V. A Vernadskian Reconsideration of Galactic Cycles and Evolution

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The following was originally written as a stand-alone article, but is being republished here as an addition to the present report.

As has been emphasized recently by Lyndon LaRouche and his *Executive Intelligence Review* magazine and LaRouche PAC, to understand climate, weather, and the behavior of water on our planet, we must start by understanding the role of our Galaxy. [34]

Yuri Beletsky, August 2010

One of the European Southern Observatory's telescopes in their Very Large Telescope array uses a laser beam to create an artificial star high in the Earth's atmosphere, allowing the astronomers to correct for atmospheric distortion (utilizing adaptive optics) as they study the central regions of our Milky Way Galaxy.

Records of the largest climate variations over the past half billion years correspond to changes in the galactic environment experienced by our Solar System—indicating that the Galaxy has the strongest role in determining the climate variations on Earth.[35]

The implications of this can be looked at in two ways.

On the one side, an adherent to the modern school of scientific reductionism may see this as, perhaps, an interesting phenomenon, but one with no general impact on our understanding of the nature and ordering of causality in the Universe.

On the other side, a mind which is not suffering from the debilitating effects of the destruction of science led by David Hilbert and Bertrand Russell[36](mathematical reductionism) will see this as a clue to defining a new understanding of the hierarchical nature of causality in the Universe—pursuing the conception of science defined by Nicolas of Cusa (as in his 1440 De Docta Ignorantia) and his follower Johannes Kepler.

Here, we will take the opportunity of the publication of the first English translation of Vladimir Vernadsky's 1930 report, "The Study of Life and the New Physics," to examine another clue, again pointing us towards the need for a higher understanding of our Galaxy.[37]

Studies have shown that there are cycles in the evolutionary development of animal life over the past 540 million years on Earth—cycles which correspond in period and in phase to cyclical aspects of the motion of our Solar System through our Galaxy.

This can also be looked at in two ways.

1. In the modern domination of Russellian reductionism, a "kill mechanism" is sought to explain how different galactic environments can accelerate the extinction rate of species and, thereby, imprint records of these cosmic fluctuations in the evolutionary record.

2. For an approach freed from the disease of reductionism, we can instead look to the views of Vernadsky, as presented in his 1930 report, "The Study of Life and the New Physics."

A student of Dmitri Mendeleev, and an avid opponent to the influence of Bertrand Russell on Russian and Soviet science, Vernadsky's hypotheses about life in the Cosmos provide an important basis to investigate the relationship between the changing expression of

34. "New Perspectives on the Western Water Crisis," *EIR*, April 3, 2015; "Galactic Man: Shadow versus Principle," *EIR*, May 15, 2015; and the LaRouche PAC water page.

35. See "Celestial driver of Phanerozoic climate?" Nir Shaviv and Ján Veizer, GSA Today, July 2003.

36. For more on the destructive role of Hilbert and Russell, see Jason Ross's presentation to the May 16, 2015 Schiller Institute New York City conference, and "The Escape from Hilbert's 'ZETA' 'X': Mapping the Cosmos!" by Lyndon LaRouche, *EIR*, March 19, 2010.

37. "The Study of Life and the New Physics," translated by Meghan Rouillard.

life on Earth and the subsuming Galactic System.

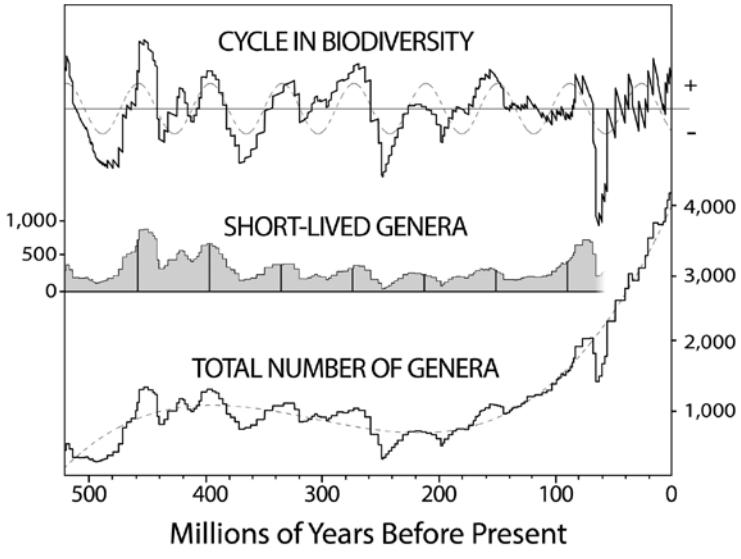
This provides another avenue for understanding that which subsumes our Solar System, our Earth, and the processes therein.

