the Development of a Theory of Transfinite Numbers* by Georg Cantor.

This work of Cantor on the fourth level, which will be crucial here, was attacked savagely by Felix Klein, who committed a fraud; was attacked more savagely by Bertrand Russell and Alfred North Whitehead; was attacked even by Göttingen scientists generally—until the work of Cantor was vindicated by a discrediting of the total life work in mathematics of Von Neumann and of Russell by a fellow called Kurt Gödel in 1931.

The center of the problem is that, in modern science, we have two conceptions of proof, of which the case of quadrature gives a perfect example. One is called a numerical proof; others call it a proof by method.

For example, let's look at Cusa's discovery of what later was called transcendental functions. We can construct, by using Archimedes' proof as an example, various kinds of simple series which will give us the value of π to any degree of accuracy. We can construct, from Archimedes' famous theorem on the quadrature of the circle—a method which is derived from Eudoxus' method of exhaustion—by taking the internal and external polygons, and increasing the number of polygon sides. It's simple. You can demonstrate that never, despite the numerical accuracy—and I can make any individual side of the polygon as small as I choose; I can create a polygon which is more than any size of the universe you choose—will you have congruence between the circumference of the polygon and the circle.

Kuznetsov: The length. This is the incommensurability of any polygon and the curve of the circle circumscribing it.

LaRouche: Thus, the difference was—which is the issue of modern mathematics often and which is the subject of Felix Klein's fraud on the subject of transcendental proofs of π—that if you examine the construction geometrically, you have *decreased* the degree of congruence, not increased it, by this process.

Cusa was the first to recognize this problem, that convergence of numeric values is not convergence of species.

Kuznetsov: I will interrupt. This is the substance of the controversy between algebra and analysis, between the discrete and the continuous.

LaRouche: Cusa recognized this problem, and defined the circular perimeter as not being a perimeter, but being a form of *action*. From this came the work of Leonardo da

Gottfried Leibniz

Leonardo da Vinci

Carl Friedrich Gauss

Vinci and Pacioli; from this came the work of Kepler; from this came eventually the work of Leibniz, where Leibniz and Bernoulli proved that algebraic functions cannot solve these problems, that you require non-algebraic functions.

Now, on the basis of that work, and the work of Leibniz on the *Monadology,* Gauss began to recognize a new problem which converged on work on the same problem by Monge and Legendre in France, which led to what's called the *continuum paradox,* which led to a result, in the case of Riemann, in one of the most inspiring papers ever written by a man of 27 years of age, the famous habilitation dissertation on hypothesis. He says after a most beautiful part—and the third part of that paper is the most beautiful, and the last sentence is the most beautiful of all—after showing that the continuum paradox *is not mathematically soluble* by existing mathematics, he says in the concluding sentence of the whole dissertation, "Now we must leave the Department of Mathematics and walk to the Department of Physics."

Now let me just describe my experience.

I was a young man coming out of the war, like our host here today, and I was at that time an ardent supporter of Leibniz against Kant, as well as [against] the empiricists. And in this context I read a book which had just been published. It was by a very well-educated hoaxster by the name of Norbert Wiener, the so-called *Cybernetics.*

Kuznetsov: This is a well-known work.

LaRouche: I also came in contact with another hoaxster by the name of John Von Neumann, who had made some very evil and stupid statements about economy. I became so angry that I devoted myself to refuting these two swindlers.

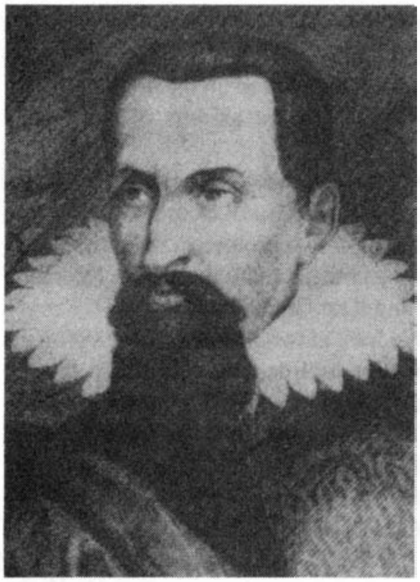
The problem is this, and this leads to the question of anomalies.

What Wiener described in terms of control theory was a very simple, ingenious engineering concept, which is very useful for non-living systems. But when Wiener attempted to apply this to living processes and introduced the hoax called information theory to explain human thought, I was angry. And I was constantly guided by my defense of Leibniz against Kant in understanding this problem. So I came to results which tend to coincide in certain parts with what our host tonight has outlined, but I came from a different direction.

