LAROUCHE PAC SCIENTIFIC
RESEARCH TEAM REPORT

Towards a Galactic Science Driver

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I. What is A Galactic Science Driver?

by Benjamin Deniston

June 21, 2015

In the spring of 2015 the LaRouche PAC science team defined a perspective for addressing the water crisis in California and other locations based on recently developing insights into the role of our Galactic System in shaping climate, weather, and the behavior of the water cycle on Earth.[1] *However, this is just one aspect of understanding our Galactic System, and how it relates to processes in our Solar System and on Earth. In this report we will recognize that galactic water perspective as just one expression of a deeper relation to our Galactic System. In what follows we will examine a broader perspective for understanding the higher-order system which is our Galaxy, in pursuit of a universal physical principle of the Galactic System.*

Over the recent months Lyndon LaRouche has increasingly emphasized the need for a science driver program focused on understanding the Galaxy.

Here we will present various paths of investigation into scientific frontiers associated with the Galaxy, but before getting to that, we must emphasize a clarification on the meaning of a science driver program.

This is different than a technology driver, or an engineering driver, or a physical economic driver. That is not to say those are not important—they are needed elements of general human progress. However, none of them are designed to achieve the same thing as a science driver (although there can be inherent overlap).

The former drivers focus on increasing the useful applications of known scientific principles, to improve the ability to utilize known principles, and to expand the scale of national utilization of those potentials. A science driver focuses on pursuing new fundamental principles, principles existing outside the entire domain of operation of these other drivers.

This is the same distinction underlying many people's miSunderstanding of LaRouche's emphasis that "there has been no progress in science, no practiced progress in science since the beginning of the Twentieth Century."

Einstein and Planck changed our fundamental understanding of the Universe. The age of space travel, smart phones, satellites, and silicon has been built upon that new understanding of the Universe. While our ability to pursue certain tracks of engineering and technological development has greatly improved, there have been no new fundamental scientific revolutions—no new Einsteins, no new Leibnizs, no new Keplers. Even worse, the understanding of true science has not merely stagnated, it has collapsed.

As Jason Ross has been developing, the understanding of how it is that the human mind comes to create and develop true science has profoundly degenerated—with a cult belief in mathematics, logic, and formal systems increasingly overtaking any true insight into human creativity.[2] The Twentieth Century has seen a profound degeneration in the very understanding of our

1. "New Perspectives on the Western Water Crisis,", April 3, 2015; "Atmospheric Moisture Control," *EIR*, April 17, 2015.

2. "Man's True Nature," by Jason Ross, *EIR*, May 1, 2015.

own nature as mankind, as expressed most clearly in modern cultural and artistic expressions.[3]

This is not merely unfortunate, it is existential. This is a rejection of the very essential capability which defines mankind as distinct from the animals—predefining a path into a new dark age.

Nicholas of Cusa (1401–1464), founder of modern science and leading organizer of the Renaissance, whom Vernadsky describes elsewhere as "one of the most original and prodigious minds of his time."

So Why the Galaxy?

Start with Nicholas of Cusa's conception of the ordering of the Universe.[4] Truth (knowledge) is not developed through the accumulation of self-defined and self-contained facts—it is developed by a unique power of the human mind to create increasingly less-imperfect conceptions of the wholes which create the facts (sometimes even seemingly contradictory or inconsistent facts). This is developed by the unique human creative capability to create valid higher-order conceptions of the unsensed causes (rather than simply recording sensed effects). Scientific understanding of causality in the Universe does not come from a Newton-Laplace style accumulation of measurements of an increasing number of individual parts; it comes from the discovery of successive higher-order unifications which determine the lower-order multiplications.

Here we will work from a developing thesis, first published in the article, "Science For A New Paradigm: Time for a Solar Noösphere."[5] By that thesis, the present scientific knowledge level of mankind could be broadly classified as a "stellar system level." For example, the revolutionary understanding of the equivalence of matter and energy underlines the energetic activity of our star, the Sun; an adequate understanding of the physics of these processes requires the understanding of the quantization of activity in the very small; the relativistic understanding of gravitation underlies the orbital organization of the Solar System's bodies.

But, what subsumes the Solar System? From what was the Solar System created, and what is the physics associated with that higher-order process?

Consistent with the destructive intervention by David Hilbert and Bertrand Russell (to call for the axiomatization of mathematical and scientific thought), the current narrative taught in schools is that everything from the Galaxy to the entire Universe will be explained in the mechanisms and capabilities associated with this stellar-level science.

Here that assumption will be rejected—both on the basis of its dubious, unnatural origins, and on the basis of the evidence and anomalies provided by the studies of our Galaxy, pointing to the potentialities of new levels of science beyond our current stellar-level conception.

Leaving the treatment of the inherently dubious nature of this rejected assumption to other locations,[6] in this report we will review two categorical tracks of evidence which could converge upon a new galactic-level of science.

Since our Solar System is a subsumed component of the higher-order Galactic System one area of study is the history of the Earth and the Solar System, seeking indications of how they have responded to and been influenced by the higher-order Galactic System. The other track focuses on properties of the large-scale structure of the Galaxy itself.

The remainder of this introductory article will briefly review examples of possible studies in each category. This will be followed by additional articles addressing some of these studies in more depth.

Response of Stellar Systems to Changing Galactic Environments

Improving records of climatic, biospheric, and geophysical activity on Earth (and in some limited cases on other planetary bodies as well) provide long histories of variations and changes of these systems. In a number of