Identifying the Important Evidence

Fossil records leave a map of the evolutionary development of complex life on Earth, showing an overall increase in the number of distinct animal species (and more clearly in measures of genera) on the planet over the past 540 million years (as is best recorded in records of ocean life). However, upon this overall increase is imprinted a smaller periodic rise and fall in the number of genera at any given time. Early indications of this go back to the 1980s,[38] but more recent analysis (with a more complete fossil record) has solidified the evidence for a cycle in the decline and increase in the number of genera over time.[39] Perhaps most interestingly, this cycle corresponds with the period and phase of cyclical aspects of the motion of our Solar System through the Milky Way Galaxy.

Existing attempts to explain this correlation between galactic activity and evolution of life rely upon a sequence of domino-like effects resulting from the introduction of a "kill mechanism." They look for ways that cosmic processes might kill off large enough numbers of individual animals (either directly, or by creating certain environmental effects which will do so), which, in turn, could then lead to extinctions of entire species; and, if the killing rate were powerful enough and sustained, then to the extinctions of large numbers of different species, resulting in the extinctions of entire genera, and then families, culminating in a "mass extinction."[40]

FIGURE 1
Marine Fossil Diversity



adapted from Rohde & Muller, 2005

The belief that increased extinction rates, or even mass extinctions can be explained by this type of a bottom-up causality is not a demonstrated generalization based on evidence, but, rather, the product of certain reductionist beliefs and assumptions. In reality, the phenomena of mass extinctions are still poorly understood.[41] What we know from the fossil record is that there can be relatively rapid—in geological terms—transitions where many species, genera, and families disappear from the record and are replaced by new forms—although these more dramatic (and rapid) shifts exist within the context of an already ongoing slower turnover rate. How and why this occurred the way it did is still not well understood.

So, rather than assuming we must accept a reductionist framework, here we will take a different approach.

Perhaps most important for this shift in approach is

38. "Periodic Extinction of Families and Genera," Raup and Sepkoski, 1986, Science, Vol. 231, Issue 4740.

39. "Cycles in fossil diversity," Rohde and Muller, March 10, 2005, Nature, Vol. 434.

40. The initial attempt to define such a kill mechanism posits that high-energy radiation experienced in different parts of the Galaxy damages and kills more animals when the Solar System is in this region, leading to greater extinction rates ("Do extragalactic cosmic rays induce cycles in fossil diversity?" Medvedev and Melott, 2007). In a more recent attempt to explain this correlation, another scientist proposed that the extinctions are the product of comet impacts with the Earth, produced periodically by the Solar System's cyclical passage through more dense regions of the Galaxy (at which times, comets hiding in the outskirts of our Solar System can have their orbits perturbed, sending some towards the inner planets). See, "Disc dark matter in the Galaxy and potential cycles of extraterrestrial impacts, mass extinctions and geological events," Michael R. Rampino, Feb. 18, 2015, Monthly Notices of the Royal Astronomical Society, Vol. 448, Issue 2.

41. For example, a rather thorough 2006 paper by Richard Bambach re-analyzed what is known about extinctions and mass extinctions over the past 540 million years. His last two conclusions were interesting. "Mass extinctions are diverse and vary in intensity, selectivity, and timing. They are not homogeneous in effect or in cause." And, "Knowledge of timing and of geographic and environmental distribution of effects is inadequate. At this time, no consensus on proximate cause of death has been obtained for any extinction event." See, "Phanerozoic Biodiversity Mass Extinctions," Richard K. Bambach, Annual Review of Earth and Planetary Sciences, Vol. 34 (May 2006), pp. 127-155.

