Eurasian Infrastructure And the Noösphere

by Jonathan Tennenbaum

The following speech was given by Dr. Tennenbaum, Schiller Institute science advisor, to a conference sponsored by the Vernadsky State Geological Museum and the Schiller Institute in November 2001, in Moscow. The title of the conference was "The Realization of the Concept of the Noösphere in the 21st Century: Russia's Mission in the World Today." Subheads have been added.

In my remarks I shall first concentrate on what may appear to be purely economic questions, and then show their profound connection to the work of Vernadsky and his conception of the *noösphere.*

Since 1988, and particularly since 1992, we have focussed attention on the unique potential for rapid economic development of the Eurasian land-mass in the decades immediately ahead. Based on the principles of physical economy, elaborated by Lyndon LaRouche, we have identified a specific strategy which is both necessary and sufficient to launch a sustained period of economic development in Eurasia over the next 50 years.

The core of this strategy is to create a network of East-West and North-South infrastructure corridors connecting the main regions and great population concentrations of Europe and Asia, and centered on high-speed railroad and magnetic levitation lines, combined with modern power production and distribution systems, pipelines, canals and water systems, and advanced communication systems. The areas within about 50 kilometers on either side of these main Eurasian transport and energy lines, will become areas of highly efficient investment into industry, intensive agriculture, urban construction, and population growth, radiating economic development into the surrounding territories. The creation of such a network of Eurasian infrastructure corridors provides the basis for simultaneously addressing several of the most difficult problems facing the nations of Europe and Asia over the coming period.

First is the complementary relationship between the growing requirements of the developing nations of Eastern and Southern Asia, for modern, high-technology capital goods, on the one side; and the requirements of Europe and Russia, and also Japan, as exporters of technology. The Eurasian infrastructure corridors provide the physical transmission-belt as well as an extended market for such capital goods exports. Although China and India have significant technological capabilities, they cannot possibly meet the requirements of their over 2 billion people, without enormous inputs of modern equipment, technology, and know-how from the outside—including technologies which have not yet been fully developed.

Secondly, infrastructure corridors provide the chief practical method of propagating economic development into the relatively underdeveloped interior regions of Eurasia, including, for example, much of the North and the Far East of Russia, Central Asia, and the Central and Western regions of China.

Third, is the immediate problem of overcoming the effects of the profound economic and financial crisis affecting most nations of Europe and Asia today, providing for a revival of investment into the real economy, for employment, a sustained demand for industrial production, and an increase in the overall physical productivity of the participating nations. This was the core of President Franklin Roosevelt's successful policy for ending the Great Depression in the U.S. in the 1930s, through launching of large-scale infrastructure development and related improvements in the real economy, financed mainly through state credit generation. The present, strong economic growth in China, is to a large extent a result of similar policies of large-scale infrastructure development.

Now, after the collapse of the gigantic financial bubble in Wall Street and in the international financial system generally, threatening the world with a profound economic depression, more and more voices are arguing in the U.S. and elsewhere for a return to the "Franklin Roosevelt" model and the experiences of the post-war reconstruction period from the late 1940s into the 1960s. In that period, the reconstruction and modernization of basic infrastructure, plus high-technology projects such as the peaceful development of nuclear energy, played a crucial role in the so-called "economic miracles" in West Germany, France, Italy, and Japan, for example.

When Lyndon LaRouche and the Schiller Institute started talking about the creation of a Eurasian network of transcontinental infrastructure corridors, this may have seemed like just a dream to some people. But in recently years already major steps have been made in that direction. . . .

From a Higher Standpoint

But now let us take a new look at these economic questions, from a higher standpoint, namely that of the *noösphere* and physical economy.

Vernadsky characterized the *noösphere* as a new stage of development of the Earth, in which man has emerged as the increasingly dominant, "geological force" in the biosphere. That "force" is exerted, not simply by the biological metabolism of the human population—its nutrition, excretion, and muscular effort—but above all, by the much larger flows of matter and energy, which are connected with the physical-economic activity of human society.

