Why the Russians lead in controlling the biosphere

The conceptual basis of the Soviet scientific advantage in control of the biosphere: V.I. Vernadsky and the Russian school of biogeochemistry. By Warren J. Hamerman.

The issue of the Russian attitude toward Lyndon LaRouche's application of the scientific work of the brilliant 19th-century German geometer Bernhard Riemann to modern questions of physics, biology, and economics has recently taken on fundamental significance in strategic affairs. Late last year, the Soviet magazine *International Affairs* (English-language edition No. 10, October 1987; Russian-language edition No. 9, three weeks earlier) published the full text of a letter from Lyndon LaRouche along with a commentary from the editors of the Soviet Foreign Ministry's journal (see *EIR*, Dec. 4, 1987, Vol. 14 No. 48). The Russian editorial commentary on LaRouche's work included the following question:

"And what are we to make of 'Riemann Surface, a Gauss-Riemann manifold,' ideas which the letter considers decisive for the development of civilization?"

What could possibly be the basis in the Russian mind for the fear that LaRouche might spark a controversy surrounding Riemann's approach to physics and biology? What is their fear that others beside LaRouche may find these ideas "decisive for the development of civilization?"

In fact, the area of work explored by Lyndon LaRouche touches upon a domain of scientific research which was the source of heated interest earlier this century in the Soviet Union itself.

Two of the leading scientists this century who have worked on a Riemannian approach to "living matter" were the Soviet scientists V.I. Vernadsky and A.G. Gurvich. The lines of work in biophysics developed by these figures and their collaborators have multiple significance:

1) They are probably the most fruitful approach to the deadly AIDS pandemic today.

2) They contain the key to scientific advances in plasma physics and basic biology.

3) They lie at the heart of man's ability to control large-scale processes on the biosphere as well as to "terraform" foreign planets such as Mars so that they may become habitable for man.

4) They are central to the methods and strategies of warfare and military technologies in the 1990s and the 21st century.

The purpose of this article will be to inform the Western reader of this area of scientific work. While aspects of Vernadsky's work have recently been promoted in the West, the most crucial features of his "Riemannian biophysics" have been ignored.

For much of the 20th century, the Russian school of "biogeochemistry" founded by the seminal scientific figure of Vernadsky has been systematically studying the interacting electromagnetic radiation processes which order and control all living and inert phenomena in our biosphere. Vernadsky's work, closely informed by the early theoretical and experimental writings on nuclear radiation of Pierre Curie, developed out of his careful blending of the work of two 19th-century scientific geniuses—the French biophysicist Louis Pasteur, and the German geometer Bernhard Riemann.

In the scientific climate created by Vernadsky's leadership, Alexander G. Gurvich in 1923 made his famous discovery of mitogenic radiation as a by-product of his exploration of the nature of the "biological field."

The basic approach of Vernadsky's biogeochemistry is to study the various physical, biological, and chemical processes in our biosphere—in near space and the atmosphere, among living species of animals and plants, in the oceans, and in the planet's mineral and geological infrastructure—

from their fundamental "interactions."

Fundamental discoveries in the "rules of the planet" have immense scientific, economic and military-strategic implications. Put simply, he who understands the rules of the planet, can "make" earthquakes, tidal waves, lightning storms, deadly diseases, chemical storms, genetic mutations, and therefore, in fact, rules the planet.

In the year 1926, Vernadsky became the founding director of the State Radium Institute in Leningrad, and presented the following conception as the basic orientation of scientific investigation:

> Only a few of the invisible radiations are known to us at present. We have hardly begun to realize their diversity and the scrappy nature and inadequacy of our knowledge of the radiations which surround us and pass through us in the biosphere, and to understand their basic role in the processes going on around us, a role which is difficult to comprehend by minds accustomed to other conceptions of the universe. . . . We are surrounded and penetrated, at all times and in all places, by eternally changing, combining and opposing radiations of different wavelengths—from ten millionths of a millimeter to several kilometers." (*The Biosphere*, 1926.)

Pasteur, Riemann, and the rules of the biosphere

Vernadsky distinguished three types of natural bodies in the biosphere: living bodies (animals and plants); inert bodies (rock, quartz, etc.); and bio-inert bodies (soil, lake water, etc.). At their death, living bodies undergo a transition into inert bodies (gases) and organic rocks.