Didier Descouens

Fossilized remains of an extinct species of sea stars (Dipsacaster africanus) from around 130 million years ago. The fossils were discovered in Taba, Morocco.

to recognize that it isn't simply extinctions which define with these cycles, but extinctions and originations (the generation of new species, genera, and families).

As stated in a 2013 paper on the subject by Melott and Bambach, the evidence for a cycle in the process of the evolutionary development of life on Earth "results from the coherent interaction of both extinction and origination fluctuations, producing a stronger signal than either would or could alone."[42] So we must also ask why there exist periodic phases characterized by the origination of new genera.

Put simply, we're looking for more than a kill mechanism. We're examining, on the one side, the anti-entropic development of life on Earth, and, on the other, the relation of our Solar System to our Galactic System—and we're asking why cycles in both processes correlate so well. The work of Vernadsky provides a new basis to investigate this relation, in these top-down terms.

Vernadsky's 'Study of Life and the New Physics'

We don't know what life is.

Vernadsky's work provides an important distinction between the study of living processes and life per se. We can study living processes as effects of life, as particular expressions of life, without assuming that these specific expressions, alone, define life per se. This important distinction provides the needed framework to properly pursue the properties and characteristics of life, per se—investigating that which underlies certain particular expressions and manifestations.

Vernadsky took up exactly this approach in his 1930 report, "The Study of Life and the New Physics." Examining the identifiable properties of living processes—as they can be studied in the context of their existence in the biogeochemical medium of the Earth's biosphere—he separated the properties into two lists:

> First, those properties which are associated with the planetary (biogeochemical) medium within which living processes are manifested on Earth;
>
> Second, those properties displayed by living processes which can not be attributed to the characteristics and properties of this planetary context, and, thus, might express something more universal about life, per se.[43]

Vernadsky immediately follows this second list with a conclusion which will be upsetting to today's reductionists: "This list is not complete, but it indicates, with evidence, that life manifests itself in the Cosmos in other forms than those which biology normally displays."

Since living processes are not merely a phenomenon of geochemistry[44] —but are an expression of a principle of life, per se, manifested in the context of a geochemical medium—we should be willing to seek out in the Cosmos, other expressions of these non-planetary properties of life.

Vernadsky then dedicates the entire latter half of his report to the two non-planetary properties of life, which he thinks could be the most fruitful in investigating how "life manifests itself in the Cosmos in other forms than those which biology normally displays."

> Here, I will dwell upon two phenomena which will allow for the clarification of the important role which the investigation of life plays in the scientific picture of the Universe, created by the new physics, notably upon the dissymmetry of the space of living organisms and on biological

42. "Analysis of periodicity of extinction using the 2012 geological timescale," Melott and Bambach, 2013; citing, "A ubiquitous ~62-Myr periodic fluctuation superimposed on general trends in fossil biodiversity. II. Evolutionary dynamics associated with periodic fluctuation in marine diversity," Melott and Bambach, 2011, Paleobiology.

43. See section 10 of "The Study of Life and the New Physics." See footnote 37.

44. Despite the delusions of Vernadsky's opponent and adversary, Alexander Oparin. See, "A.I. Oparin: Fraud, Fallacy, or Both?" by Meghan Rouillard, Spring 2013 issue of *21st Century Science & Technology*.

time. In the first case, this is a matter of new properties (a particular state of physical space), observed in living organisms, and in the second, new properties of physical time.[45]

In his 18-section report, Vernadsky focuses most of the latter half to the first of these two, "the dissymmetry of the space of living organisms" (sections 11-16), followed by one section on biological time (section 17).

Vernadsky's work—both distinguishing a principle of life, per se, from the particular expressions of living processes we're familiar with on Earth, and positing the need to investigate other potential expressions of this principle in the Cosmos—provides a critical, non-reductionist basis for investigating the correlation of cycles of extinction and origination in the fossil record with the cycles of our Solar System's motion through our Galaxy—that is, to investigate the potential relationship between the process of the anti-entropic development of living processes on Earth, and the processes of the cosmic system of our Galaxy.

As we will see, Vernadsky's conception of dissymmetrical states of space will be key.

