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## VLADIMIR VERNADSKY'S 160<sup>th</sup> ANNIVERSARY

Standing at the Pinnacle of Russian Science: Vladimir Vernadsky at 160

by William Jones, August 2, 2023

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March 12, 2023 was the 160<sup>th</sup> anniversary of the birth of the great Russian-Ukrainian scientist, Vladimir Ivanovich Vernadsky. Vernadsky was born in St. Petersburg, the son of a noted Russian family with its roots in Ukraine. His grandfather, Vasili Ivanovich, descended from a Zaporozhia Cossack family, had been a medical doctor in the Russian Imperial Army and had served under Generals Suvorov in the Italian campaigns against France as well as under Marshal Kutuzov in the war of 1814. Vasili Ivanovich was also instrumental in promoting the establishment of the first major university in Ukraine, Kiev University. Both Vladimir's parents were born in Kiev, and his father, a noted economist, was the first to introduce the work of American economist, Henry Carey in his lectures at Kiev University and later at Moscow University.

At a young age, Vladimir was introduced to the wonders of the galaxy by a cousin, Evgraf Korolenko, who would take him out at night near his home in Poltava, Ukraine, to observe the night sky, about which the self-educated Korolenko had many stories. In a letter to his then-fiancé, Natalia Yegorovna Staritsky, in 1886, Vernadsky wrote: "The Milky Way fascinated me and on these evenings I listened as my uncle talked about them. Afterwards, for a long time I couldn't fall asleep. In my fantasies, we wandered together through the endless spaces of the universe...these simple stories had such an immense influence on me that even now it seems I am not free of them...It sometimes seems to me that I must work not only for myself, but for him, that not only my life, but his will have been wasted if I accomplish nothing." While the professional work of Vernadsky

would be primarily associated with what we call the “earth sciences”, the galactic dimension of these was never missing, and would achieve a crowning role in his last unfinished opus, *The Chemical Structure of the Biosphere and Its Surroundings*.

The Vernadsky family was also deeply involved in Ukrainian culture. Both parents could speak Ukrainian and his mother, a professional singer before her marriage, would often sing Ukrainian songs at gatherings in their home in Kharkov, where his ailing father transferred after a stroke that ended his career at Moscow University. As Vernadsky attests, his father had “strong and clear Ukrainian sympathies.” The family had a long tradition of sympathy with the Decembrist uprising, an uprising of Russian officers against the autocratic Imperial regime, and there was a portrait of George Washington hanging in the their home. The southern grouping of Decembrists also included many officers of Ukrainian background and helped laid the basis for the movement for Ukrainian autonomy, which from the middle of the 19<sup>th</sup> century was suppressed by the Empire under Nicholas I.

Vladimir’s father also saw to it that his son became acquainted with the Ukrainian language, Ukrainian culture and Ukrainian literature, often purchasing Ukrainian books on their trips to Europe. While he was in the gymnasium in Kharkov, young Vladimir immersed himself in the work of Alexander von Humboldt, reading Humboldt’s 5-volume *Cosmos* and his *Ansichten der Natur* in the original German. The lessons of Humboldt’s kaleidoscopic vision of the realm of nature would not be lost on the young student, who himself never lost the sense of the great expanse of the galaxy, which would play such a central role in his last major opus. From the gymnasium in Kharkov, he registered for classes at St. Petersburg University in 1884.

### **Vernadsky’s University Years**

This was something of a golden age at the university in St. Petersburg, particularly in the Faculty of Physics and Mathematics, where Vernadsky studied, with such leading lights as D. I. Mendeleev and A. M. Butlerov in chemistry and V.V. Dokuchaev, the father of soil science, who would take the soon-to-be

professor under his wing. Vernadsky always said that he did not want to be restricted to one science, and the future would show that he encountered, and would make contributions to, innumerable sciences during the course of his scientific life. He began his work in crystallography, later writing a basic text on the subject, but soon transferred to mineralogy, a science which at that time was largely a descriptive science.