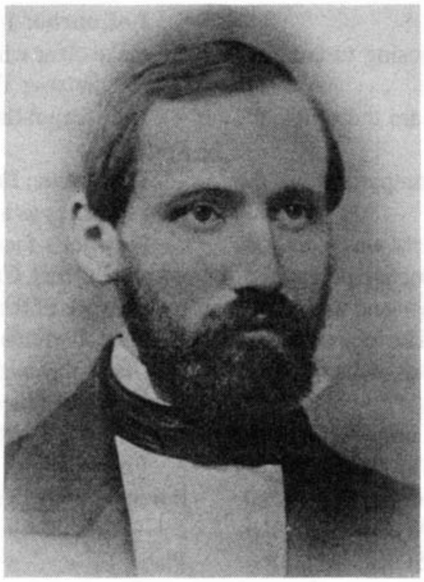
My first reaction to Wiener and Von Neumann was to look at it from the standpoint of biology. I knew some systems; I concentrated on the work of a famous professor, Nicholas Rashevsky, who was teaching at the University of Chicago. Rashevsky's work was very unsatisfactory in the conclusion, but was very useful, even though it failed. As you know, the way to success is often paved by the rigorous and vigorous and honest failure of some predecessor; and Rashevsky was very stimulating.

But it was obvious to me that we lacked at that point the *means* to solve the problem rigorously, satisfactorily, from the standpoint of our knowledge of biological systems, though I would insist today that the work of V.I. Vernadsky as a point of departure is extremely important for dealing with these kinds of questions. Vernadsky and his influence have many products to be admired today, which should be continued. I think that in Russia, if the means exist, a special, expanded study of the work of Vernadsky would be extremely important, in order to bring the question of economics into coordination with the noosphere, and so forth. And perhaps we can solve some of the problems which could not be solved back in the 1940s.

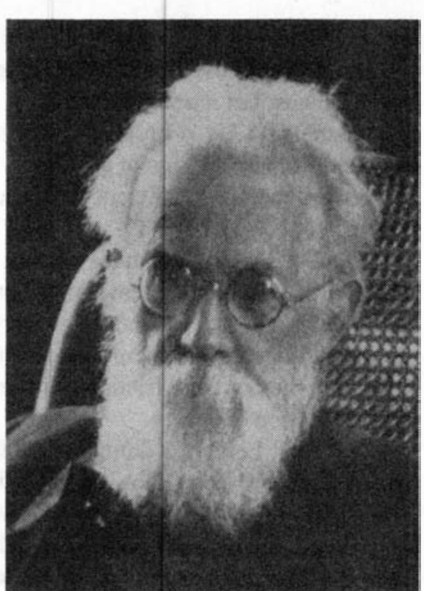
So on the basis of that, I attacked the problem from the standpoint of economy. My first approach was to take some



Johannes Kepler



Bernhard Riemann



Vladimir I. Vernadsky

facts which are very well known to industrial engineers, which led to exactly the kind of statement I expected, but showed me the way to attack the problem.

The first thing to do to understand an economy, is to forget money. How do we correlate purchases and wages without money? We make a bill of consumption. For every household, every individual, every firm, every enterprise, you can construct a bill of consumption. For the household, it's a simple list, with coefficients. For the industry, it is a bill of materials plus a process sheet (the analysis of the industrial productive processes).

Kuznetsov: There is no guarantee that the lists are complete.

LaRouche: It makes no difference, because you use methods that will enable you to eliminate or even out those errors.

What is the list?

My list is as follows, for reasons which I'll make clear. Number one is physical items of consumption which are obviously essential. And Leibniz described this in his first paper on economics, called "Society and Economy." There is an obvious correlation between the standard of consumption and the level of sustainable technology of the household. You cannot reduce consumption below a certain level without having damaged the production of the individual by the household.

Take the society at any level of technology, it makes no difference. Accept whatever the bill of consumption is for that society. Take four parameters for studying the society. One, the primary one, the society as a whole; number two, society as a number of human individuals; the individuals as members of family households; and all activities measured in terms of the surface area of the Earth, or equivalent.

With such measurements, make two kinds of comparisons. Compare the input at any given time as a flow. Compare the output as a flow. So you get a measure of simple gain. You get a ratio which is analogous to a free-energy ratio. The free-energy ratio is the ratio of the flow.

That's simple, everybody can understand that. But here comes the problem. The anomaly comes immediately thereafter, and that is that the energy of the system per capita and per square kilometer must increase. At that point, you've thrown away all concepts associated with conventional thermodynamics.

You come to another, next step; Leibniz again.