Studying physical economy according to the method of

Economic progress depends uniquely on the development of human cognitive mental processes, argue Vernadsky and LaRouche. Here, a scientist in her laboratory.

LaRouche, we first put aside the financial and monetary aspects of economy, and treat the economy of the world, a nation, or region as a single, integrated, self-reproducing physical process—an entity analogous to a living organism. The "metabolism" of the physical economy encompasses the totality of the physical processes, organized by man, by which the human population maintains its continued existence on this planet: the generation and distribution of energy, the vast network of interconnected productive processes of agriculture, mining, industry and construction, transportation, distribution and consumption of goods; plus necessary nonproductive activities such as education, medical care, scientific research, state and cultural activities, etc. It is that physical-economic activity, connected with an increasing scale and intensity of anthropogenic flows of matter and energy in the biosphere, through which man exercises an increasingly dominant influence over the biosphere, drawing in ever larger amounts of living and nonliving matter into the "metabolism" of human physical economy; and eventually even extending the biosphere beyond the limits of the Earth.

The unique character of physical economy, as a special kind of living system, is that it evolves under the influence of human cognitive mental processes. This is most clearly exemplified by the effect of scientific and technological progress: Through the use of individual, creative mental powers, a scientist discovers and experimentally demonstrates a new physical principle; other scientists, engineers, inventors, and workers incorporate the experimental demonstration of the new principle into new families of technologies and technical processes, and introduce them into the network of production. By integrating these new principles and processes, the "metabolism" of the physical economy is transformed, expanded, and intensified. Thus, the "geological force" of mankind develops on the basis of an unending accumulation of creative contributions from a vast number of human individuals working at all levels of the physical economy.

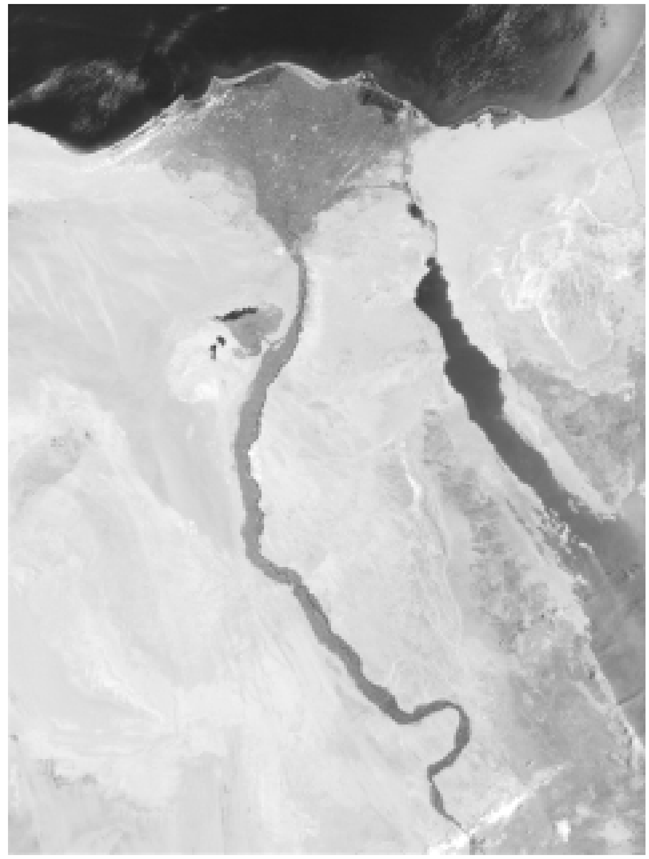
All of this, of course, is well-known; but the implications for the scientific *measurement* of economic processes, and of the *noösphere,* are seldom fully appreciated.