Vernadsky, however, was particularly keen on studying the actual genesis of minerals rather than pursuing a simple investigation of their structure and properties, which previously dominated the field, thus providing a new depth to the study. Vernadsky's interest in the formation of minerals as opposed to their simple morphology was further stimulated by his work under Dokuchaev, who underlined the significance of soil as a different form of "earth", bringing into focus the work of "living matter", which would become the primary subject of Vernadsky's life work.

But Vernadsky was far from simply engaging in a fruitful scientific career. This period in Russia was a period of intense political turmoil and activity, and Vernadsky found himself in the midst of it for a time. The reforms of Alexander II in abolishing serfdom still left a country that was ensconced in a tightly run autocratic system. Vernadsky's father, Ivan Vasilievich, had been a major force in pushing reforms of the economic system which would help lay the basis for the Witte system of Russia's industrial development in the 1890s, but the lack of political freedom and the continued existence of an immense peasant class still ensconced in poverty and in which the old landed aristocracy still continued to hold sway was grist to the mill of young radicals like Vernadsky.

One major element in the political reforms of Alexander II had been the creation of the *zemstvos*, elective political bodies in the countryside which were open to popular representation. Vladimir had, together with friends he had made at the university, organized themselves into a humanitarian group with the aim of improving the conditions of life of the Russian peasantry. They called themselves the *Bratstvo*, or Brotherhood. They were also generally sympathetic to, and studied, the ideas of Leo Tolstoy, and worked personally with Tolstoy in famine

relief efforts during the famine of 1891-92. Vernadsky was very active himself in the *Zemstvo* movement, and on many of his trips to conferences in Europe was also actively involved in surreptitiously organizing a political movement. By 1905 when the growing turbulence led to a call for a constitution, this organization would become the basis for the Constitutional Democrats, the *Kadets*. While the party remained rather small and consisted largely of the professional classes, Vernadsky was elected a member of the party's Central Committee and a member of the Duma, which was created after the 1905 Revolution. Vernadsky's home was the central hub of the *Kadet* Party in Moscow. As a member of the Duma, he also put forward legislation, some of which passed into law.

In 1909, on one of his visits to Dublin for a conference, he attended a lecture given by John Joly on the latest developments in the recent discovery of atomic science. Vernadsky immediately understood the tremendous significance of this discovery, a revolution in human knowledge, and in 1910 he wrote one of the most remarkable papers on the implications of that discovery, entitled simply "The Task of Today in the Area of Radium". Here he paints a picture of how that discovery by Becquerel in 1896, had changed the course of history for mankind, giving extensive background to the discovery from the 17<sup>th</sup> century on. He described it as a force never yet seen by mankind, and noted that developing its potential would help to deal with many of the ills facing humanity. "In the phenomenon of radioactivity we anticipate a source of nuclear energy which is millions of times greater than any energy resources that mankind had been dreaming of," he wrote. He called for the rapid development of nuclear energy, outlining its implications in the realm of energy, scientific research, in medical treatment. His suggestion later for its use in treating cancer, at this early stage, was rejected out of hand by the disbelieving medical personal who still couldn't fathom the tremendous force that had been unleashed by this discovery. The first task to be accomplished was to determine as quickly as possible all the sources of uranium in the Russian Empire. Not to be detained by much of the skepticism toward his proposal, he set off personally with a few colleagues on an expedition to the Fergana Valley region to look for uranium. He had also suddenly become free from his other occupations since he, along with 21 other professors as well as the



rector, had resigned from Moscow University when the government started sending in agents to arrest students suspected of engaging in “radical activity.”

When the war broke out in 1914, Vernadsky, still in the Duma, was working to bring science to bear in the war effort. Through a chance meeting abroad with Professor A. P. Pavlov, a noted geologist and paleontologist, Vernadsky had been offered the post of heading up the Mineralogical Museum in St. Petersburg, the institution which had been established by Peter the Great as the first scientific collection in Russia. In 1915, Vernadsky proposed the establishment of the Committee for the Exploration of Productive Resources in the Empire (KEPS). In continuing the war and with restrictions on imports, the country must know what physical resources were available to it domestically. Vernadsky was named chairman of KEPS and would remain so until 1930 when it would be reorganized under another name.