Cosmic Dissymmetry

In a different address (delivered one year later), Vernadsky made some interesting remarks specifically regarding Galactic Systems. Citing early studies examining the distribution of "spiral nebulae" (as spiral galaxies used to be called), Vernadsky hypothesized their orientations could be an expression of a "dissymmetrical" characteristic of the Cosmos.

> The spiral form of nebulae and of some stellar agglomerations indicates the probable presence of analogous dissymmetrical phenomena in the Cosmos. If the right spirals predominate in effect, clearly, among the spiral nebulae, as numerous photographs attest, or in certain parts of the Universe, right spiral nebulae are concentrated, and in others left spiral nebulae, the existence of dissymmetric spaces in the Cosmos would become more than probable. This dissymmetry would seem to be analogous to that which we observe in the space penetrated by life, that is to say, that it possesses enantiomorphic vectors and both of the vectors—left and right—could exist there at the same time, but not in equal number; the right-handed vectors most often predominate there.[46]

While recent studies indicate Vernadsky may have been onto something interesting regarding the large-scale distribution of galaxies,[47] here we're interested in the potential dissymmetrical characteristics of a single Galaxy—our own.

For a single spiral galaxy to express an inherent dissymmetry—i.e., to have an inherent handedness—there has to be a physical distinction between the top and bottom (north and south),[48] a distinction expressing the global characteristics of the galactic system as a whole.

Most importantly, if we are working from Vernadsky's conception of potential cosmic expressions of a quality of dissymmetrical space which we see expressed in living organisms, then perhaps the top-bottom (north-south) distinction which defines the dissymmetry of a spiral galaxy should be expressed in the response of living processes most strongly. That is, it would make sense that the most important evidence for defining an inherently dissymmetrical space of a galaxy would be the reaction of living processes to the influence of that dissymmetrical space.

Holding that thought, let's return to what we know about the relationship of our Solar System to the Galaxy.

As we orbit around the center of our Galaxy, the

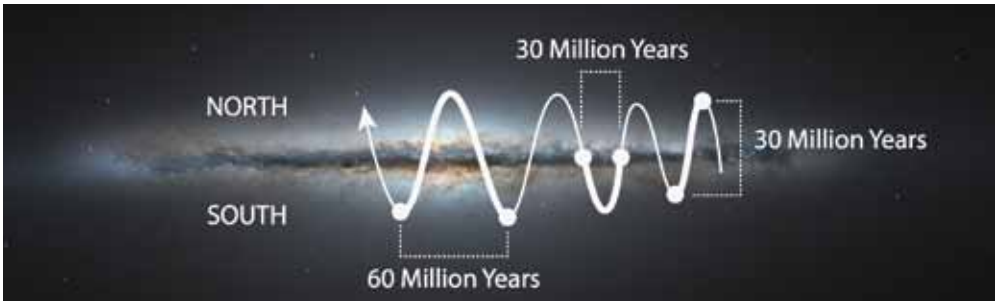
45. See section 11 of "The Study of Life and the New Physics." See footnote 37.

46. From Vernadsky's 1931 speech, "On the Conditions of the Appearance of Life on Earth," translated from French by Meghan Rouillard. See footnote 37.

47. Although it is unclear exactly which "spiral nebulae" (spiral galaxies) Vernadsky was referring to in 1931, 80 years later, a professor from the University of Michigan, Michael Longo, published a study showing that there is indeed a preferred orientation to spiral galaxies, depending on which direction one looks. Using a data set of 260,000 clearly defined spiral galaxies, Longo found that in a specific direction (about 10° from the spin axis of our own Galaxy), we see more left-handed spiral galaxies than right-handed ones. In a following study, looking from the Southern Hemisphere (instead of the Northern), Longo showed that, in the exact opposite direction, the opposite is the case: There are more right-handed galaxies are seen than left-handed ones. This is a remarkable finding, one we can be sure Vernadsky would find highly significant. See "Detection of a Dipole in the Handedness of Spiral Galaxies with Redshifts z ~0.04," by Michael J. Longo, Physics Letters B, 699, pp. 224-229 (2011).