For example, how should *economic growth* be defined and measured? The presently dominant school of Western economics measures economic growth in terms of so-called national income accounting, mainly as increase in the Gross Domestic Product (GDP). But in the calculation of GDP, no essential distinction is made between productive and nonproductive activities; the income from gambling houses and sales of pornography is counted on an equal basis with income from agricultural or industrial production. For these and related reasons, an economic policy which leads to maximum GDP growth is often one which destroys the productive base of a country at the highest rate! An extreme case of this is the "New Economy" in the United States during the second half of the 1990s, when the supposedly spectacular growth of the economy was a complete illusion, based on a huge expansion of the monetary supply by the central bank, which led to the largest speculative financial bubble in modern history, and a gigantic net inflow of goods and capital from abroad. Now that the bubble has popped, it is clear the real economy of the U.S. has actually been continuously collapsing, throughout the 1990s.

A seemingly opposite approach to the GDP method is to measure growth in terms of physical production parameters—

like kilowatt-hours of electricity production, tons of wheat and steel, ton-kilometers of transport volume, and so forth. But although such parameters are closer to reality than mere monetary accounting figures, they miss the most essential feature of physical economy, upon which everything else depends: the cognitive activity of the population. For example, it is entirely possible to have an impressive growth in physical production parameters, while at the same time the realization of scientific and technological progress slows down, essential resources are being exhausted without replacement, the cultural and educational level of the population stagnates or declines, and the overall physical efficiency of the economy drops. There are enough examples of this in the history of the so-called socialist economies.

Reflecting on what I have said earlier, it should be evident, that the development of the human population, and of its cognitive powers especially, must be at the center of any adequate approach to measuring "real economic growth." Furthermore, we must rule out the kinds of unhealthy, short-term growth, which occur at the expense of successful long-term survival. For example, a society may stop investing into fundamental scientific research and education, and invest the corresponding resources in areas that produce a quick profit. The result might be an apparent boost in growth in the short term, but that society has doomed itself to collapse in the long term.



While regions such as the Nile River delta, shown here from a satellite photo, can sustain an average population of 100 persons per square kilometer, other regions, like Siberia, can hardly sustain 5. Thus, potential population density is "relative" to the specific area, and must be compensated for with human intervention.

Potential Relative Population Density

Thus, what we have to examine, is not the momentary physical state of the economy and its population, but rather the *potential* of society to maintain itself, at a given level of existence, into the future. From this standpoint, the essential *output* of a physical economy, is not physical goods per se, but *potential.* What we must measure, is the *effect* of current economic activity on the rate of change of that potential, whose essential source is the cognitive powers of the population. The development and exercise of those cognitive powers, however, depend on constant improvements in the material conditions of society, on education, on the realization of scientific and technological progress, and so on.

These and related considerations, which I cannot elaborate more here, lead us to the notion of "rate of change of relative potential population density," introduced by Lyndon LaRouche as the foundation for the science of physical economy. While seemingly very simple, it is one of the most profound conceptions in all of science.

In a very rough first approximation, we define *potential population density* of an economy as the maximum number of human individuals, that potentially can be sustained, per square kilometer of inhabited land, on the basis of the technology and modes of social production, prevailing in that economy.

It is obvious, that the potential population density, defined in that way, will depend upon many natural conditions such as climate and geography. A level of technology, which is entirely adequate for sustaining an average population of 100 persons per square kilometer in the fruitful river deltas of the Nile or Brahmaputra, could hardly sustain 5 persons per square kilometer in northern Siberia. For this reason LaRouche "normalizes" the concept of "potential population density," by defining it as *relative* to a given quality of land, climatic conditions, etc. So we get a notion of "relative potential population density" which permits us to compare the productive power of economies or sub-economies in regions with different natural conditions.

The fact, that any fixed mode of production tends to gradually exhaust the resources for its future continuation, leads us to the paradoxical result, that even a hypothetically constant value of potential population density can be maintained only through a certain minimal level of scientific and technological progress. If we examine the paleontological and historical record, however, we find that not only the potential population density, but the actual density of human population on the Earth has increased by orders of magnitude in the course of man's development. One can estimate, that on the basis of the so-called "hunting and gathering" mode of existence, the total human population of the planet could not exceed a few hundreds of millions. Today, if the most advanced presently known technologies were to be fully and optimally utilized throughout the world, a total human population of at least 12 billion, perhaps 20 billion, could be sustained, at living standards and life expectancies far beyond what earlier periods could have dreamed of.