### **Promoting Science in Ukraine**

Also at this time in the Duma, Vernadsky was also working with his colleagues in the Academy of Sciences to create a National Academy of Sciences in both the Ukraine and in Georgia, both then part of the Russian Empire. During the events of 1917, Vernadsky's position became somewhat precarious. In 1918 when the Bolsheviks began a campaign against their opponents, members of the Kadet Party were beginning to be portrayed as “traitors,” and arrests and imprisonments began. Vernadsky, who felt that whatever the results of the present turmoil might be, the Russian Empire was at an end, and he decided to retire to his property in Ukraine, which at that point was no longer a part of the Empire. German troops occupied a good part of it, and a variety of other political groupings, both foreign and domestic, were trying to bring it under their control.

Whether independent or as a part of a reunited Russia, Vernadsky felt that Ukraine should play its role in the scientific arena. While he was supportive of the use of the Ukrainian language, which he himself spoke, and the proliferation of Ukrainian culture, he felt that the connection to Russia was vital for Ukraine's development, whether it ended up as an independent nation or again became a part of the new Russia. Knowing his views, he had been asked by Ukrainian friends to

come to Kiev to help set up such an Academy, which he proceeded to do from 1918 to 1920. The Academy was formed in 1920 and Vernadsky was elected its first president. His insistence on maintaining the use of both Ukrainian and Russian as a part of the Academy's work, was essential for a fruitful outcome. At the same time Vernadsky had had to fight tooth and nail in founding the academy against the radical nationalists who wanted complete "Ukrainization" and wanted to eliminate the Russian language and culture in a country in which the majority of people had Russian as their native language. Vernadsky characterized this attitude as "zoological nationalism," or racism. In a letter to his daughter, Nina, in 1922, Vernadsky wrote, "I feel I should write you about the Ukrainian situation...it's in the hands of people who have a narrow fanatical opposition to Russian culture. Partly crazy, and partly simply people of low caliber. Small people. The controversy about Ukrainization is a question of a connection between Russian culture or Polish culture. Ukraine exists and will continue to exist. It's important that the Dontsovs and the KO ? are not in the lead." [Dontsov was the intellectual predecessor of the Stepan Bandera crowd].

As the Bolsheviks began to win ground in Ukraine, and were approaching Kiev, Vernadsky decided to retreat to the still independent Crimea where his wife and children had already sought refuge from the war. Vernadsky was stricken on his arrival with typhoid fever. And, as he explains, in his sometimes half-delirious state he suddenly came to the realization of his greatest scientific discovery, the real nature and workings of living matter in the universe, the elaboration of which then became his life's vocation.

While recovering, Vernadsky was asked to become the rector of Tauride University in Simferopol, Crimea, after the death of its rector. There were many Russian intellectuals in exile in the region and a dearth of teachers at the university, many killed during the war or victims of typhoid and other diseases. But it required organizing a stable working cadre. Vernadsky, intent on maintaining a center of Russian culture coming out of the chaos of the war, accepted the post. He established there what was the first independent university in the former territory of the Russian Empire as a center of Russian culture and language. Today this is the Vernadsky Crimean Federal University.

While he was in the course of this reorganization, he was also considering his options for achieving a position where he could begin his investigations on the study of living matter. He put in inquiries about the possibility of creating a laboratory for this purpose in Great Britain and in the United States, where his son – and, eventually, his daughter - were headed, but with little result. He also inquired among his colleagues back in Russia, of the possibilities of doing science under the new Bolshevik regime. Then, at the end of 1920, Bolshevik forces under the fierce Bela Kun, occupied Crimea. Vernadsky, along with other Russian intellectuals, was placed in confinement. His fate seemed uncertain. Under Bela Kun, there were incarcerations as well as summary executions. But the wheels were turning in Moscow, and the authorities in Crimea were informed by Moscow that a special train would be arriving in Crimea to pick up a number of Russian intellectuals held in custody there, including Vernadsky and his wife.