Leibniz, in defining physical economy, considered the individual, but he also considered two other things in respect to physical economy. One aspect, on which our host concentrated today, was the relationship to increases in *power* with respect to productivity. And this relationship of power, which has to include the notion, as Kapitsa emphasized, of energy-flux density, is a very important correlative in production, as we all know.

But the economic process cannot be explained in those terms. These power relationships act as a constraint. You must satisfy the constraint. It's a bounding condition, but it is not a causal agent by itself.

The second consideration which Leibniz took up, which defined for him the term *technology*, does not correlate with energy in any ordinary sense.

Given two principles of machine-tool design, assuming that the manufacture of these machine tools is good, according to design (it's a common kind of comparison, but this is just an idealization of it); we can compare the two machines, which may use the same power, and find that one, because of a design principle, is more productive than the other.

Dr. Chesnokov: Basically he is proposing to compare not machines, but machine design.

Kuznetsov: He is proposing to compare the efficiency obtained from one design or another.

LaRouche: Not efficiency; it's a comparison of the design.

There are many examples of this. This was Leibniz's notion of technology: increases in the productive potential of labor which are independent of power changes, and which can be attributed to a principle of design. The idea of energy attrition, whether from friction or otherwise, does not enter into this notion of design.

This was Leibniz's definition of the term *technology,* which is crucial here. Now the question is, we're talking about ideas in mathematics; our host was doing that earlier. I do not like the Bourbaki group or André Weil in particular. Weil is a French infestation of the United States.

Kuznetsov: This is necessary in order for these things to be understood.

LaRouche: First of all, the limits here that our host put on mathematics, I would not put quite that way. I do not agree that you can go from one mathematical system to another, without a *fundamental change* in axioms. You cannot go by deductive methods from one mathematics to another.

We have two kinds of axioms to deal with. One are the axioms of mathematical form, which also have an ontological implication. For example, when we define the difference between incommensurables and the rational numbers, we are dealing with a difference in species which is ontological in form.

When you're dealing with the difference between the derivatives of circular action or *least action,* as Leibniz defined it, and algebraic functions, we have derivatives of the *least action principle,* which are generalized forms of the cycloid, both geometric and hypergeometric, and these are of a different species than algebraic forms. We have the form as such, as opposed to the ontological implications of form.

Now we get to the higher transfinite of Cantor, which is based on a density of discontinuities, which is another, higher species of mathematics. That is simple. I think the training of the student in mathematics from that classical standpoint, is the grounding for the understanding of the other aspect of the inquiry, which is the physics.

André Weil, the Bourbaki group, absolutely reject this notion of these kinds of limits, of species difference in mathematical forms. So I disagree with [Dr. Kuznetsov's] structure to the degree it would imply agreement with Bourbaki. I reject absolutely the axiomatic assumptions of Bourbaki.

Kuznetsov: This is not correct, because if the dictionary in the language of your theory includes the names of objects Bourbaki does not have—see my points one and two—you can make up new axioms about new objects that Bourbaki doesn't know about.

LaRouche: I know what Dr. Kuznetsov is saying, but I'll make clear what I'm doing.

Kuznetsov: The axioms are based on the dictionary.

Dr. Kapustian: These are not axioms of Bourbaki's system.

LaRouche: I know. But this does concur with what Bourbaki specifies as a requirement. It's not Bourbaki's axioms.

Now let's focus on these two problems, from the standpoint of Georg Cantor and the refutation of Von Neumann by the work of the young Kurt Gödel.

Instead of this, let's look at two possibilities. First of all, let's take the mathematics as I described it as a reference point. Each of these discoveries and developments in mathematics, is associated with a distinct, fundamental discovery.

For example: The Greeks were the first to prove that rational numbers and geometric magnitudes were not identical—particularly the school of Eudoxus, Theaetetus, and Plato.

Cusa and a whole series of people explored the transcendental, through very discrete experiments beginning with Cusa's reinterpretation of Archimedes' quadrature of the circle.

The idea of *cardinality* in mathematics was used by Cantor to show the existence of non-denumerable magnitudes, orderings. The diagonal method is used as a simple way of measuring cardinalities. In the indefinitely small, you come into an area where you can interpolate non-denumerable numbers within the smallest possible denumerable ordering.

Kuznetsov: This means the *aleph* system.

LaRouche: Exactly.

Kuznetsov: Then we understand.

LaRouche: In this case again, there is a discrete experiment which makes the difference.

But mathematics is not reality. Numeric values—throw those out. They're not proof. But mathematics as a method of measurement is the real aspect, which goes back to my problem with Wiener in 1948. I can measure certain magnitudes in economy. The mathematics that Wiener is using, which is Boltzmann, cannot measure that. Therefore, Boltzmann is wrong; doesn't apply. The *method of measurement* is what the standard of proof must be.