The "rate of increase of relative potential population density," is the primary measure of real economy growth, and of the development of the *noösphere.* Even more fundamental, though, is the rate of change of the ratio of (relative) potential population density, to the actual population density. This parameter is a measure of development of the per-capita power of man over nature, as that power is expressed in terms of the ability to sustain and expand human activity in the universe. It is therefore a crucial parameter of the *noösphere.*

When we define "economic growth" in the indicated way, it is easy to see, that it is very strongly correlated with an increase in the density of the anthropogenic flows of energy and materials, per capita and per square kilometer of the Earth's surface, as well as an increase in the technological quality of those flows. For example, the energy-flux-density (power density) of technical processes, expressed (to a first approximation) in watts per square centimeter of work surface, increases by successive "jumps" in the course of technological development.

Above all, however, potential population density is a function of the state of development of basic economic infrastructure—especially transport, energy, water systems, as well as health and education systems. Looking at the future of Eurasia, we see that infrastructure determines both the potential to maintain the highly populated areas of China and India, and the potential to settle and develop remote areas of Siberia and the Far East.

Dams such the Hoover Dam in the United States, shown here, are a product of man's necessary work of improving and expanding the biosphere.

The Malthusian Complication

Before turning to some final observations concerning Eurasian infrastructure development, however, I want to address a problem which today often leads to a false understanding of the *noösphere* and its relationship with physical economy. This problem is connected with the spread of neo-malthusian ideas in politics, economics, and natural sciences over the last 30 years. The most conspicuous case is the famous book by the Club of Rome on so-called *Limits to Growth.* That book—and the mathematical model of Forrester and Meadows, upon which it was based—essentially ignored the key characteristic of the *noösphere,* which is the impact of scientific and technological progress, and other effects of human cognitive activity. The result was to predict supposed "limits" to the growth of population and living standards, which are entirely a consequence of the arbitrary assumptions of the mathematical model, and do not exist for a real human society in a state of scientific and technological progress. One of the main sources of the "limits," asserted by the Club of Rome, was the claimed finiteness of natural resources available for economic development.

In fact, I always emphasize, that the concept of "natural resources" and "raw materials" is only *relative,* not an absolute concept. The same is true of so-called "limits" of resources, which never exist in an absolute sense, but only relative to a given state of human knowledge and technology. The definition of what constitutes a "natural resource," depends on man's relationship to nature. But that relationship constantly *changes* as a function of scientific and technological progress, as well as factors of a cultural and political nature. A characteristic of scientific and technological progress, is that it constantly *transforms* the array of natural bodies that function as "resources" for human existence. New types of resources are opened up, while at the same time the range of existing types of resources, that can be exploited in an economic way, is constantly extended.

So, for example, for the so-called "Stone Age man," the concept of "iron ore" did not exist. Similarly, prior to the discovery of nuclear fission, the concept of "uranium fuel" did not exist; but today, using nuclear fission reactors, we can extract from 1 kg of uranium the caloric equivalent of 50,000 kg of coal! Similarly, the realization of controlled nuclear fusion will suddenly transform the deuterium isotope content of the world's ocean water into a gigantic fuel resource.

In a less dramatic, but equally important way, we have a constant tendency for growth in the exploitable reserves of mineral resources, as the result of an ongoing accumulation of thousands of small improvements, introduced every year into the techniques of prospecting, mining and processing of materials. So, for example, the exploitable petroleum reserves of the world are today vastly *larger* than they were over 30 years ago, when the Club of Rome's study *Limits to Growth* warned that oil was about to run out. This, paradoxically, is in spite of the fact, that vast quantities of oil were consumed since then.