3. See the May 20, 2015 LaRouche PAC A New Paradigm for Mankind show, "Mankind Is Not An Animal."

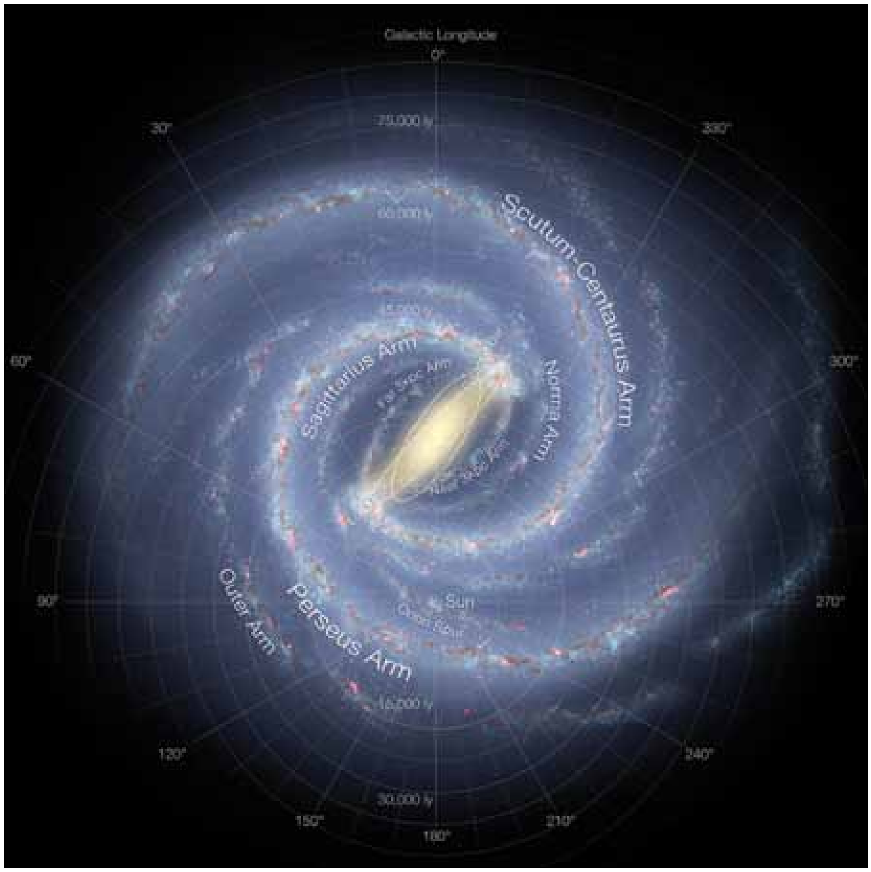
4. *De Docta Ignorantia*, Nicholas of Cusa, 1440.

5. November 28, 2014 issue of **Executive Intelligence Review**.

6. See, "Man's True Nature," Jason Ross (*EIR*, May 1, 2015) and upcoming work by Ross.

cases the changes of these systems correspond quite well with what is presently known about the travels of our Solar System through our Galaxy, and with the associated changes in the galactic environment. In some cases there are hypotheses for the mechanisms by which a changing galactic environment can affect these planetary systems; in other cases the current scientific paradigm fails to provide adequate hypotheses.

Evidence for such responses can be seen in three types of systems (climate systems, biospheric systems, and geophysical systems), though they are not mutually exclusive, and clearly interact. In certain cases, perhaps some of the most provocative evidence could come from indications of separate planetary bodies responding and reacting simultaneously—indicating that each planetary body would be responding independently to the same external, cosmic influence.

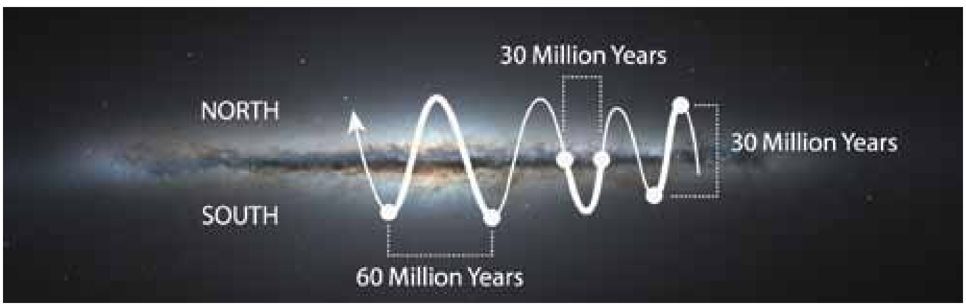


NASA

Artist's rendering of our Milky Way Galaxy, with the galactic coordinate system, Solar System location, and spiral arms labeled.

Climate and Weather

The collaborative work of scientists Henrik Svensmark, Nir Shaviv, and their associates has provided a growing body of evidence showing that the different galactic environments experienced by the Earth have a profound effect on the Earth's climate system. First, it was shown that periods of major ice ages (spanning tens of millions of years) corresponded with the passages of the Solar System through our Galaxy's spiral arms.[7] More recently it has also been shown that the cyclical motion of our Solar System above and the galactic plane also corresponds with temperature variations (on a cycle of about 30 million years).[8] They have developed a solid theory that this galactically-induced climate change is mediated through variations in the galactic cosmic radiation environment of our Solar System, our Earth, and our Earth's thin atmosphere—controlling the behavior of

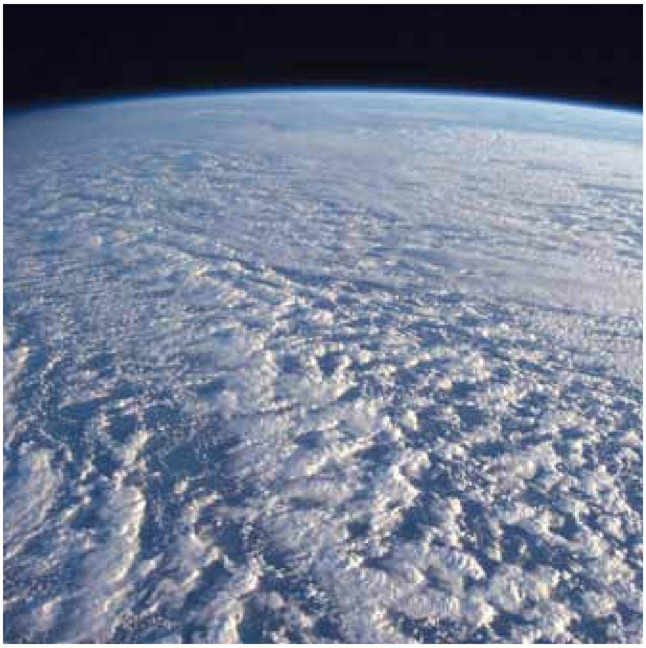


NASA, LaRouche PAC

Side view of a spiral galaxy, with an exaggerated illustration of the motion of the Solar System above and below the galactic disk.

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

8. "Is the Solar System's Galactic Motion Imprinted in the Phanerozoic Climate?" Nir J. Shaviv, Andreas Prokoph, & Jan Veizer, Nature Science Reports, August 21, 2014.



NASA

Stratocumulus Clouds Over Pacific, January 2013. Evidence now shows that high energy galactic cosmic rays play a significant role in cloud formation.

2005 David Monniaux

Tyrannosaurus rex at the Palais de la Décourverte, Paris. Tyrannosaurus rex was just one of billions of animal species which have gone extinct.

atmospheric water vapor, cloud formation, and, thereby, the climate.

This overall framework provides the basis for an understanding of how mankind can manage these conditions himself—controlling aspects of the weather, rainfall, and climate.[9]

Additional insights could be provided by an examination of changes in the climate and weather systems of different planetary bodies, in an attempt to define indications of external factors influencing and controlling certain aspects of entire planetary systems (see "Solar System Weather Changes Challenge Conventional Theories," by Meghan Rouillard).