### **The Eternity of Life**

Immediately back in Moscow, again after another brief arrest, which was canceled after an appeal of his colleagues to the Bolshevik authorities, including to Lenin himself. Vernadsky began to elaborate his ideas on “living matter.” He gave a lecture entitled “The Beginning and Eternity of Life”. In it he posited the view, in accordance with the views of the 17<sup>th</sup> century Italian physician, Francesco Redi, that life, or living matter, only came from life, and for Vernadsky might well be coeternal with energy and matter. The notion that life could be found anywhere in the universe and that it had not been generated “spontaneously” from non-living matter went against everything that was (and is still) being taught in biology. “Life is eternal,” Vernadsky wrote, “to the same extent that the Cosmos is eternal, and is always transmitted through biogenesis. That which has been the case for tens and hundreds of millions of years stretching from the Archean period to our days, is also true for the incalculable course of time of the cosmic periods in the history of the Earth. And it is also true for the Universe.” Needless to say, the lecture did not win many adherents, but the die had been cast!

In 1922 Vernadsky was invited to lecture at the Sorbonne in Paris, a city where he had spent many happy years already as a university student. He was

allowed to travel abroad as he generally would be until 1936. Although his time in Paris was limited, he would in fact remain there until 1926. This Paris period was extremely important for Vernadsky and for the development of his ideas. Here he became acquainted with the paleontologist and theologian, Theilhard de Chardin, and the ethnologist and philosopher, Eduard LeRoy, both of whom were influenced, as was Vernadsky initially, by the philosophical treatises of French philosopher, Henri Bergson, and his book, *Creative Evolution*. LeRoy had characterized our present epoch as the Noosphere, a term that Vernadsky would borrow to explain his own unique ideas about the present state of the universe. Vernadsky would soon place his own concept of the Noosphere on a firm scientific basis and leave the mercurial realm of philosophy, which Bergson inhabited. Vernadsky held a few lectures on the subject of geochemistry, a new science of which he can well be considered one of the founders. LeRoy and Chardin were both in attendance for these. These were later published in French and were the beginning of Vernadsky's international reputation. He would also in Paris conduct studies on the rate of production of various life species which would form the basis of his later publication, *The Biosphere*.

The years in Paris were also spent at the Curie Institute, headed up by Marie Curie, alone in charge after the tragic death of her husband, Pierre, in a car accident. At the Curie Institute Vernadsky was able to deepen his knowledge of the nature of nuclear energy and could examine samples of uranium from the Congo which were available at the Institute. Also, through discussions with Marie Curie, he also became aware of Pierre Curie's studies of Louis Pasteur's work in investigating the phenomenon of chirality in living processes. In inorganic matter the fundamental symmetry of compounds seems to always apply, that is, they appear in both right-handed and left-handed forms. This is not the case in compounds of living matter. They are generally left-handed only. Why was this the case? This was the issue that fascinated Pasteur. And it was later taken up by Pierre Curie who characterized the phenomenon not as dissymmetry, as Pasteur called it, a category from crystallography, but rather as a different *state of space*. Pierre had no time during his short lifetime (he was killed in a traffic accident in 1909) to pursue the matter as the pressing requirements of investigating the atom had taken



up most of his time, and Vernadsky felt that this issue was of great importance in understanding the nature of the universe and therefore something that deserved looking into, which he would pursue until the end of his life.

When the Academy said that he return in 1925, Vernadsky insisted that he must stay longer since he was in the midst of formulating some ground-breaking ideas. He was working on the final touches of his work *The Biosphere* and he wanted to give two lectures on the topic of symmetry in science, encompassing his reflections on the work of Pasteur and Curie. Undoubtedly, using Paris as the backdrop for these issues would assure it a more rapid proliferation in the scientific community. He was granted an extension.