Contrary to the ideological biases of the environmentalist movement, that the problem is not to protect *the biosphere from man; but rather, it is to insure that the physical economy can meet the costs connected with man's necessary work of* improving *and expanding the biosphere.*

Therefore, to determine whether real, sustained growth is occurring, or only an apparent growth maintained at the expense of looting the potential for future growth, the crucial parameter is the *rate of scientific and technological progress.* We must compare the *rate* of marginal exhaustion of resources, as these resources are defined in terms of the *existing* state of development of science and technology, with the *rate* at which the progress of science and technology is transforming and expanding the effective resource base for maintaining physical-economic growth.

From this we see, that the problem connected with resources is *not* that they are really limited in the absolute sense. Rather, all essential problems are connected with an insufficient rate of scientific and technological progress, as actually applied in the economic process. We can see exactly this problem in the world today.

Measuring Real Economic Performance

This discussion of resources is just a special case of a general principle in the science of physical economy. To measure the real performance of an economy, in physical terms, the following three magnitudes must first be compared:

One (T) is the total *physical output* of the economy, i.e. of the entire agricultural and industrial production process.

The second is the *physical cost* of sustaining the human population and its continued reproduction (V), including the direct and indirect consumption of households which produce the population, necessary physical investments into housing, educational and health services, etc.

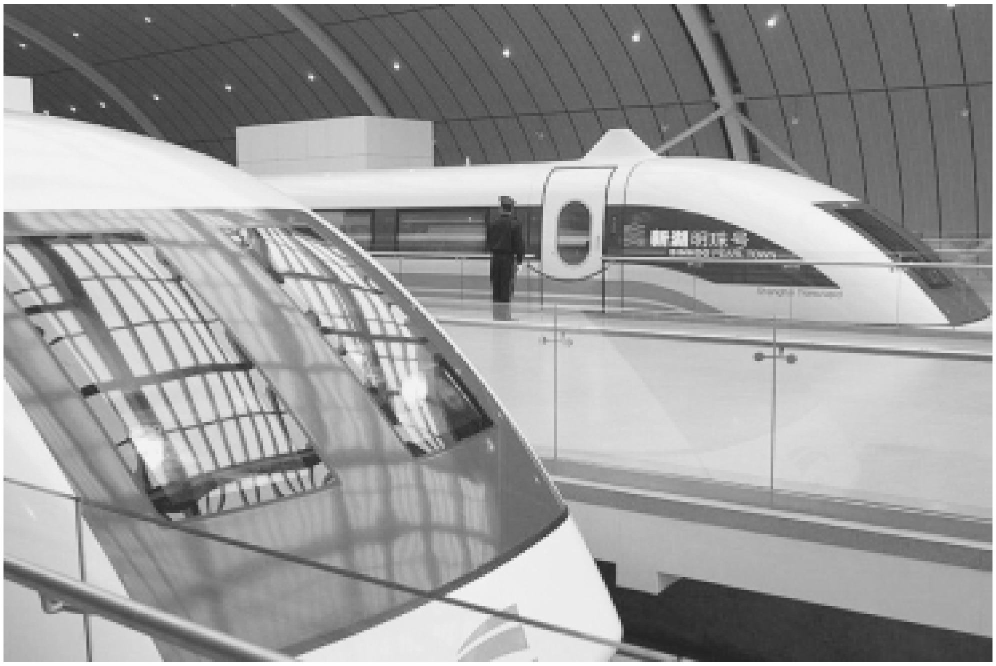
The third parameter is the *physical cost* (C) of maintaining what LaRouche calls the *equipotential of man-transformed nature,* which is the basis for sustaining existing levels of production and consumption into the future. "Man-transformed nature" includes the means of production—machinery, infrastructure, the quality of agricultural land, etc.—as well as the natural resource base, and, more broadly, the biosphere itself, insofar as it is increasingly transformed, as a system, by man's activity.

The ratio of total output T, to the sum V+C of the two physical costs just defined, gives us a first-approximation measure of the real physical productivity of an economy. Successful economic practice is characterized by a sustained rate of increase in the ratio T/(V+C), correlating with an increase in the potential population density of human society. The definition and estimation of C and V pose some fundamental questions, closely connected with the work of Vernadsky, and in my view first really clarified by Lyndon LaRouche in his work on the foundations of physical economy.