Evolution of Living Matter on Earth

A 2005 study showed very strong cycles of rise and fall in the number of distinct fossilized species over the past 540 million years—a stronger cycle of 62 million years and a weaker but still significant cycle of 140 million years.[10] Both of these cycles of rise and fall in biodiversity correspond (in period and phase) with these same two cyclical aspects of our Solar System's motion through the Galaxy (mentioned just above)—the motion above and below the galactic plane and the passage through the spiral arms. While this correspondence has been noted, the cause for such a relation is more ambiguous. Additional studies have also shown evidence for a relation between the galactic environment and the evolutionary development of living matter, proposing a few possible mechanisms. Svensmark has shown a relation between changing galactic environments (characterized by the expected changing rate of nearby supernovae) and the overall productivity of the biosphere—hypothesizing that the relation is mediated through climate change.[11] Another scientist has examined a possible periodicity in mass extinction events which might correspond with the periodic passage of our Solar System through the Galaxy's central disk—hypothesizing that this could perturb and provoke periodic comet impacts.[12]

Even with these proposed mechanisms, there is much ambiguity for how and why such a galactic relation to evolution would exist, perhaps reflecting a profound lack of understanding about the fundamental nature of living processes and/or of our Galactic System. The work of Vladimir Vernadsky provides an

9. See the LaRouche PAC show, A New Paradigm for Mankind, for May 6, 2015 and for May 13, 2015; also published in *EIR*, May 15, 2015 ("Galactic Man: Shadow versus Principle"), and May 22, 2015 ("Bringing the Rain").

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

11. "Evidence of nearby supernovae affecting life on Earth," Henrik Svensmark, Monthly Notices of the Royal Astronomical Society, Volume 423, Issue 2, pages 1234-1253, June 2012.

12. "Disc dark matter in the Galaxy and potential cycles of extraterrestrial impacts, mass extinctions and geological events," Michael R. Rampino, February 18, 2015, Monthly Notices of the Royal Astronomical Society, Vol. 448, Issue 2.

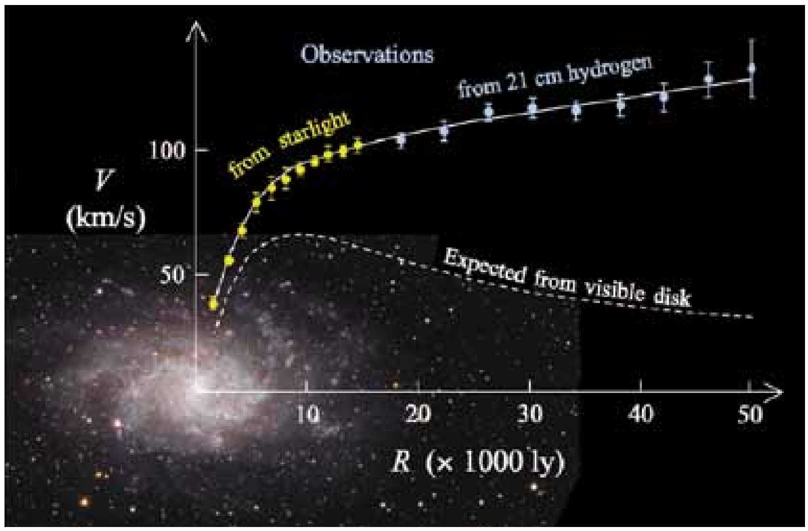
epistemologically better framework for approaching this question (see "A Vernadskian Reconsideration of Galactic Cycles and Evolution," republished as a contribution to this present report[13]).

Wikicommons: Williamborg

Three Devil's grade in Moses Coulee, Washington is part of the Columbia River Large Igneous Province (LIP). Lips are produced when massive amounts of hot magma extrudes from inside the Earth and flows over the surface.

Geophysical Activity

Studies have also shown a provocative correlation between records of periodic geophysical activity on Earth, the evolutionary development of living matter, and the motion of the Solar System above and below the galactic plane—all approximating the same ~60 million year periodicity.[14] Because the current stellar-level scientific paradigm lacks adequate hypotheses for how the influence of the Galactic System could affect the internal dynamics of planetary bodies, most authors touching upon this subject tend to put little (if any) emphasis on the galactic correlation to geophysical activity. However, at least one study has cited a theoretical mechanism by which the varying galactic environments experienced by the Earth could induce a type of geophysical activity (in this case volcanism).[15]



Wikimedia Commons:Stefania.deluca

The orbital speed measured at different distances compared with what would be expected for the galaxy M33.

Returning to the method of comparing different planetary bodies for indications of correlated activity provides some preliminary but provocative indications that recent (in geological time) periods of large-scale volcanism on Earth correspond quite well with the most recent periods of volcanism on the moon—indicating a coordinated response of seemingly independent planetary bodies, pointing to external cosmic influences on timescales corresponding to galactic variations (see "Earth-Moon Comparative Planetology," in this report).

Taken together we see indications that the long-term changes and development of various processes on Earth (and perhaps on other planetary bodies)—from geophysical activity, to climate and weather, to the evolutionary development of living matter on Earth—correspond with the changing galactic environment experienced by the Solar System.

As stated above, in some of these cases there are hypotheses for how this interaction may occur; in other cases the current scientific paradigm fails to produce adequate hypotheses. The point is not to expect a resolution from within the existing framework, but to seek the clues indicating a higher level galactic principle, subsuming the present scientific level. The response of Earth systems (and potentially other planetary bodies) to changing galactic environments is only one path of

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13. Originally published in *EIR*, May 22, 2015

14. "An ~60-Million-Year Periodicity Is Common to Marine 87Sr/86Sr, Fossil Biodiversity, and Large-Scale Sedimentation: What Does the Periodicity Reflect?" Melott, Bambach, et al, Journal of Geology, Vol. 120, No. 2 (March 2012),

15. "Disc dark matter in the Galaxy and potential cycles of extraterrestrial impacts, mass extinctions and geological events," Michael R. Rampino, February 18, 2015, Monthly Notices of the Royal Astronomical Society, Vol. 448, Issue 2.

pursuit of this galactic principle—we can also examine the large-scale, global dynamics and features of Galactic Systems as a whole.

Global Galactic Structure, Dynamics, and Singularities

Certain characteristics of galaxies, when studied as single systems, remain outside the scope of explanation within the current stellar-level science. Many characteristics could possibly be included, but here we will review just a few: evidence for an effect associated with the investigations into so-called dark matter; evidence for a large-scale coherence in the global organization of galactic systems; and the association of this coherence with a physical singularity (often referred to as a supermassive black hole).

These phenomena challenge our current conceptions of causality (expressed across space and time on these scales), and the energy flux density limits of reactions.

So-Called 'Dark Matter'

For decades it has been known that the orbital periods of stars in the outer regions of galaxies are much faster than can be explained by the amount of mass which can presently be detected in the respective galaxies. This has given rise to speculations and investigations into hypothetical types of matter which haven't been able to be detected, but which exert gravitational effects—so-called dark matter. Others view this as evidence that our understanding of gravity is not complete, and needs to be modified when expressed on galactic scales.