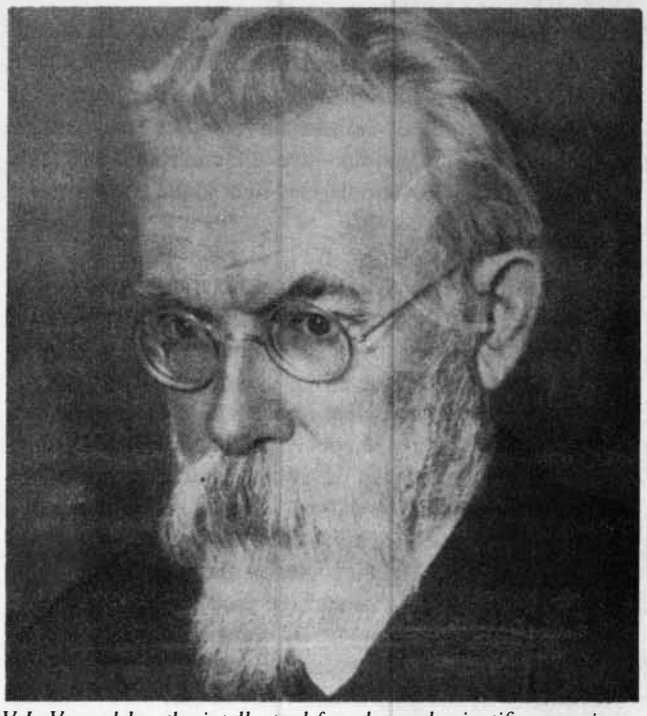
The fundamental distinction between living and inert bodies is threefold: 1) differences in energy organization; 2) differences in chemical manifestations; 3) differences in geometry and space time.

With regard to energy differences, Vernadsky asserted that, except for radioactivity, inert bodies decrease the free energy and increase the entropy of the biosphere. Living organisms, on the other hand, increase the free energy of the biosphere and decrease its entropy.

With regard to chemical differences, Vernadsky observed the following.

The chemical composition of inert natural bodies is a function of the medium in which they are created; the number of chemical compounds is limited; the chemical composition corresponds to nearly pure compounds with precise stoichiometric ratios between the elements; the isotopic ratios of terrestrial elements do not change except by radioactive disintegration; stability throughout geological time is overwhelming.

The chemical composition of living natural bodies is created by themselves. By nutrition and respiration they select



V.I. Vernadsky, the intellectual founder and scientific organizer of modern Soviet physics and the study of living matter. His research approach was one of "biogeochemistry": mineralogy, geology, and crystallography are subsumed by their participation in the "living" cycles and development of the biosphere.

chemical elements needed for their existence and for the creation of new living forms. Vernadsky called this the "autarchy of living matter." They are able to change the composition of their isotopic mixtures. The number of chemical compounds in living bodies is not limited. Living beings have extremely complicated mixtures of chemical compounds because the molecules are "chemically and physically bound to water" to the extent of 60-90% of all molecules. The elements of water—oxygen and hydrogen—dominate in living matter. In addition, the other prevailing elements of protoplasm are C, N, P, S, K, Na, Cl, Ca, Fe, Si, and Mg. The skeletal parts are dominated by Fe, Ca, Mg, P, S, N, C, H, O, Mn, and Si. Living organisms have the capacity to change isotopic ratios. Living bodies change their forms in the process of evolution.

The most dramatic differences between inert and living bodies, Vernadsky observed, occur with respect to space-time and geometry.

All physical-chemical processes in inert bodies are reversible in time. Vernadsky credits Louis Pasteur's work on "molecular dissymmetry" as the critical conception in distinguishing the curvatures of living from inert "space." Pasteur showed that the crystal state products of chemical reactions in which living organisms were not involved always generated an equal number of molecules of the same composition but some curved "left-handed" and others curved "right-handed." When living organisms were involved, however,

only the left-handed or right-handed isomer was produced, because the organism utilized the other curved molecule in the process of the reaction. Pasteur developed a method of distinguishing which of the two curved spaces was present by their optical interactions—the direction and degree to which they rotated plane-polarized light in the polarimeter.

As Vernadsky observed:

> The discovery of molecular dissymmetry, completely analogous to the dissymmetry of crystal polyhedra, thus made by Pasteur, had a far-reaching importance. It resulted in the creation of the whole new science of stereochemistry. With this there entered into chemistry the concept of asymmetry, or the absence of symmetry in the structural arrangement of atoms, surrounding a carbon atom. . . . Following Pasteur, P. Curie generalized the concept of dissymmetry, looking at the phenomenon discovered by Pasteur in organisms as its specific case, and applied it to basic physical phenomena, electric and magnetic fields, etc., as a fundamental postulate of physics. (*Problems of Biogeochemistry,* II, 1944.)