First is the notion of "equipotential," which enters into the determination of the cost "C." As Vernadsky emphasized, man constantly and irreversibly *transforms* the biosphere; that process of transformation and intensification of the biosphere through man's activity, continuing the process of biosphere evolution in a new mode, is the characteristic of the *noösphere.* Therefore, "maintaining the equipotential" of man-transformed nature does *not* mean restoring the biosphere to some earlier state, nor converging on some sort of asymptotic *equilibrium* of man with nature, as the many so-called environmentalists today believe. On the contrary: Just like the preceding biological evolution of the biosphere, the *noösphere* evolves farther and farther away from equilibrium.

The requirement is, that the *potential* of man-transformed nature, to sustain the existing (or increasing) levels of human population and economic activity, must be maintained (and actually enhanced) in the course of successive cycles of transformation. That involves a *cost,* which expresses itself in many ways. For example, it means the maintenance and eventual replacement of production equipment, preferably by equipment incorporating more advanced technology; in agriculture it includes maintaining or increasing the fertility of the land, by various sorts of improvements, including irrigation systems; in the extraction of raw materials and other natural resources, these costs may involve a combination of recycling and reprocessing of materials, and the implementation of scientific and technological innovations which, in effect, expand the exploitable resource base at a faster rate, than it is being used up. It includes also costs of processing of water, organic and industrial wastes of all kinds, and other rational forms of compensation for negative effects of economic activity on the functioning of the biosphere.

I must once more emphasize, contrary to the ideological biases of the environmentalist movement, that the problem is not to *protect* the biosphere from man; but rather, it is to insure that the physical economy can meet the costs connected with



Eurasian infrastructural development will require new technologies for high-speed ground transport, such as magnetically levitated rail systems. Here is the Chinese pilot project, using the Transrapid system, now in effect between Shanghai and its airport.

man's necessary work of *improving* and expanding the biosphere. This includes, for example, the use of water transfer and (in the future) large-scale desalination for "greening the deserts."

Now, the costs of maintaining the equipotential of man-transformed nature, are constantly increasing in absolute terms. For example, even in the hypothetical case of "zero growth," a physical economy will tend to gradually exhaust the easily-exploitable resources for its existence; as a result, an ever larger physical investment is required to supply the economy with the necessary resources. This gradual increase in costs causes a tendency for decrease in the net productivity of man's physical economy (as I defined it earlier), and finally to a collapse, as a result of the intrinsically "entropic" nature of any fixed technological mode of economic reproduction. ("Sustainable development" at a fixed technological level is just as much an impossibility as the idea of a "perpetual motion machine!")

In successful human practice, however, this "entropic" tendency is overcome by scientific and technological progress, and other improvements derived from the exercise of human cognitive powers. Maintaining scientific and technological progress, of course, involves additional costs; it requires infrastructure development; continual modernization of plant and equipment; and large expenditures for education, cultural activities, and the material consumption of the workforce. The costs V and C are both greatly increased. But, for a sufficiently high rate of scientific and technological progress and a proper development of infrastructure, the overall output of the economy grows much faster than its costs, and the net productivity T/C+V increases. The relative potential population density of the human race increases, both absolutely and relative to the actual population.

This is exactly what we find in successful periods of human development. The powers of human cognition—exemplified by the successful discovery of new physical principles and their integration into social practice—are the unique source of the "anti-entropic" growth of physical economy, upon which the emergence of the *noösphere* is based.

Eurasian Development

From this standpoint let us turn to the deeper significance of Eurasian infrastructural development.

The major problem we are facing, is that the world economy, at present, is operating at a *net loss* in physical terms. The present physical output of the world economy is considerably less than would be required to adequately maintain both the existing population and the equipotential of man-transformed nature. The potential population density of the planet is falling below the actual population. Some see this as an "ecological crisis," others as an "socio-economic crisis," but from the standpoint of the *noösphere* they are really the same thing.