From the standpoint of the thesis of this report, we should start with the original discovery of universal gravitation, as done by Kepler in his discovery of the harmonic organization of the Solar System as a single system. To assert that we can take the mathematical interpretation of that discovery, and apply it to the organization of the higher order system of a galaxy, is an assumption—one which could very well be invalid. The so-called dark matter paradox might only be resolved with a discovery of a higher-order principle governing the harmonic organization for the Galactic System as a whole.

M-Sigma Relation

Another indication of a higher-order principle governing the structure of a single galactic system is referred to as the "M-sigma" relation (or the black hole-bulge relation). This is an indication that the mass of a supermassive object found at the center of most galaxies (thought to be a supermassive black hole) is always in a very direct proportion with the mass of the spherical bulge structure of the host galaxy. A larger galaxy, with a larger bulge, will have a larger supermassive central object, and a smaller galaxy, with a smaller bulge, will have a smaller supermassive central object.

At first this would intuitively seem to make sense. However, because the scales are so different, it is not understood how either the supermassive central object could exert control over the bulge, or how the bulge could exert control over the supermassive central object (or how they could both be subject to the same external control). Moreover, this is not a broad relation; it is a very tight proportion, holding across many orders of magnitude of size of different galaxies.

Within the existing mechanisms available to the current level of stellar science, it is not yet clear how to explain this relationship—nor is it clear that it could be explained within the current framework. Perhaps a new level of science is required (see "Singularities and Supermassive Black Holes," in this report).

A Physical Singularity?

This takes us to another particularly interesting area of investigation: the phenomena referred to as supermassive black holes. The very idea of a black hole is inherently an anomalous phenomenon.

According to the mathematical interpretation in general relativity, a black hole is a location where the equations explaining space and time go to infinity (a singularity), and attempts to understand the physics break down. This is an unambiguous boundary marking the limits of present knowledge—what happens here (and beyond here) is not only unknown; it is unknowable in the present stellar-level scientific framework, and will require a new revolution in science to discover (see "Singularities and Supermassive Black Holes," in this report).

Active Galactic Nuclei

What makes this even more interesting is the association of supermassive central objects (physical singularities) with a phenomenon known as active galactic nuclei.

In a small percentage of observable galaxies, the very central region of the core is incredibly active and

NASA

Galaxy NGC 4414.

energetic, shining more brightly than the entire rest of the galaxy (i.e. producing more energetic output than billions of stars combined). Moreover, evidence indicates this immense activity is coming from an incredibly small region of the galaxy. There are attempts to explain this energetic output from within the current paradigm, but they are very sketchy and contradict observational evidence.

Is it a coincidence that the most energetic phenomenon presently observed in the known Universe is associated with a phenomenon for which our current mathematical framework literally breaks down? Perhaps the energetic output of this mysterious phenomenon is an expression of a new type of reaction, associated with a galactic-level of science (see "Singularities and Supermassive Black Holes," in this report).

In Search of Principle

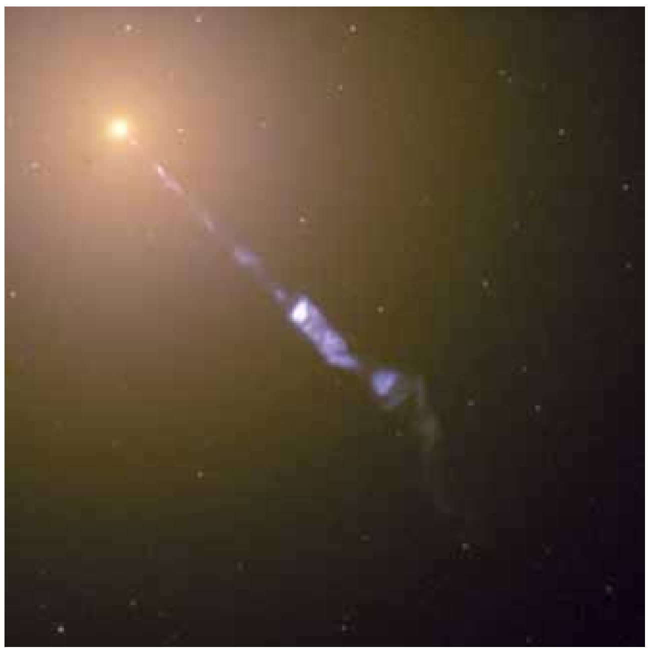
This is a brief overview of some important lines of investigation into the science of our Galaxy. On the one side, we can study the history of changes on the Earth (and on other bodies in the Solar System) as possible records indicating what the Galaxy is by what it does to lower-order stellar systems. On the other side, we have anomalous features of the large-scale structure and dynamics of a galactic system as a whole, which might only be explained by an as-yet-unknown organizing principle.

Most important will be unexpected convergence of multiple tracks which were thought to be independent.

The goal is to discover a new principle which subsumes current notions—by this very nature (with respect to current knowledge) its character, and how and why it subsumes what notions, is not deducible before its discovery.

We can be guided by certain general epistemological insights (following the principles of the foundations of modern science developed by Cusa), but there is no formula, and we must seek the anomalies and clues which can provoke the unique power of human creativity to generate new hypotheses (existing outside the current framework) in pursuit of a new discovery of principle.

What follows are a series of articles elaborating various aspects of this investigation, brought together in pursuit of convergence on a new principle.