Kuznetsov: The assertion that Boltzmann is wrong, is in regard to his statistical theory. That doesn't mean we don't need the Boltzmann-Hammel equations.

LaRouche: It's very useful for certain topics.

Kuznetsov: I would like very much to emphasize, that when one points to an error of a given scientist, it is desirable to indicate in what area he committed his error.

LaRouche: I'm talking about Wiener's use of it.

Kuznetsov: It is better not to discuss Wiener whatsoever.

LaRouche: You cannot reverse entropy to get negentropy, to get this kind of process.

Kuznetsov: The word "entropy" is a phantom of the imagination. There is nobody in the world who knows what it is. But you can stupefy any audience by using this word, because everybody is afraid to ask what you mean by the word "entropy." Everybody just pretends that they understand what you're talking about.

LaRouche: [Laughs.] All right, fine, we agree. But you know what I'm saying.

Kuznetsov: Yes, I know. It's better not to spend our energies on this.

LaRouche: The history of mathematics shows that we have created different ontological forms, hierarchies of mathematics, which correspond to our ability to create methods of measurement. The problem here is that there is no necessary correspondence, however, that you can project from a mathematical system, which is a language, to the actual physics. You must always create a mathematics to correspond to your physics.

So let's take, simply, physical discoveries.

It's very simple. Let's take A. Let's call that our first system of physics. We make another discovery; call it A_1. We make another discovery, we call it A_2:

$$A, A_1, A_2$$

What happens?

Just as there are axiomatic changes—

Kuznetsov: There will be a different physical magnitude, which is invariant in the new physics.

LaRouche: Now wait a minute, let's hold it, because it's not quite so simple. It's true, but it's not. That's not my point.

The point is this. We get to A_3:

$$A, A_1, A_2, A_3$$

What happens in each case? We have two kinds of discoveries we make in physics, or in biology. One is a discovery which conforms to the existing axiomatics of physics, but which is like a postulate which expands the dimensions of exploration of physics, which does not change the mathematics you use. Then you get to a second level of discovery, fundamental discovery, which is sometimes called by Riemann *einzigartig* [unique], a unique discovery or a fundamental discovery, or I use the term axiomatic-revolutionary—a discovery which overturns a generally accepted axiom of physics practice.

Whenever we change an axiom in mathematics, we create an absolute discontinuity, which is what we do when we make fundamental discoveries. And all discoveries flow from fundamental discoveries.

Let's take, for example, the result of the work of Cusa. Cusa's writings were transmitted to Pacioli, who taught them to his student Leonardo da Vinci. Out of this, da Vinci came up with, among other concepts, a concept of a *finite rate of retarded propagation of light*. He was the first to come up with a shock-front theory, too, in the same way.

This idea lingered until Huygens taught it to a student of his, Ole Roemer, a Danish student in Paris.

Kuznetsov: Roemer, who determined the speed of light from Jupiter's moons.

LaRouche: Roemer determined the speed of light by observations from different parts of the Earth. This measurement, which is approximate to actual, affected Huygens, who wrote his book the *Treatise on Light*. Huygens' *Treatise on Light* influenced Leibniz and Bernoulli to study the problem of refraction in a more generalized way. This experimental work with light established the physics of a transcendental mathematics.

So we can take an axiom. The idea of the finiteness of retarded propagation of light radiation starts with Leonardo da Vinci.

Kuchkarov: Do you mean a finite velocity of light?

LaRouche: No, retardation. The thought was, as Riemann uses it, for example, that instead of thinking of light as being propagated at a certain speed, think of it as being *retarded* at a finite rate, because it leads to a different physical conception, to say "finite speed of light" as opposed to "rate of retardation."

So this discovery, which was begun by Leonardo da Vinci, goes through into Jean Bernoulli and into Leibniz in 1697, and then becomes a whole new physics. So we have such discoveries, which generate whole families of subsidiary discoveries.

Take another example. Take the case of Mendeleyev, with the Periodic Law. The beginning of the Periodic Law, is actually a discovery of Leonardo da Vinci, which becomes a feature of the work of Kepler, which results in Mendeleyev in applying this to chemistry, to come up with a proven Periodic Law, which leads to a notion of quantum field physics today.

I just cite these two cases as cases of *fundamental discoveries* which generate whole families of other discoveries.