Back in St. Petersburg (then Leningrad) in 1926, Vernadsky plunged into his work. No longer with the Mineralogical Institute, he concentrated his activity on the Radium Institute, which he had succeeded in establishing in 1911, and on KEPS. He wrote the guidelines for the development of work at the Radium Institute on atomic energy. In May 1926, Vernadsky's *The Biosphere* was published in Russian in 2000 copies. (It had already been published in French.) The book received positive reviews, including one by Maxim Gorky.

In addition to his scientific work, Vernadsky was also a contributor to the history of science and the history of science in Russia. As a young professor he had given lectures on the history of science, underlining the period of the great discoveries in the 15<sup>th</sup> and 16<sup>th</sup> centuries, including the contribution of Nicholas of Cusa, whose works he had found as a teenager in the library of his father. He helped revive the reputation of Mikhail Lomonosov, the first major Russian scientist, in a tribute to him in 1900 on his contributions to mineralogy and geology. During his days as lecturer, he had also given lectures on the history of the Academy of Sciences from its founding by Peter the Great (at the urging of Gottfried Leibniz) until his own period.

In 1927 Vernadsky was in a delegation to Berlin to celebrate "The Week of Russian Scientists and Russian Science" which was also attended by Albert Einstein, then still working at the Kaiser Wilhelm Institute. In Germany, Vernadsky gave a lecture on "The Geochemical Energy of Life in the Biosphere."

This led to the German translation of his work “Geochemistry” which had previously appeared in French. Vernadsky would also visit Germany the following year where he visited Otto Han and Lise Meitner at their institute at the Kaiser Wilhelm Institute to learn of the latest developments in atomic research. On this trip he again visited Paris where he looked at the new facilities at the Curie Institute, stopping on his way home to visit the Radium Institute in Prague. In 1928 the Soviet Academy of Science established Vernadsky’s long-awaited Biogeochemical Laboratory in St. Petersburg, the first of its kind in the world.

In 1929, Vernadsky established a Commission for the Study of Permafrost, which he also chaired. That same year he called for an investigation of cosmic particles, establishing another commission within the Academy of Sciences chairing that as well. In 1931, Vernadsky gave a lengthy report: “The Problem of Time in Contemporary Science” where he proposed radical change in our understanding of space and time in physics, which had been determined solely in Newtonian and Euclidean terms, in the light of discoveries in the atomic realm and advances in astronomy. This was attacked by some of the Academy members who felt it was undermining the official dialectical materialism.

In 1932, Vernadsky gave a presentation on radiogeology. A commission had already been set up on his recommendation to study the possibility of using nuclear processes to determine the age of material deposits. He was made the chairman of that commission. In 1934 he was again abroad lecturing on radiogeology at the Radium Institute in Prague and the Radium Institute in Warsaw. In May he attended the All-Russian Conference on the study of the stratosphere, delivering a lecture “The Stratosphere and the Biosphere.” Also the same year, Vernadsky’s “Problems of Radiogeology” was published in French.

In 1935 Vernadsky published a plan for the study of meteorites. In 1927, Vernadsky had already become interested in the study of meteorites and had arranged to have colleague his colleague, Leonid Kulik, who had accompanied him on his uranium search in Kazakhstan in 1911, to visit Siberia on an expedition to investigate a meteorite which had come down there in an area near Tunguska. In

1938, a Committee on Meteorites would be created within the Academy of Science and Vernadsky named its chairman.

In 1936 a jubilee was prepared for celebrating Vernadsky's 50 years as an academician, even against his objections for such an affair. Greetings were sent from many of his colleagues, A.E. Fersman, A. P. Vinogradov. B.G. Khlopin, I.V. Kurchatov and many others. Congratulations also came from scientists of international fame like Max Born. Otto Hahn, and others. Again this year, he was on foreign travel [his last] where he went to Paris, London and Prague. Writing to his colleague, Alexander Fersman, he noted that he was again studying the works of Pasteur, to delve further into the issue of symmetry, which he considered so important - and neglected - since the death of Pierre Curie. Vernadsky had repeated Pasteur's experiments at his Biogeochemical Laboratory, and had assigned Georgi Gause to continue this work, the results of which Gause published in the U.S. under the title "Optical Activity and Living Matter."