48. Otherwise, a spiral galaxy which appears to be right-handed when being observed from one side would, at the same time, appear to be left-handed when observed from the other side. The left vs. right distinction would merely be a product of the location of observation, not an intrinsic expression of the galactic system itself, unless something distinguished one side from the other.

FIGURE 2



NASA, ESA, & Hubble Heritage Team (STScI/AURA)

Variations in the climate, the temperature, corresponding to the motion of our Solar System, above and below the galactic plane are shown here.

Solar System also passes above and below the galactic plane, in a bobbing-type motion. Based on current measurements and analysis, the cycles of this up-and-down-motion are roughly 30 (26-37) million years from mid-plane, through a peak, back to mid-plane, or 30 million years from one peak to the opposite peak, or 60 million years from one peak, through the opposite, and back to the same side. (See Figure 2).

Most researchers think that the conditions north or south of the galactic plane should be generally similar, and, therefore, any imprint of this changing galactic environment recorded in the Earth's history should express a 30-million-year periodicity.

In fact this is true for at least one abiotic process, the climate, where a 30-million-year cycle has been found.[49]

However, records of the evolutionary development of life on Earth display a ~62-million-year fluctuation.[50] As mentioned above, this biodiversity cycle appears strongest when one is not only examining extinctions, but extinctions together with originations (the appearance of new genera), a pairing which forces the investigation beyond the reductionist's search for a kill mechanism.

Thus, the evidence for a relationship between processes of our Galactic System, and the evolutionary development of life on Earth, is not simply associated with being either above or below the galactic plane, but with the characteristics of one side vs. the other. Within the reductionist camp, this is taken as evidence to doubt the existence of a connection between this galactic process and the evolution of living processes on Earth (despite the clear correlation), because the reductionists have no reason to hypothesize a distinction between the north and south sides.[51] But when viewed from the conceptions of Vernadsky, the distinction which serves as their basis for doubt becomes our point of interest.

A physical distinction between one side of the Galaxy and the other is required for our Vernadskian hypothesis of a dissymmetrical characteristic governing the physical space of the Galactic System—providing the critical evidence needed to define a distinct, intrinsic handedness of the system (irrespective of one's vantage point).

The evolutionary cycle being 60 million years, rather than 30 (and matching the proper phase), provides the needed evidence for a distinction, indicating the potential for an inherent difference in the north vs. south sides of our Galaxy, and, thereby, its inherent dissymmetry. It is most appropriate that fluctuations in the history of the evolutionary development of living processes on Earth are what provide the critical evidence for defining an intrinsic dissymmetry of our Galactic System—indicating galactic manifestation of dissymmetrical space, to which living processes on Earth are responsive.[52]

Space-Time of Anti-Entropy

In the terminology and framework pursued by Vernadsky, this could be an expression of a [[the]] dissymmetrical spacetime characteristics of our Galactic System.[53]

49. See "Is the Solar System's Galactic Motion Imprinted in the Phanerozoic Climate?" by Nir Shaviv, Andreas Prokoph, and Ján Veizer; Scientific Reports, Article number: 6150 doi:10.1038/srep06150, published Aug. 21, 2014.

50. Indications of other cycles have also been identified, but this one is clear and unambiguous, as stated in the initial paper identifying its existence, "…the 62-Myr cycle is not a subtle signal. It is evident even in the raw data, dominant in the short-lived genera and strongly confirmed by statistical analysis." See "Cycles in fossil diversity," Rohde and Muller, March 10, 2005, Nature, Vol. 434.

51. For example, "The Sun currently oscillates up and down across the Galactic plane every 52-74 [million years], but plausible responses would seem to occur every mid-plane crossing (namely 26-37Myr)" (Rohde, Muller; "Cycles in fossil diversity," 2005); and "Thus, these ~60 Ma periodicities are probably unrelated to the 32 Ma cycle discussed here, unless there is a very large north-south asymmetry relative to the galactic plane" (Shaviv, Prokoph, Veizer, "Is the Solar System's Galactic Motion Imprinted in the Phanerozoic Climate?" 2014).

52. Recall how Vernadsky was calling for investigating how "life manifests itself in the Cosmos in other forms than those which biology normally displays."