Technology belongs to this. Each of these fundamental discoveries *changed an axiom of our notion of the physical world.*

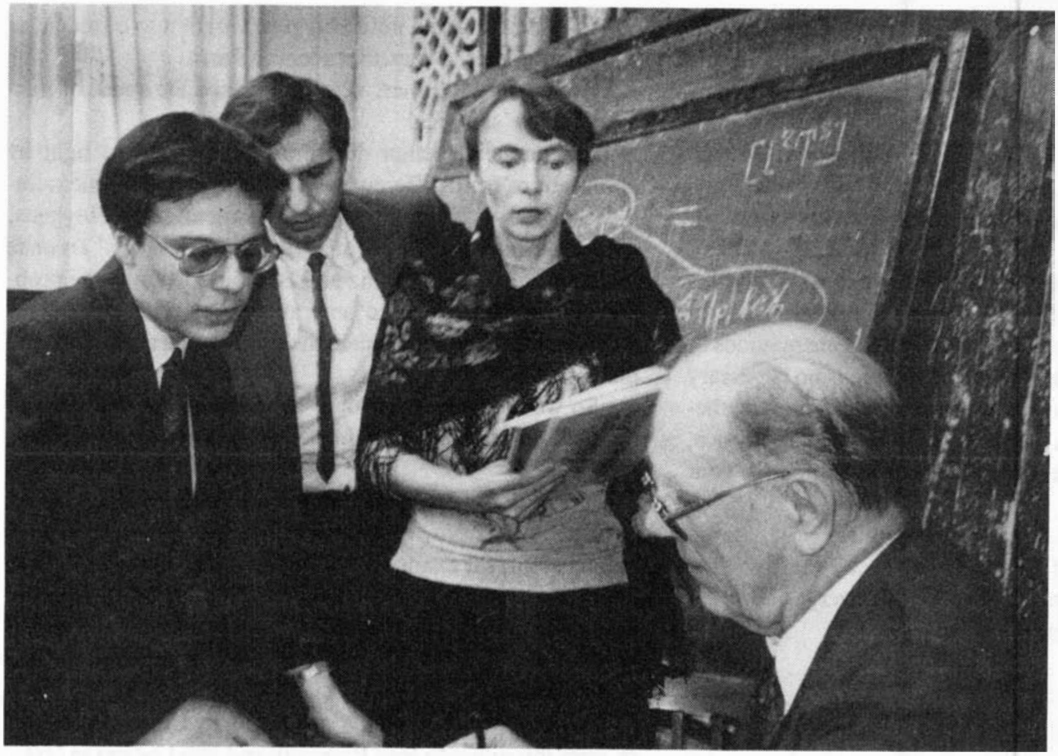
I used to tease people who were talking about not-entropic, living processes, by asking the statistician if it was statistically possible for life to exist. The very fact of human existence and that human existence and living processes have certain measurable forms, is an axiomatic demonstration of their existence and of the necessity to include those forms of behavior within the notion of physics in general.

Kuznetsov: We should not ask statisticians. For example: The probability of synthesis of one simple molecule of DNA is 10^{-200}.

LaRouche: But that still doesn't give you a living process. Was it a dead molecule or a living one?

Kuznetsov: But for this what we need is not statistics, but a different chemistry.

LaRouche: Exactly! And that's what we mean by these



LaRouche talks with participants in the Prezident seminar.

changes, which are called fundamental discoveries. . .

Let me go to just a bit of history first, because we have to define the phenomenon we're trying to measure, before we measure it. And I shall try to push this through, because this could take ten hours, and we don't have the time for it.

Mankind has existed on this planet for at least as long as the Ice Age—for over 2 million years. That is, if we can believe anybody who's testified on this subject. Mankind is different than any other animal; how do we prove this? And how does that bear on this question of technology? If the hominids—mankind—were higher apes or animals, we would have the population potential (approximately) of higher apes, baboons (which some people behave like), or chimpanzees. In that case, in the past 2 million years of the interglacial period, at no time would the human population of this planet have exceeded 10 million persons approximately.

Kuznetsov: Excuse me. Unfortunately, I've looked around the room, and I don't see the man who has proven the qualitative distinction between man and the animals.

LaRouche: We're going to prove it right now. That's the issue here, that's what we're coming to. That's the crucial question here, raised by the debate.

Kuznetsov: I would like to name this person, before you speak.

LaRouche: *I* have proved it, nobody else has. And I'll prove it right now.

Kuznetsov: The person I have in mind said that animals use tools they have found and that man differs from the animals in being the only species which improves tools.

LaRouche: I know that, but I'm getting to a more fundamental proof.

Kuznetsov: And that is what makes possible the development of technology. His name is Yun, Oleg Mikhailovich. He wrote this in 1967.

LaRouche: I've been at this a long time. I was before him. (This is fun.) That's what my whole work is based on.