In 1938 Vernadsky published his first major attempt to systematically explain his view of the Noosphere. It appeared under the title, *Scientific Thought as A Planetary Phenomenon*. This incorporated the sum of his views up to that point regarding the evolution of man and man's new role in the propagation of the biosphere. It was also decided that year to form a Commission on the Investigation of Heavy Water under the Commission on Isotopes. Vernadsky was named the chairman of that commission as well.

### **The War Years**

In 1940 Vernadsky gave a speech in memory of A.P. Pavlov, the person who had first helped him find a post in Moscow after the protests had left him without a position in St. Petersburg University. Pavlov was also one of those people who, like Vernadsky, believed that mankind had now entered into an era in which man's activity was now fundamental for the continued development of the universe. Pavlov had called it *the anthropogenic era*. In his memorial address, Vernadsky also referred for the first time to the work of the American scientist, James Dana, who had introduced the notion of cephalization, the development of the brain leading to the evolution of *homo sapiens* and the beginning of the noosphere.

In 1940, Vernadsky again began to put pressure on the authorities to move quickly in the area of atomic energy, which he also realized could be developed into a weapon. He was concerned that the authorities had not moved more quickly on his proposal to find all the uranium deposits on the territory of the Soviet Union.

When the Germans invaded Russia in June 1941, Vernadsky and his wife were in Uzkoie, a sanatorium outside Moscow. Vernadsky had developed heart problems which would plague him on and off for the remaining years of his life. It was clear to him that the war was an historical turning point, although he never faltered in his belief that Russia would succeed in crushing the invaders. He also feared that the Germans would be coming with gas and possibly with some sort of nuclear weapons, aware of the advances that had been made in the field in Germany before the war. A meeting was held at the Presidium of the Academy of Sciences in mid-July 1941 which Vernadsky attended. Those attending were asked to put forward their ideas in assisting the war effort. Vernadsky again pushed for quickly finding major uranium resources in the country. Vernadsky thought the idea had not been properly understood by the authorities, but on July 30 at another meeting of the Presidium, a Commission on Uranium Issues was formed with Vernadsky's colleague at the Radium Institute V.I. Khlopin as chairman. The Commission included Vernadsky, A.F. Joffe, Fersman, S.I. Vavilov, P.P. Lazarev, A.N. Frumkin, L.I. Mandelstam, P.L. Kapitsa, Vernadsky's colleague, Alexander Vinogradov, I.V. Kurchatov, and Iu. B. Khariton. Vernadsky and Joffe were made deputy chairmen. In November 1942, Vernadsky wrote: "It is necessary to seriously and extensively establish the development of nuclear energy of actin-uranium." He called for the quick discovery of uranium in the country and as soon as possible the utilization of a few kilograms of uranium "for experimental work with practical applications". "We need to quickly solve the dilemma regardless of whether we are, as I and many other geochemists and physicists believe, in the wake of a new era of mankind," Vernadsky said, "with the application of these new forms of atomic energy. In the light of the devastation that Nazi barbarians have wreaked on the national economy, we need to find out if it is realistic and beneficial to utilize this form of energy."



During the course of the war he would continue to complain that things were moving too slowly in this regard. There was also tension between the Vernadsky group and the physicists. In his diary, Vernadsky had written: "I pointed out to him [one of the Academy vice presidents] that now obstruction was caused by the physicists (Joffe, Vavilov – I did not name names). They are directing their efforts to the study of the atomic nucleus and its theory and here...much of importance is being done – but life requires the mining-chemical direction." Two weeks later he wrote: "The physicist directs his attention to the theory of the nucleus, and not to the real task which face the physical chemist and the geochemist – the separation of isotope 235 from uranium." Vernadsky was also clear about the possible use of atomic energy as a weapon. In a note to V.L. Komarov, the president of the Academy of Sciences of the USSR, on March 13, 1943, Vernadsky wrote. "I consider it necessary to revive the activity of the Uranium Commission with the view towards using uranium for military purposes as well as the necessity of quickly rebuilding from the destruction that the Hitler barbarians have dealt to our country." It seems, however, that Vernadsky and some of the other "graybeards" in the Academy were ultimately left out of the real decision-making and the more politically reliable Adam Joffe was put in charge of the program, which he then wisely transferred to the more capable hands of Ivan Kurchatov. The discovery of the details of the U.S. program through espionage had also given a boost to their efforts and put them on the same track as the Americans.