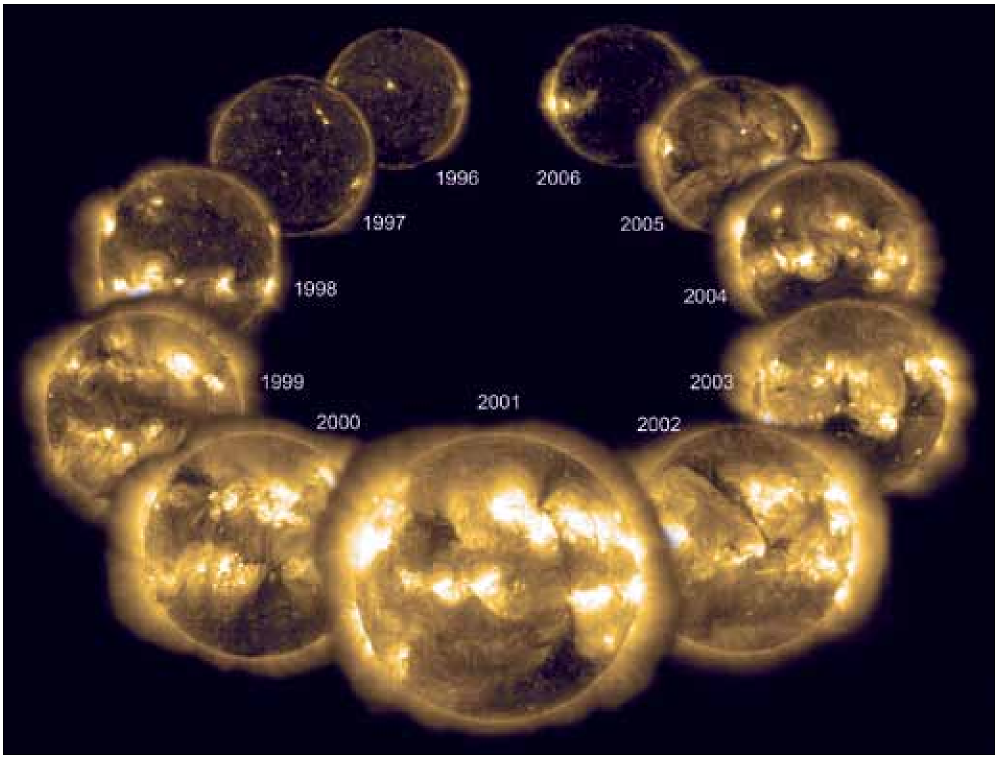
NASA

A Hubble Space Telescope photograph shows a massive jet of plasma being ejected from the massive galaxy M87.

II. Climate Change as a Case Study: Categories of Causality

by Benjamin Deniston

Adapted from a May 14, 2015 research memo



Steele Hill, SOHO, NASA/ESA

Year by year X-ray images of the Sun as it progresses through an eleven year cycle (starting weak in 1996, peaking in 2001, and ending weak in 2006).

This is a brief examination of the distinction between the different cosmic principles shaping our Earth's climate, water, and weather systems. Other studies has demonstrated that the Sun and the Galaxy act to shape these processes on Earth,[16] but here we will step back and investigate the categorical structure of causality. What is the hierarchy of active principles, and what are the successive boundaries of their respective expressions?

As cited in the opening article to this report, Cusa initiated the needed framework of scientific thought for this top-down investigation. Another, more recent reference point in this approach is the thesis developed in the November 2014 article, "Time for a Solar Noösphere".[17]

In short: space, time, and material substance—as modern science tends to understand them from an epistemologically sense-perceptual basis—are varying shadows, cast by the actions of principles. As developed in "Time for a Solar Noösphere," we can associate certain boundaries in the scales of temporal, spacial, energetic, and material action associated with certain principles—and perhaps most importantly, we can define coherence in an anti-sense-perceptual unification of seemingly separate boundaries in the very small and the very short, with boundaries in the very large and the very long.

But these interconnected boundaries—appearing in the shadows of temporal, spacial, energetic, and material expressions—are the effects, not the cause.

Starting from the discoveries of Cusa enables the delusional conceptions of self-defined objects floating in empty space through absolute time to fall away, and provides, instead, a conception of the hierarchical nesting of supra-sense-perceptual principles of development, expressing their distinction (subjugation or sub-

16. See the LaRouche PAC show, A New Paradigm for Mankind, for May 6, 2015; also published in *EIR*, May 15, 2015 ("Galactic Man: Shadow versus Principle").

17. November 28, 2014 issue of *EIR*; and LaRouche PAC.

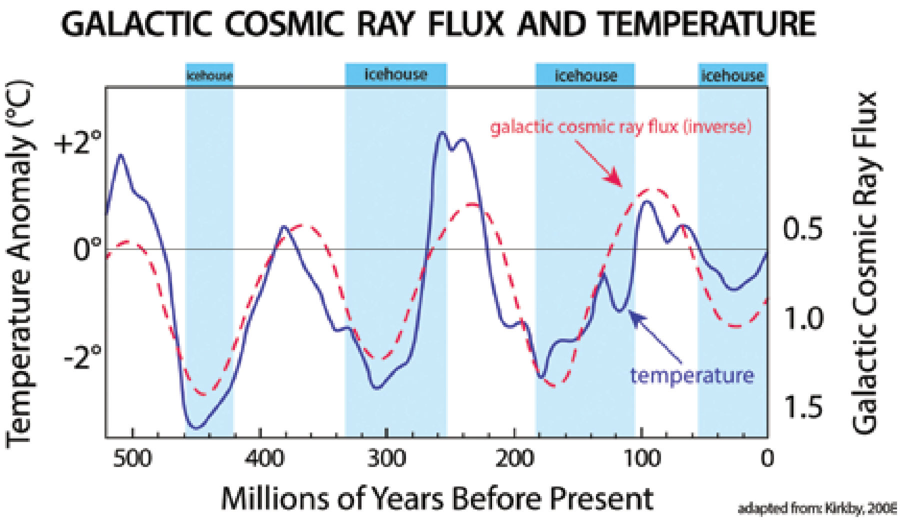
summation) in the effects cast as the boundaries in the scale of spacial and temporal actions.

Climate as a Case Study

With respect to astronomical drivers of the changing climate on Earth, we can define three successive categories of causality—defined by their different strength of influence and by the timescale associated with each process.

Solar Variations—Cycles in solar activity spanning decades to centuries dominate climate variations over scales of thousands of years.[18] However, these variations are subsumed by more influential activity.

Solar System Variations—For the past hundreds of thousands to millions of years, climate change was dominated by variations in the structure of the Solar System (rather than just the Sun alone). Cyclical variations in the Earth's orbital elements and the tilt in the Earth's axis (with periods measured in tens of thousands of years) give rise to the phenomenon referred to as the Milankovitch cycles.[19]



LaRouche PAC

Spiral Arms, GCR, and Ice Ages.

Galactic Variations—The travels of our Solar System through the Galaxy are measured in tens and hundreds of millions of years. Passages into and out of the Galaxy's spiral arms (approximately every 140 million years) are thought to govern the largest climate changes measured over this time, the major swings from ice house to hot house modes over the past hundreds of millions of years.[20]

This general framework indicates a hierarchical ordering of causality for cosmic drivers of the Earth's climate—the activity of the Sun (alone), subsumed by the activity of the Solar System (as an entirety), subsumed by the activity of the Galaxy. Each lower level is overtaken, in timescale and in the strength of influence, by the higher-order system.

This case study points to the dominating role of the Galactic System (that from which the Solar System was formed and created), providing an important reference point for considerations of causality in the following articles in this report on the galactic principle.

18. For example, see the presentation by Professor Carl-Otto Weiss, "Climate Change Is Due To Natural Cycles," at the June 2015 international conference of the Schiller Institute, held in Paris, France.

19. An interesting anomaly arises here—one which could require a return to Kepler's work on the harmonic organization of the Solar System. According to the basic idea of the Milankovitch cycles, different variations in the Earth's orbit (and tilt and precession) change the amount of Sunlight hitting the Earth (and at which times and which locations). It is generally accepted that the periodicities in these orbital variations match climate variations quite well (over the past three million years).