Kuznetsov: But if the world is constructed that way, different people in different places will have the same thoughts.

LaRouche: Mankind in the past 600 years has increased more in our power over nature than in all human existence before it. It is a fair estimate, from archaeological evidence and other evidence, that the human population reached a level of several hundred millions which it never exceeded before 1400 A.D.

What was the difference?

What happened in the fifteenth century does not change the nature of man but merely shows it more clearly. What happened in the fifteenth century were two things fundamentally: the idea of a new kind of state—the modern nation-state under law; and secondly, the generalization of the notion of science, which is actually laid down as a doctrine by Nicolaus of Cusa in his *De Docta Ignorantia,* which gave us immediately such results as those of Leonardo da Vinci and so forth.

This generalized the use of science. Look at one particular parameter which is most interesting to us in economics: the percentile of the total labor force required merely to sustain the population. Into the eighteenth century at least, 90%

of the labor force had to be employed in agriculture and existing technology merely to maintain the society. From the beginning of the introduction of powered machinery and also other devices, there was an explosion in urban development of labor and in population potential.

From the fifteenth century through the nineteenth century, there is the greatest density of fundamental discoveries in human knowledge, in all human existence.

What are the physical measurements of a mental act of fundamental discovery?

Let's ask just one more question in this connection, and pose one more Socratic question: What is the most effective way of educating a child?

We have in modern education two general methods. The usual method, is to give the child a textbook and a teacher who recites from the textbook a politically correct science. The child learns, by habit, to acquire the habit of the so-called right answers. That method is not awfully productive. It may produce some passable engineers, but it does not produce great scientists.

In a good education, we start from several thousand years ago.

Kuznetsov: The second method will be "problem-solving" instruction.

LaRouche: This comes to the same problem.

Kuznetsov: Vasili Vasiliyevich Davydov, who is the vice president of Academy of Pedagogical Sciences and also a member of our scientific council, is the leading expert in this. The Dutch have translated his magazine and textbooks.

LaRouche: I'm making a specific point. The point is, the best method to educate a child is the method which resulted in the Renaissance in the fifteenth century. The exemplary institution which is responsible for the Renaissance in Italy and elsewhere was an order called the Brothers of the Common Life. It is called sometimes a Classical humanist form of education. The child was picked from poor but talented children, talented children from poor families. The same method was used by Monge in the Ecole Polytechnique. The child *must re-live the experience of each discovery*.

Any good scientist, as we can all attest, has a mind full of the memory of the experience of discovery of many great scientists from history. When colleagues are referring to a certain scientist's work by name, they are trying to recall among themselves the mental experience they had as a student, in living through that experiment. It is *impossible* to put that discovery in a textbook; it is possible to set up a textbook which frames the problem which the student, with the help of a teacher, must fight through.

So we transmit ideas not by words, but with the assistance of words. Mankind has a quality which no animal has ever been demonstrated to have, which is not simply tools. It is the ability to make fundamental discoveries of the type we associate with physics.

Kuznetsov: Our Soviet pedagogy dealt with the problem of educating blind-deaf-mute children. When I mention the name of Davydov, we have to add also Meshcheryakov, Ilyenkov. A great deal of work on precisely this problem was done not long ago.

LaRouche: I've heard of that.

The point is this: What is the weight, what are the physical characteristics of a thought associated with discovery, a thought which is transmitted in this form of pedagogy from a man two thousand years ago, a thousand years ago, two hundred years ago, to a child today?

So what we should call scientific culture, is a child's mind, a student's mind, filled with the living, re-created memory of a thought of a person who was dead one hundred years, two thousand years ago. You can imagine the painting of Raphael, of the famous School of Athens. People who are separated from each other by hundreds of years are sitting in the same large hall. How is this possible? Because in the mind of the person who knows the creative work of each, *they are living contemporarily*—this is your nonholonomic process.

These ideas, represented by the creative contributions of original thinkers, transmitted by teachers who have re-lived that experience, to students and others who re-live the experience—that is where this power comes from. That is where it comes from.

We have this in mental processes, in society, and we obviously have it in living processes. What is this? Is it not true that life and mental processes have a certain special kinship of form, which defies the so-called inorganic conception of the universe? So we do not have to go from inorganic physics to prove the possibility of life, when we have a living, thinking person standing before us. We must accept the existence of thinking man, who is creative—unlike the animals—in its own terms, on the basis of the *physical evidence* before us.

Kuznetsov: Several decades ago, 20 or 30 years, a movement arose in theoretical physics, to say that a physics that does not explain the existence of a theoretician who constructs cosmological theories is not physics. This is Hawking, one of the greatest physicists of our time.