Vernadsky generalized the distinction between living and inert space-time in the biosphere in terms of the distinction between Euclidean and Riemannian geometry.

The space in which inert bodies reactions take place exists in Euclidean geometry—an isotropic or anisotropic crystal state.

Physical-chemical processes in living bodies, on the other hand, are not reversible in time. Vernadsky thought that this was the consequence of the fact that the processes occurred in a non-Euclidean geometry corresponding to the ideas of Bernhard Riemann, since living beings naturally were in constant transition from one geometrically characterized space into other spaces of different characterization.

Vernadsky wrote in 1938:

> We will start with the working scientific hypothesis that space inside living matter is different from that inside the inert natural bodies of the biosphere. The state of the former space is not confined within the limits of Euclidean geometry. Time may be expressed in this space by a polar vector. The existence of rightness and leftness and their physico-chemical inequality points to a geometry different from Euclid's, a special geometry of space inside living matter. From my discussions with the geometricians it became clear to me that a geometry corresponding to the conditions required has not yet been worked out. New research work by geometricians is needed. As suggested by Academician N.N. Luzin and Professor S.P. Finikov, it is possible that this would be one of the geometries of Riemann's type. . . . It is desirable that the attention of the geometricians be called to these questions. The research of the naturalists must always be based on the structures of the geometricians, in order to achieve regular development. On the other hand, the mathematical thought grows and reveals new domains when either the scientific thought or the environing life puts new problems before it. The geometrical character of the space occupied by living matter is one of such problems. It is distinguished by polar vectors (that is, the absence of a center of symmetry, or of complex symmetry) and the chemical non-identity of right and left stereo-isomers. The conspicuous absence in living organisms of flat surfaces and straight lines is characteristic; the symmetry of living organisms is marked by curved lines and curved surfaces, characteristic of Riemann's geometries. Another characteristic of Riemann's geometries is that they deal with space which is finite, closed, sharply differing from its environment. This corresponds to the aloofness of living organisms in the biosphere. Which then of the great number of Riemann's geometries fits in here? What are its properties? It seems to me that this problem must not be overlooked by our geometricians. It deserves their full attention even in itself, as a geometrical problem, and especially since it is connected with an even more general physical problem, that of the geometrical states of physical space, which has been touched upon but little by philosophical and physical thought. (Uzkoe, June 1938, *Problems of Biogeochemistry,* II)

Who was Vernadsky really?

V.I. Vernadsky (1863-1945) organized the scientific-technological basis of the Russian war machine for both World War I and World War II. Thus, he was effectively the Russian-Soviet approximation of "Lazare Carnot," the scientific genius behind Napoleon's victories, for *both* the World War I and War World II war mobilizations.

In 1911, his laboratory studies in the spectroscopic analysis of minerals were part of a national study of Russian radioactive elements funded by the Ledentsov Society. In 1915, Vernadsky emerged as the main spokesman of the KEPS—Commission for the Study of Natural Productive Forces of Russia—which had been established by the Academy of Sciences. Vernadsky personally created the National Resource Commission which mapped out Soviet mineral resources.

KEPS had a threefold mandate: a) to provide technology for industries central to war—e.g., explosives, aviation, military electrical instruments, poison gas, chemicals, medical supplies, etc., b) an interdisciplinary national mineral survey, c) to coordinate research through unifying scientific

manpower. Vernadsky emphasized the need to proliferate research groups and the relationship between the development of science and the national economy.

Based upon his close study of Pierre Curie's work, Vernadsky focused very early in the 20th century on the importance of atomic energy. Below are two selected quotes from his pre-World War I writings:

> Before us here are opening up sources of energy, which the power and significance of steam, electricity and chemical explosive processes pale. Mankind has entered a new age of atomic energy. (1910)
>
> We are approaching a great revolution in the history of humanity, which is beyond comparison in all its preceding history. The time is drawing near when man will harness atomic energy, a source of power which will enable him to shape his future at will. (1911)

In 1922, he became founding director of the Radium Institute in Leningrad. Almost immediately he left Russia. He went to the Curie Institute in Paris. He lectured at the Charles University in Prague, the Sorbonne, and M. Curie's Radium Institute. His work in France was funded by the *Rosenthal Foundation*. In 1926, he returned from exile to become director of the State Radium Institute in Leningrad from 1926-38. In 1926, he established a Department of Living Matter within KEPS and a Commission on the History of Knowledge within the Academy of Sciences.