However, when scientists calculate the variation in incident Sunlight which would be caused by these orbital variations they run into a paradox. The factors which are expected by the calculations to have the largest effect on climate, are the changes in the tilt of the Earth and the precession of the equinox, which are cycles of 41,000 and 26,000 years, respectively. But, in the climate records for the past one million years the strongest cycle is neither of these, it is 100,000 years, which corresponds to the changes in the eccentricity of the Earth's orbit.

This is a paradox, since the variation in the amount of Sunlight reaching the Earth attributable to orbital eccentricity changes—according to the referenced calculations—should not be enough to drive the amount of climate variation which is observed in these 100,000 year cycles. Yet the strongest climate variations correspond with the eccentricity changes, not the tilt or precession changes (for the past one million years). This is referred to as the "100,000-year problem."

This anomaly becomes quite interesting when seen from standpoint of Kepler's work, because the eccentricity is the key factor in Kepler's harmonic hypothesis, and, by his investigation, is connected to the organization of the entire Solar System as a unity. This points in an interesting direction; perhaps the climate variations are a response to changes in the harmonic organization of the entire system (rather than just solar irradiance).

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

III. Solar System Weather Changes Challenge Conventional Theories

by Meghan Rouillard

It is not only on our own planet Earth where we have much to learn about what factors are driving the weather. All around our Solar System, changes are occurring which point toward the need to improve our understanding of Solar System weather as a unified process and study, and the role that solar, galactic, and other factors might be playing.

It is also in examining weather on other bodies in our Solar System that we can easily dismiss assertions that the mere fact that weather on Earth is "changing" is an automatic sign of the massive role that man (and technological progress) must be playing to cause this.

Planet Earth is the only planet currently burdened by a species which, on the whole, has a lot of assumptions about what is, or is not, causing its weather. But the case continues to build for the role which galactic cosmic rays are playing in affecting cloud cover, precipitation, and climate on Earth. Studies have demonstrated the likely presence of this effect at many different time scales— from global ice houses events which corresponds to Earth's passage through the spiral arms of our Galaxy, to changes which seem to mirror solar cycle activity, and even much shorter term changes caused by geomagnetic storms. While these effects appear to vary region by region, and to have different relatively localized expressions, the evidence continues to grow.

Changing Martian Climate

About 10 years ago, the deafeningly stupid, lying campaign of Al Gore, on behalf of truly evil forces who have made no secret of their desire to depopulate (notably Prince Philip), worked many into a frenzy, convinced that man's actual progress was destroying the planet. Many of Gore's forecasts completely failed to pan out. For him, the solar and galactic factors likely driving climate are the real "inconvenient truth!"

While the status of ice caps and glaciers on Earth is far from meeting Al Gore's assertion that, for example, by 2013 the Arctic would be ice-free, Earth is not the only planet which has changes in its surface ice. Take Mars. Some people have put this forth as a quick example in an attempt to silence those who refuse to think on the matter of climate change. This takes the form of "Ice caps are melting on a planet without human life, so please shut up." As an individual case, it is not really a proof of anything—and with minimal overall ice melting on Earth, trying to show that both planets have global warming is really beside the point. But some of the specifics, and the response to them, were certainly revealing.

In 2005, the Mars Global Surveyor and Odyssey missions showed three years of melting of Mars' southern ice caps prompting debate about what causes climate change on Mars and other planets which don't have human life, and not surprisingly, this evidence was cited frequently during 2007, in the midst of and likely in response to Gore's big campaign. Early indications of the melting prompted some to say that it was simply seasonal and a local change "with no sign of external forcing," but as it continued for three years, reports then focused on the fact that it is no secret that many of Mars' temperature changes are due to changes in Mars' own Milankovitch cycles, which also affect Earth's climate, as changes in orbital characteristics and the planet's wobble and tilt affect its relationship to the Sun.

But these reports usually claimed that this was "well studied" (ironically, these non-anthropogenic cycles are not often discussed with reference to Earth, but this case made it unavoidable). Scientists who posited that changes in solar irradiance could be a factor were generally dismissed for not holding the majority opinion. Essentially, it was claimed that nothing happening on Mars was a surprise. If only that were the only example!

Stormy Planets

There are other changes on Mars and elsewhere in the Solar System which reveal how much more we have to learn about weather and the forces that control it.

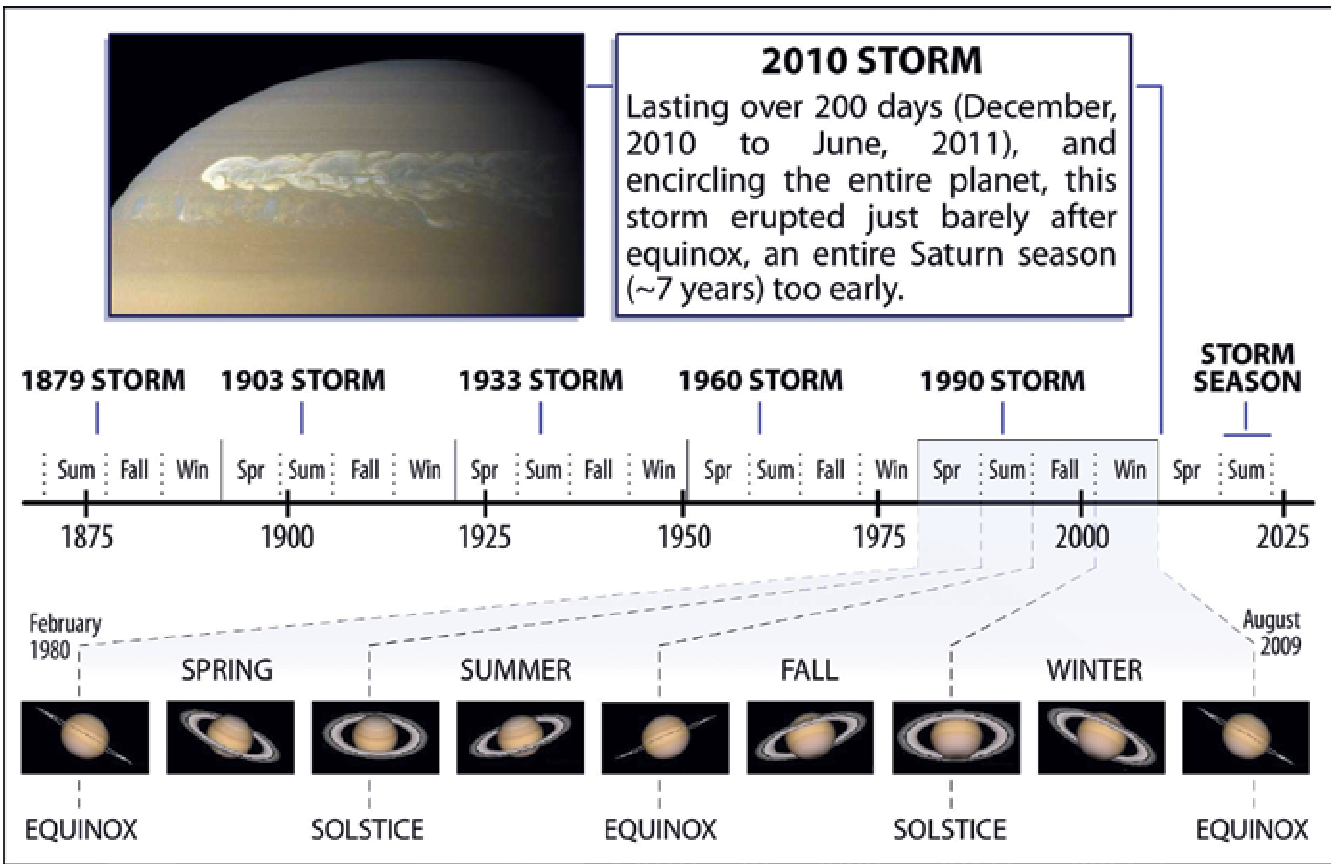
Mars is known for some storms, mostly in the form of "dust devils," but recent plumes seen on Mars baffled astronomers. In 2012, several massive plumes were