Vernadsky, who would become 80 in 1943, was also busy working on the major questions he felt he had to resolve: the issue of space-time as expressed in biogeochemistry, elaborated in a series of papers entitled *Problems of Biogeochemistry* and the other was a major work examining the development of the Earth from the standpoint of living matter in the galaxy. *The Chemical Structure of the Biosphere and Its Environment*. He was also working on a chronology of his family and his life which was meant for posterity.

In these works, Vernadsky elaborated his final ideas which he hoped would be published both in Russian and in English. The one dealt with the galactic nature of life. If life were not a product of abiogenesis here on Earth, it had to be brought to Earth from somewhere else, perhaps in the form of cosmic particles. This

assumes, or course, as Vernadsky posited, and is generally believed today, that life existed elsewhere in the universe. He also dealt, in detail in *The Chemical Structure of the Biosphere and Its Environment*, with the notion that life is a constituent element in the formation of the Earth, penetrating even below the biosphere into the granitic core of the Earth through the migration of atoms from living substances interacting with atoms of non-living substances.

The other major issue was the issue of space and time in biology, or as Vernadsky put it, space-time. This was not the same as Einstein's space-time in his "thought experiment," but rather the fact that the naturalist finds in his own sphere phenomena which do not coincide with the Euclidean notion of space and time. This was most striking in the phenomenon that Pasteur encountered with the lack of symmetry in living matter. During his final period, Vernadsky was again looking at the writings of Pasteur, attempting to continue the path laid out by Pierre Curie in viewing the phenomenon as a different "state of space." And Vernadsky seemed to indicate that as we proceed further in our study of the galaxy, we may well come across other phenomena that also cannot be characterized by Euclidean geometry and thus represent different "states of space."

In 1943, his wife, Natalya, died. She had spent her time assisting him in his work and taking care of him during his convalescence. It was a major blow, but it spurred him on to finish his last work, to which she had devoted so much of her efforts. In March on his 80<sup>th</sup> birthday, Vernadsky was awarded the Stalin Prize and received a personal message from Stalin. Half of the money which came with the award, he returned for the war effort. He also sent Stalin his "Notes on the Noosphere" which he also asked be published in Pravda. Stalin never replied (if indeed he ever received Vernadsky's letter) and Pravda never published it, but it was published in a scientific publication, "Achievements in Contemporary Biology." In Ufa, a celebration of Vernadsky's 80<sup>th</sup> was held by the Physical-mathematical Department of the Ukrainian Academy of Sciences, with reminiscences of Vernadsky's work in the founding of the Ukrainian Academy. An academician from the Georgian Academy of Sciences also wrote Vernadsky on this occasion: " I look at myself as a popularizer of your ideas and my task is to

make them known to the younger generation. We, your former students, carry through life with solicitude the fire you ignited in us and try to light it in others.”

As the Germans had advanced on Moscow in 1942, Vernadsky and other scientists had been evacuated to safety. Vernadsky was in a sanatorium in Borovoy in Kazakhstan. But in August 1943, with the threat receding, Vernadsky was brought back to Moscow for the last time. In September he was again attending meetings of the Academy and seeing friends that he had not seen for two or three years. He was busy preparing the first part of his magnum opus, *The Chemical Structure of the Biosphere and Its Environment*, for publication. He was also optimistic about the future. In December he wrote B.I. Lzhkov: “I am completely under the pressure of thoughts - over the direction of the historical process. These stem from the psychozoic era. I am now delving very deeply into the noosphere, and it seems that I am empirically approaching a real foresight of new discoveries in science – of the future of mankind in one or two generations.”