It would be a fundamental error, for example, to suppose that a collapse of the physical economy would benefit the biosphere, by reducing the "disturbance" caused by human activity. On the contrary, the flows of matter and energy, connected with man's physical economy, are an integral part of the present structure of the biosphere, and are actually sustaining that structure to a very significant extent. This includes the intensification of biomass generation, connected with modern agriculture, and indirectly with the functions of industry and infrastructure which support agriculture. Thus, a collapse of man's physical economy inevitably generates shock effects within the biosphere as a whole, triggering a transition of the biosphere to lower states of organization, and leading (among other things) to mass outbreaks of old and new human, animal, and plant diseases. This phenomenon, which LaRouche warned about in the mid-1970s, can actually be observed today in Africa and other areas of the world which have suffered dramatic economic decline, including in your country. On the level of human society, the effects of physical-economic collapse include, for example, a drastic increase in political instability, the weakening of the institutions of civilization, and the potential for epidemics of ethnic and religious conflicts.

Thus, the creation of a network of infrastructure corridors in Eurasia—and analogous projects in other areas of the world—cannot be seen merely as a commercial undertaking. In combination with certain measures to stimulate scientific and technological progress, these projects provide the most efficient means to reverse the current "entropic" degeneration of most of the world's physical economy, and to restore real growth in agreement with requirements of the *noösphere.*

Of crucial importance is the relationship between increase in the potential population density of a given territory, and improvement of key infrastructural parameters, measured both per capita and per square kilometer of territory. These include: 1) supply of energy, in various forms; 2) capacity and performance of transport systems; 3) supply of fresh water and other water-related infrastructure; 4) access to communication education and health services. The growth of productivity of a physical economy is strongly correlated with an increase in its *power density*—the density of infrastructure (energy, transport, etc.), combined with the density of population and economic activity. In particular, the per-capita cost of supplying essential infrastructural services decreases as the density of infrastructure and population increases. This is one of the main reasons for the high productivity of *cities,* where the per-capita cost of providing energy, transport, water, and essential social services is much less, than for the case of a population spread out over a large area. The concept of an *infrastructure corridor* applies the same principle to development of a relatively dense, band-like region around main transport lines, thereby providing an efficient means to extend development into the interior regions of Eurasia.

The requirements of Eurasian infrastructural development already determine certain priority directions for scientific and technological progress in the coming period. Let me just give some examples:

1. Technologies for high-speed ground transport. Besides conventional high-speed rail technology, development of automated, magnetic levitation systems for passengers and freight. Application of ekranoplanes and other novel forms of air transport, to development of Eurasia. New types of highly efficient mass transit systems for urban development.

2. Development of advanced, "intrinsically safe" forms of nuclear energy, suited to large-scale use within Eurasian infrastructure corridors. Nuclear energy has the highest power density and highest intrinsic efficiency of all known energy sources. Application of nuclear reactors as industrial heat sources, for the production of synthetic fuels, and for large-scale desalination of sea water. Development of controlled fusion and more coherent forms of nuclear energy. Transmutation of nuclear waste.

3. Development of synthetic fuels and electric propulsion for automobiles, trucks, and buses; utilization of fuel cells.

4. Application of revolutionary biophysical methods to the prevention, diagnosis, and treatment of disease, as well as agriculture—including magnetobiology, biophoton methods, and the biological effects of coherent electromagnetic radiation. Applications to the problem of settlement of regions with extreme environmental conditions. These methods which are based on the fundamental space-time distinction between living and nonliving processes (Vernadsky, Gurwitsch) are potentially far more powerful than so-called "genetic engineering."

This short list of examples, underlines the absolutely decisive role of Russia in the future of Eurasia—Russia on the one hand, as the cultural and infrastructural bridge between Europe and Asia, and the greatest single area for development on the Earth; Russia, on the other hand, as a unique treasure-house of advanced scientific, technological, and engineering capabilities, and together with Ukraine, the birthplace of the *noösphere* conception.