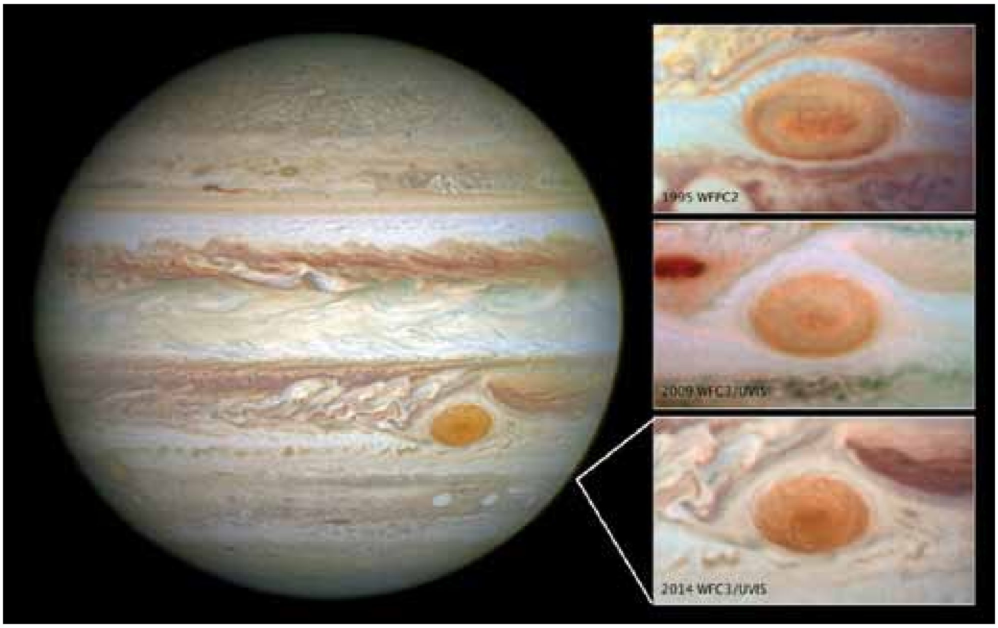
P. James (Univ. Toledo), T. Clancy (Space Science Inst.), S. Lee (Univ. Colorado), and NASA. May 20, 1997.

Melting Martian ice caps: "Here a progressive shrinking of one of the Martian polar ice caps is very visible. While this fact should give pause to those who equate melting ice caps with human activity, there is much more to be discovered about the dynamic weather across our solar system."

visible and larger than anything previously observed. Dust has never been seen at comparable altitudes, up to 155 miles above the surface. Two of the explanations put forward, that the plumes were carbon dioxide ice particles or auroral activity, also didn't quite work. Mars' magnetic activity would be too weak for such auroral activity, and its atmosphere should not be cold enough for ice particles to exist at that level. Studies published in *Nature* magazine stated that the plumes seem to defy our current understanding of atmospheric physics on the red planet.

Almost every planet in our Solar System has storms,





NASA

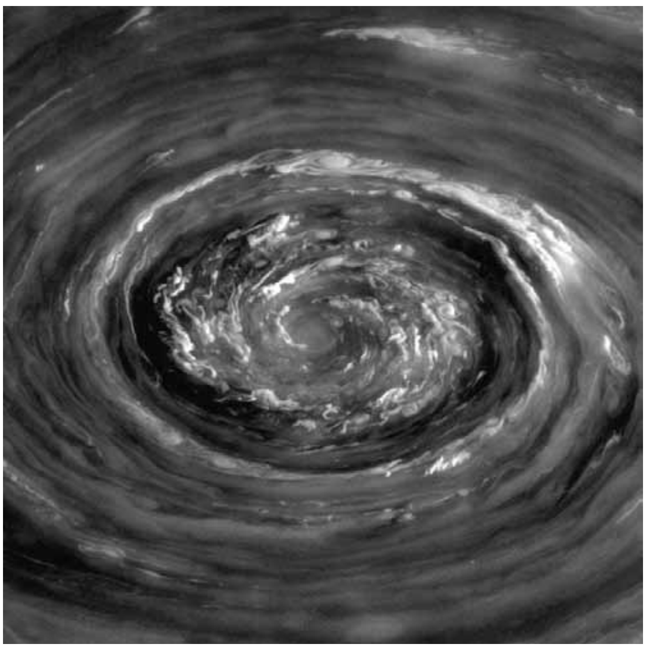
Jupiter's shrinking spot: "The accelerated shrinking of Jupiter's Great Red Spot currently lacks any clear explanation."

and storms which change in ways we don't expect. Extraterrestrial vortices are apparent on every planet but Mercury, and even some moons. Venus has such storms as relatively permanent fixtures at each pole, discovered in 2006 by the Venus Express probe. Venus' atmosphere is known to rotate relatively quickly around the planet, compared to its year. Its winds now appear to be rapidly speeding up, clocking in at 300 km/h in 2006 and 400 km/h by 2013. This large variation is new, and has not been observed before, nor is it understood.

Other unprecedented and unexplained changes literally surround us. Jupiter's famous "Great Red Spot" has becomes less intense, and surprisingly so. We have observed this storm for 150 years, but it is now smaller than ever, less than half the size we originally observed. While some note that eddies surrounding the storm appear to be changing it, or hypothesize something within the planet's atmosphere that is serving to drain energy from the storm, nothing is certain, and the shrinking appears to be accelerating.