LaRouche: The point is, that the attempt to define the universe as lawfully organized in a way which is sufficient to make happy gas particles, is not the physics of the real universe. A physics which makes happy gas molecules, by denying the existence of any higher form of life, is obviously not competent to explain a physical universe in which man exists.

Kuznetsov: This is a superfluous discussion. There are people in this hall who know physics very well, and who are thinking about what expansion of modern physics is needed in order to explain man.

LaRouche: Exactly. Maybe we're doing that. Maybe we'll do it.

Kuznetsov: But do you think that the physics which includes man will not be physics?

LaRouche: It will be a different kind of physics entirely. It will not be physics in the ordinary sense of physics.

Kuznetsov: This is a real conflict.

LaRouche: No. There is, but there isn't.

What kind of mathematics corresponds to what we're discussing? The *alephs*. How do you do this?

Kuznetsov: We might not have quite enough time tonight to solve that problem.

LaRouche: All right, let's just quickly skip to the result.

How does this come up in economic planning?

We all know here, I presume, how we set up an input-output table for computer use. We know how to do this with the axioms for that. We set up a set of axioms. The system will operate as an input-output linear system matrix according to the so-called hereditary principle.

We can generalize the matrix as being of a certain type. We know all about the matrix, because all the theorems are implicit. Some kind of iterative method in indefinite time will find every possible theorem for the matrix.

Now, what happens when we introduce a technological change or when we have a technological catastrophe? We end up by not only changing the coefficients of our matrix; we also change the lines and the rows and the constraints.

Kuznetsov: That depends on how you define the elements of the technological matrix.

LaRouche: Let me skip ahead, I think we'll all be understanding each other when I get through this.

Kuznetsov: If you're defining this traditionally, that's true.

LaRouche: All right, fine. We're looking at the form; first we're getting the form of the problem.

Kuznetsov: But to evaluate ideas—

LaRouche: We'll come to that. In the shortened time we have, I want to get this through, because all these things can be discussed.

If we were to continue with the same matrix, with only some change in the coefficients, we would have a degenerative economy. Not because of a falling rate of profit, but because of changes in resources, changes in relationships. Therefore, if I project that change of attrition in the model in time (I don't even have to know the time; all I have to know is that there will be time), what happens to my function? I see a collapse, a catastrophe developing in my economy, even in this simple mathematical representation. If I want to do it properly, I will not only include production and consumption; I will also take in transportation, power, and other considerations.

So I have a deterioration in my economy. What does this mean to the government and to business?

This means that I need a new technology, which will reverse this. I may say, as in the former Soviet Union: "Transportation stinks. We cannot be economical with this kind of transportation." And so forth. That may lead to what is called optimization, but you'll find that even optimization doesn't solve the problem.

So therefore, what does it say? It says we need a new technology, which will mean changing some of the rows and columns. It will mean changing all of the coefficients, or a lot of them.

Kuznetsov: This is what happened 20 years ago. Twenty years ago, there was a report on a blueprint for an aircraft carrier that could travel at 600-700 kilometers per hour at a height of 5 to 8 meters and double the normal carrying capacity. My co-author, Dr. Di Bartini, the aircraft designer, made this report in 1974. This was to have been a ship built under the Ministry of Shipbuilding. But insofar as it was going to move through the air, not in the water, by the Aviation Directorate.

LaRouche: Instead of trying to calculate and project the new input-output matrix from the old, we construct another one, entirely different. There is a total mathematical discontinuity between the two successive matrices.

Prof. M.E. Gertsenshtein: The Earth has existed for 2 billion years and life has existed on Earth for around 2 million years. It receives energy from the Sun and all the atoms undergo recycling. Civilization should strive to replicate this technology.

LaRouche: I'm talking about something else.

We change the matrix. What we are actually doing, is going back to this historical educational model.

Take the former Soviet Union and Russia today as an example. And I'm coming to the space program, because I think that's the crucial thing to talk about.

What we do, is we say we must be generating enough technology of the right type to address these problems as they are going to occur. This is coming from what I would call, in honor of Leibniz, *pure technology*. What we need, of course, is the scientists doing the work—discoveries. We must have the machinists to make the instruments so we can give proof of principled experiment. Then we need the advanced machine-tool industry to turn that design and experiment into a machine-tool principle.

If we talk about the quality of education of scientists and engineers, this comes down to a percentage of the total population which must be engaged.