In 1934, he organized and was first president of the Commission for the Study of Heavy Water. In 1937, he formed a Commission on Radioactive Dating. In 1939, he formed a Commission on Isotopes. In 1940, he became a member of the Special Committee for the Problems of Uranium (the wartime nuclear effort). The "Special Committee" included Academicians Vernadsky, Ioffe, Fersman, S.I. Vavilov, P.I. Lazarev, A.N. Frumkin, L.I. Mandel'stam, G.M. Krzhizhanovskii, Kapitsa. The "Special Committee" also included professors Kurchatov, D.I. Shcherbakov, A.P. Vinogradov, Yu. V. Khariton. Out of the 14 total, Khlopin, Fersman, and Vinogradov were Vernadsky's direct students. The committee's purpose was to revamp the nuclear program in all aspects. Throughout the late 1930s, Vernadsky championed the need for the Academy not to underfund the "cyclotron project." In 1944, Vernadsky's Institute under the direction of I.V. Kurchatov constructed the first cyclotron in Moscow.

A short biographical summary of Vernadsky's life follows:

1863 Born in St. Petersburg. Father was a professor of political-economy.
1888 Tours Italy, Germany, Switzerland, France, and Britain while studying crystallography and mineralogy.
1907 Trip to Scandinavia.
1908 Attends British Association of Science Conference in Dublin.
1910 Begins campaign in Russia for study of radium.
1911 Delivers keynote to Second Mendeleev Congress.
1913 Attends International Geological Congress in Toronto.
1915 Chief Spokesman of KEPS.
1918 Founds Ukrainian Academy of Sciences.
1922 Founds State Radium Institute.
1922-26 Exiled in Paris and Czechoslovakia.
1926 Returns to Leningrad to direct Radium Institute.
1927-35 Periodic trips to France, Germany, Holland, and Czechoslovakia.
1934 Moves to Moscow with transfer of Academy Center.
1937 Coordinates XVII International Geology Congress in Moscow.
1939 Forms Commission on Isotopes.
1940 Member, Special Committee for Problems of Uranium.
1945 Dies.

What is Vernadsky's conception of biogeochemistry?

Vernadsky's conception of biogeochemistry, which he first articulated in 1916 and continued to develop until his death in 1945, can be summarized as follows:

1) Living matter is distributed more or less uniformly on the surface of the Earth, which forms a layer that concentrates the "free energy" of chemistry, provided by the sun. Life on the Earth's crust is a series of layers or envelopes in which are contained the processes which define the "biosphere." The biosphere includes the entire atmospheric troposphere, the oceans, and a thin layer in the continental regions, extending down three kilometers and more.

2) The biosphere is distinguished by two processes: a) It is the domain of life; b) It is the region where transformations due to incoming radiation can occur. The unique physical, chemical, and biological characteristics associated with life in the biosphere can be thought of as an ensemble of nested envelopes concentrated at the Earth's crust. The study of these envelopes has the highest importance in understanding the interrelated processes of biogeochemistry.

3) There is an incessant and regular movement of elements from one envelope to another, a movement which is eternally renewed. In the biosphere, there is a continual migration of atoms from inert matter to living matter and back again. All of the migration of atoms between inert bodies and living natural bodies—what can be called "biogenic migration" and "biogeochemical energy transfer"—are determined by the volume, chemical composition, and energy of the biosphere. Therefore, the properties of all existing organisms, in turn, are strictly determined by the structure of the biosphere. It is usually forgotten that living organisms are a

regular function of the biosphere. The living organism and the medium are not two independent, contrasting objects.

4) Usually in the examination of the biosphere, the single living organism recedes from view; the sum of all organisms, i.e., living matter, is what is important. However, from the standpoint of the activities of modern man, a single personality can determine planetary biogeochemical phenomena. A single individual can change or accelerate geological processes of immense importance. For instance, man can create new biogeochemical processes which did not exist before. Previously non-existing elements can be created in quantity. Animal and vegetable life is radically altered, and new species can be created.

5) The biosphere is the only envelope of the planet into which cosmic energy penetrates, transforms the envelope, and is itself reorganized. What is the primary source of the creation of living matter? Living matter accumulates the energy of the biosphere from both the light and chemical energy of solar radiation as well as the chemical energy of terrestrial atoms. Nuclear radiation may also play an integral part. The scientific basis exists to precisely study these envelopes as heterogeneous equilibrium "fields." In general, one can take for the parameters of the equilibrium in a given field the temperature, pressure, and other variables such as the chemical composition and physical phase state of matter and the nature of their electromagnetic fields in relation to the total electromagnetic field of the Earth. Each of the fields can be characterize by its own thermodynamic laws.