53. Vernadsky often focused on, and returned to the space-time proper-

This is not the first indication that the study of Galactic Systems could require a new conception of a self-bounded space-time intrinsic to that Galactic System.[54] However, Vernadsky's direction of work indicates that we should open our minds to the qualities of the space-time characteristics of living processes (rather than simply abiotic physics), if we are to truly attempt to understand the Cosmos as containing a principle of life, per se, and galactic systems therein.

With this evidence for a relation between the evolutionary development of life on Earth and the processes of our Galactic System, we see the option to invert the investigation—to examine the characteristics expressed by evolution as informing us about the nature of our Galactic System as a whole.

As Vernadsky correctly identified in his 1926 address on evolution,[55] there is an intrinsic direction in the evolutionary development of life on Earth—the increasing energy-flux density of the biosphere system—which Vernadsky called his "second biogeochemical principle":

> This biogeochemical principle which I will call the second biogeochemical principle can be formulated thus: The evolution of species, leading to the creation of new, stable, living forms, must move in the direction of an increasing of the biogenic migration of atoms in the biosphere. . . .
>
> [This second biogeochemical principle] indicates, in my opinion, with an infallible logic, the existence of a determined direction, in the sense of how the processes of evolution must necessarily take place. . . . All theories of evolution must take into consideration the existence of this determined direction of the process of evolution, which, with the subsequent developments in science, will be able to be numerically evaluated. It seems impossible to me, for several reasons, to speak of evolutionary theories without taking into account the fundamental question of the existence of a determined direction, invariable in the processes of evolution, in the course of all the geological epochs. Taken together, the annals of paleontology do not show the character of a chaotic upheaval, sometimes in one direction, sometimes in another, but of phenomena, for which the development is carried out in a determined manner, always in the same direction, in that of the increasing of consciousness, of thought, and of the creation of forms augmenting the action of life on the ambient environment.[56]

Since Vernadsky's time, we've accumulated a much larger and more detailed map of the evolutionary development of life. While the new evidence strongly conforms to Vernadsky's second biogeochemical principle,[57] we are still far from understanding the principle which has composed that map.

In pursuit of this, we've been pointed to the processes of our own Galactic System—as the macroevolutionary pulsations associated with the anti-entropic development of living processes on Earth beat in harmony with our Solar System's experience of the dissymmetrical characteristics of our Galaxy.

Rather than simply an Earth-based phenomenon, the development of life on Earth could be an expression of an anti-entropic character of our Galaxy, returning us to the opening challenge: understanding the causal role of our Galactic System in the hierarchical ordering of the Universe.

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ties of living processes as critical to investigating and understanding life phenomena. He developed the need to consider the space-time of living processes as dissymmetrical with a polar vector. This is the case in the cited paper, "Life and the New Physics" (see footnote 37), as well as other works, emphatically his series on the Problems of Biogeochemistry, available in "150 Years of Vernadsky: The Biosphere," 21st Century Science & Technology, Jason Ross (Editor), Meghan Rouillard (Series Editor).

54. Observational evidence indicating discrepant redshift measurements for galactic systems (i.e., redshift values which cannot be attributed to any currently accepted cause of redshifts, such as cosmological expansion, recessional velocity, or relativistic effects), can (although highly controversial) be taken as possible evidence for unique space-time characteristics distinct to an individual galactic system (see Quasars, Redshifts and Controversies, Halton Arp, 1988, Cambridge University Press). Also the "M-sigma relation" (showing that the mass of a galaxy's bulge scales in a very tight proportion to the mass of a phenomenon often referred to as the supermassive black hole at the center of that same galaxy) indicates a higher structure and coherence to a galactic system as a unity. These (and other provocative lines of evidence) tickle the imagination to ponder the yet-to-be-discovered principle organizing the existence and development of a galactic system.

55. "The Evolution of Species and Living Matter," 1926, translated from French by Meghan Rouillard.

56. This second biogeochemical principle should also be considered as a non-planetary property of life, according to Vernadsky's analysis in his "Study of Life Phenomena and the New Physics." See footnote 37.

57. For example, see, "Macro-Ecological Revolutions: Mass Extinctions as Shadows of Anti-Entropic Growth," Benjamin Deniston, *EIR*, March 23, 2012.