So look at the modern history of this. We come from agriculture into industry. As we improve industry, we increase the producer goods sector. Now, instead of scientists being a small percentage of the population, science and engineering are emerging as a *new category of production* which produces, directly, nothing in terms of tangible goods. This I estimate today for an industrial society has to be between 5 and 10% of the total labor force, just as a rule of thumb based on observation,

Now once we say we agree that we require a certain percentile of the labor force employed and trained as scientists and engineers—which also means a certain growth of the machine-tool sector—now we need to give science a mission. That doesn't mean you tell the scientist what to do exactly; it means you give a general overall mission for collaboration among scientists.

It is my considered view that aerospace or space exploration and colonization is the basic mission. Because we are in that kind of work, we are driving science to discover solutions to every problem of taking man to the limits of his present capability. By doing that, we are now creating automatically, as a by-product, everything that man could be capable of doing on Earth.

Let me just conclude that point, and then come to the summation, because we're running out of time.

In the modern period, especially since the experiment of the Ecole Polytechnique from 1794 to 1814, we have had a number of military and other so-called science-driver programs. Modern warfare and preparation for warfare has also the characteristic of a science-driver program. The best examples, of course, are the space programs, which gave us the greatest rate of technological attrition and development of new technologies.

The criticism of these programs was an understandable but mistaken criticism. They say military production is useless. They say space production is useless for man on this planet. Yet our experience shows exactly the opposite to be true. Because what we are producing—forget the military weapons, forget the space vehicles—what we are producing is the same thing we produce in a research laboratory, on an enlarged scale. We do not sell the products of a research laboratory. They are consumed by the experiment. But from the experiment, we gain the technology which accelerates human progress.

We have reached a point on this planet, that unless we save the scientific community in several principal countries, through aid of a mission assignment of this type, we shall not produce enough technology to enable us to save mankind from disaster.

Kuznetsov: There will be a reverse chain-reaction from man to the monkeys.

LaRouche: Exactly. If we do not do this. Because we have increased the world population to 5.3 billion people. Twenty or twenty-five years ago, we had the basis for, in a normal fashion, going to 25 billion people, without any great problem. In the past 30 years, we have destroyed so much of the planet's productive technology and productive capacity, that we are in a disaster.

Kuznetsov: Which criteria are you using: food, consumer goods, or industrial output?

LaRouche: Both. You find in the book, that I lay out certain inequalities which show this relationship. You must satisfy those inequalities in so doing. You must not decrease the standard of living in order to produce; but you must increase the producer goods ratio. If you cannot do that, you cannot survive; and that's precisely what we've done.

Therefore, we need a global crash program for some good purpose, which will give us the technology which, through investment, can save mankind from a disaster.

I will conclude with the following observation, even though it is not complete—we could go on for weeks with this: Not only is this view of technology and the mathematical significance of this kind of notion of technology sound scientifically, but we have come to a point in man's history at which this concept is a practical concept essential for human survival. And therefore, I am enthusiastic about the *Prezident* project proposed by our host, Dr. Kuznetsov.

From the discussion period

Dr. Alekseyev: This meeting has made a tremendous impression on me. I am speaking not only for myself, but for the schoolchildren in clubs in Moscow, who study space. Your book [*So You Wish to Learn All About Economics?* in Russian translation] is one of the subjects we studied, introducing the children to broad studies of space. My fifth-graders made golden section constructions using this book as a guide, following your wonderful idea, which is on page 61, about the golden section. Also, your presentation of self-similar spiral development is brilliantly, simply, and easily grasped by children from fifth through nine grades. Using a straight-edge and a circle, they construct the golden section; they construct logarithmic spirals; they study the rhythmic characteristics of sound; they rediscover the elliptical orbits of the planets in our solar system. We find an enormous intellectual potential in these children.

I would like to say that I am very impressed by your proposal that the knowledge we are exchanging here and the work proposed by Pobisk Georgiyevich Kuznetsov be made, through our activity, a joint product for teaching children. I have another concrete proposal, for which I request three more minutes of time.

Pobisk Georgiyevich spoke about the blind-deaf-mute children whose intellect our Russian scientists inculcated and who learned draw, to invent fairy tales. And in those drawings and fairy tales by blind-deaf-mute children, my children—educated about the golden section according to your book—find the rhythmic characteristics of the golden section, negentropic processes, and the alphabet of the musical scale.

As a concrete proposal, I would like for an electronic mail connection to be set up as soon as possible between the scientists of Russia represented here and those American scientists, represented by you, who stand for negentropic scientific interests. Then we will be able to exchange and share ideas with you, as well as possibilities for children to grasp ideas by Occam's principle, whereby we approach the idea of the golden section directly, without prolonged theoretical discussion.

Thank you so much for your book and the hope that we may have further creative collaboration among our scientists and organizations.