6) Natural phenomena are much more complex than the traditional theories of thermodynamic equilibrium. In reality, the envelopes are not characterized by equilibrium theory but by a series of variables unknown in the standard theory—namely, the flow of magmas, the dispersion of the chemical elements and, of course, living matter. "Biogeochemical energy" may be expressed in the velocity with which the biosphere could be colonized by a given species.

7) Within the biosphere, matter is either living or inert. Living matter can be regarded as matter that is in an "active state" because it can accumulate and process solar energy—its radiation and heat—in chemical energy and molecular movement. As Louis Pasteur discovered, the most general property of living matter and its products is its optical activity.

8) The skin of the earth is not an inert mass of matter, but a complicated mechanism which, by the intermediary of matter in an active state, holds the atoms of the crust in energetic and incessant movement.

9) One may distinguish in the biosphere three types of natural bodies: living bodies (plants, beetles, etc.); inert bodies (rock, quartz, etc.); and bio-inert bodies (soil, lake water, etc.) The biosphere consists of clearly delimited regions formed by living, inert, and bio-inert bodies. The transition of living bodies into inert bodies occurs at death, when a living body ceases to exist as such, and organic rocks and inert bodies (for example, gases) are formed. Spontaneous generation or the formation of a living body from inert bodies has not been observed.

In the mid-1930s, Vernadsky summarized his approach in a two-part essay entitled, "Problems of Biogeochemistry: The Fundamental Matter-Energy Difference between the Living and the Inert Natural Bodies of the Biosphere":

> The foundations of biogeochemistry rest on a few basic concepts free from hypothesis and representing precise and clear scientific ideas, empirical generalizations derived from experiment and observation. To begin with, the very concept of the *living matter* of the biosphere is such an empirical scientific generalization. The living matter of the biosphere is the sum of its living organisms. Hereinafter this concept will be employed rather than the concept of "life." Usually, in the examination of the biosphere, the single living organism recedes from view; the sum of all organisms, i.e. living matter, is what is important. However, even in biogeochemistry, in certain strictly defined cases,

Selected bibliography of Vernadsky's works

1904 *La Radiographie*
1904 *Foundations of Crystallography* (Moscow, in Russian)
1916 *On the Utilization of Chemical Elements in Russia*
1922 *Essays and Addresses* (Leningrad, in Russian)
1924 *La Géochimie* (Paris, in French)
1925 *The History of the Minerals of the Earth's Crust*
1926 *Biosphere* (Leningrad, in Russian); **1926** (Paris, in French)
1930 *Works of the Biogeochemical Laboratory* (Leningrad in Russian)
1934 *Studies in Geochemistry* (Moscow in Russian)
1935 *Problems of Biogeochemistry I* (Russian) and **1944** (English edition)
1937 *On the Limits of the Biosphere* (Russian)
1938 *Problems of Biogeochemistry II*
1940 *Biogeochemical Essays* (Moscow, in Russian)
1940 *The Evolution of Species and Living Matter*
1942 *On the Geological Envelopes of the Earth as a Planet* (Russian)
1944 *Problems of Biogeochemistry, I and II* (English) Posthumous
1945 *The Biosphere and the Noösphere* (English)
1954 *Essays in Geochemistry* (English)

one has, at times, to consider the individuality of single organisms. This is inevitable in cases involving the activities of modern man, when a single personality sometimes clearly manifests itself in large-scale phenomena of planetary character, by changing and accelerating certain geological processes of immense importance. We live in an unprecedented, geologically significant epoch. Man by his work, and his conscious attitude toward life, is remaking a terrestrial envelope, the geological domain of life, the biosphere. He is transforming it into a new geological state, the noösphere. He creates within the biosphere new biogeochemical processes that did not exist before.

During the 1990s and on into much of the 21st century, the decisive discoveries in biology, general science, and space exploration, as well as military and economic technological applications, will occur in this area of science, variously known descriptively in the West as "optical biophysics," the "non-thermal effects of shaped bioelectromagnetic fields" or the "non-linear spectroscopies of living tissue."

While this area of work continues to be downgraded in the West as "off the main line," the Soviets are continuing their systematic research based on a seven-decade commitment.

Such disparities may in fact prove decisive as to who rules the world in the 21st century.