In 1944, the final year of Vernadsky's life was also full of activity preparing the country for the future after the war. The scientific institutes under the Academy of Science had to be put into full operation in order to accomplish the post-war task of rebuilding the nation, he insisted. He also worked intensively on the scientific and organizational activity of two laboratories in particular, the Laboratory for Geochemical Problems and the Committee on Meteorites. Vernadsky proposed building an observatory in Alma Aty in Kazakhstan. His final paper, his “swan song,” as he called it, was dedicated to “The Manifestation of Mineralogy in the Cosmos.” He also received word from his son that his “Notes on the Noosphere” would soon be published in the U.S. [Scientific American, January, 1945], for which he was very happy. He also completed the first two parts of his *Chemical Structure* book. Part I: The Geological and Geochemical Manifestation of the Earth as a Planet in the Solar System and the Milky Way. The biosphere in its relationship and connection to the geological envelopes of the Earth; and Part II: The Geochemical Structure of the Biosphere. The planetary role of living matter. Part III was to deal with the Noosphere, but it was never written. Vernadsky called this his “Book of Life” and considered it in the direct tradition of Humboldt's monumental “Cosmos” which had been so important to him in his formative years.

During his last days, his secretary Anna Shakovskaya, the daughter of a close friend during his student years and later, who had been executed during the recurrent purges, was reading to him from Pushkin's "The Captain's Daughter" and "Dubrovsky." Vernadsky recorded in his diary. "Yesterday, Anna was reading to me from "The Captain's Daughter" and I enjoyed it immensely, the simplicity and clarity of his [Pushkin's] depiction of life, which was at the same time so profound and so similar to what we are now experiencing. In that context Pushkin can only be compared to Tolstoy in his productions"

**Vernadsky died on January 6, 1945.**

A fitting tribute was given Vernadsky by the great economist and statesman. Lyndon LaRouche in a visit to Moscow in 2014 at the Russian Academy of Sciences on the occasion of the 90<sup>th</sup> birthday of Russian scientist and LaRouche friend, Pobisk Kuznetsov. "The urgent matter immediately before us, is that of the present follies among the nations, errors which must be corrected by a proper order in the cooperation of the willing nations immediately among us. In brief, we must act to end war as a global institution, an institution which must soon become, itself, relegated effectively to the past. We now face the reality of the presently rising threats of a global potential which menaces our planet with the threats of thermonuclear warfare's capability to bring about the summary extinction of the human species, which demands that we lift our passions above the notions of massed warfare. We should have recognized, and overcome such warfare in earlier times. To accomplish that purpose, a new order among sovereign nations, ending the influence of modern oligarchical empires in the Zeus tradition, is presently a virtually immediate precondition for the continuation of human existence itself. The work of Vladimir Ivanovich [Vernadsky], when suitably considered by actually qualified scientists in these subject matters, must be presently re-considered with the greatest regard for relevance, and, therefore, must be considered from a retrospective view of the imperfections of previous customs. What is wanted presently, is a prescience which reaches beyond the ordinary notions of past experiences respecting the ordinary past notions of our Solar system.



“Now, instead of mere notions of “space and time,”” LaRouche went on, “the fact of the inherent immortality expressed by the very fact of successively progressive generations of the human mind, as such, shows that there is no proper solution to be found within the bounds of the behavior within the animal kingdom,” LaRouche said, “but only the creative powers of mankind which no lower form of life could express.”

As the issue of the value of human life is being place into questions today in an extremely dramatic form by the great earthquake in Syria and Turkey and by the extension of the NATO war in Ukraine which is threatening to evolve into a nuclear holocaust, it is all the more important that the ideas of Vernadsky of the Noosphere serve as the basis of a new paradigm for mankind in which the nations of the world can begin to work together for the common aims of mankind.

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