Other storms are picking up in intensity, or simply arriving early based on our understanding of seasons. This was the case for Saturn's last storm. Saturn's seasonal storms have tended to arrive on time like clockwork in the Saturn spring (roughly every 29) years since we began observing in 1876, but this storm arrived quite early—seven years early, to be specific, or an entire season, and it was the largest storm we had ever seen on Saturn. There is also the fascinating case of "Saturn's hexagon," a persisting hexagonal cloud pattern at its North Pole. Attempts to simulate such a formation in the laboratory, by rotating a circular tank of liquid at different speeds between its center and surface, sometimes yielded this shape, but not always.

Studies of the Saturnian moon Titan point towards a solar, and solar-magnetic, influence upon planetary and satellite atmospheres, even at this far distance from it. In a recent paper submitted to the American Geophysical Union entitled "Observed Decline in Titan's thermospheric methane due to solar cycle drivers," the authors put forward evidence of an 11-year cycle, corresponding to the Sun's own 11-year change from



Benjamin Deniston, LaRouche PAC

Saturn' early storm: "As this infographic shows, Saturn's recent "seasonal" storm was anything but seasonal."

solar minimum to solar maximum (corresponding with the intensity of its magnetic activity).

Titan is the only moon in our Solar System with an atmosphere as thick as Earth's. Changes in its atmosphere's chemical makeup, specifically the methane component, is seen to vary according to this cycle, with its methane levels declining with the Sun's activity, and increasing with its inactivity. The authors believe that the radiation expelled from the Sun during flares and other eruptions is actually capable of reaching Titan and breaking apart the methane molecules, a process which was evident during the 2008-2013 period, with methane levels declining as the Sun reached its maximum. This analysis, based on reviewing data from Cassini, also corresponds to the earlier 1980 observations of Voyager, which coincided with a solar maximum and low levels of methane.

NASA, ESA, and L. Sromovsky (University of Wisconsin)

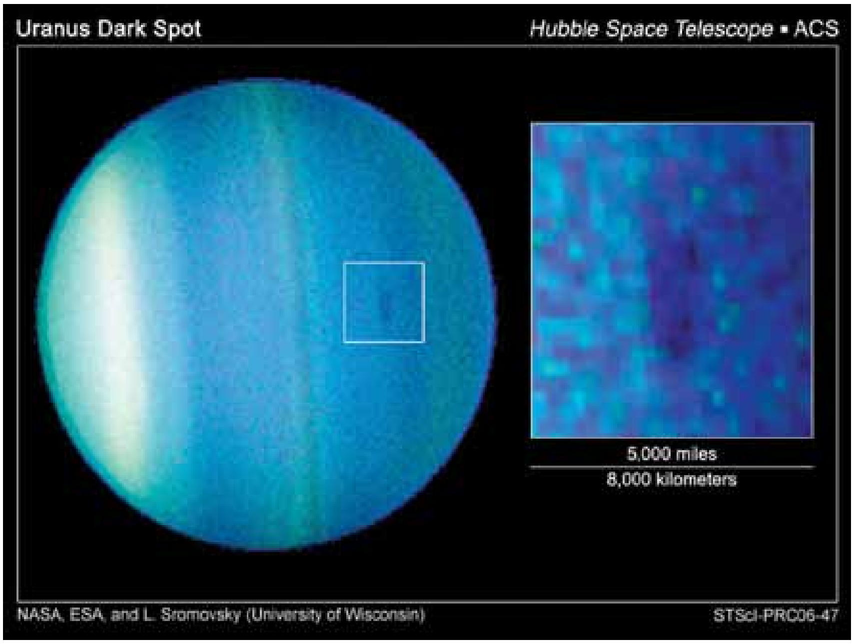
Neptune spots: "In this image, the two visible spots represent storm activity on Neptune, one of the most distant and most active bodies in our Solar System."

The Forgotten Ice Giants

The windy worlds of Uranus and Neptune, with top wind speeds of 560 and 1500 mph respectively, also present paradoxes. These winds are thought to originate due to causes that are either very deep, or, alternatively, very shallow processes in their atmospheres. The fact that the body which is farthest away from the Sun has some of the most intense weather in the Solar System does not have an obvious explanation. In a 2014 BBC documentary on the Ice Giants (part of a series called "The Sky At Night"), planetary scientist Leigh Fletcher of the University of Oxford said the following of these mysterious bodies, which he believes are well worthy of new missions:

> If you look at Uranus and Neptune, they formed at roughly the same sort of temperature, they took about the same length of time to form, you would expect them to be roughly the same. The same sort of composition, the same sort of weather, they have similar colors and that's because of the amount of methane they have in their atmospheres…
>
> But that's where the similarities really end. In fact, Neptune, despite being the farthest planet from the Sun, is actually one of the most dynamic places in our Solar System. It has these incredibly strong weather patterns and weather systems with clouds popping up and large cumulus systems developing that then get sheared apart by all the winds and jets and these can happen on an hourly basis, so that Neptune really doesn't look the same each night that we look.
>
> Now contrast that with somewhere like Uranus. Uranus, when Voyager flew past it in the 80's, was a very sluggish, dare I say boring planet. All said and done, Neptune is a much more powerful, much more active planet than Uranus despite being much much farther away at 30 AU vs 20. [The expectation is that this would make the weather less "dynamic."] Most of the giant planets, if you were to look at them with infrared eyes, would be glowing hot, they are emitting energy. Neptune has the biggest heat source of any of the giant planets… maybe that's contributing to this really powerful weather we see on that planet. But then contrast that with somewhere like Uranus. Uranus has almost no appreciable heat source that we can detect.

Fletcher supports a new mission to Uranus to answer some of these questions. But with winds upwards of 500 miles per hour, it can't really be fairly described as



NASA, ESA, and L. Sromovsky (University of Wisconsin)

Uranus Dark spot: "The first image of a dark spot on Uranus, which often appears calm and opaque, obtained in 2006."

boring, and it, like Saturn, has also recently shown evidence of surprising storms.

Uranus' virtual 90 degree tilt to the rest of the planets in our system makes it quite unconventional (and the cause of this tilt in and of itself is an interesting question), but theoretically it could have seasonal weather. In part, it simply hasn't been observed very much or very closely, but there was an increase in reported observations of cloudy spots in 2014, which turned out to be intense storms, viewed by the Hubble Telescope and from the Keck Observatory in Hawaii, with the initial observations drawing attention to it. This activity came seven years after the Northern Spring Equinox of 2007, when each pole was equally illuminated, and which was expected to be the height of convective activity.

The 2014 storms came from the Northern polar region, which, however, should not have sufficiently warmed after its long winter to produce such intense storms. "Why we see these incredible storms now is beyond anybody's guess," said Heidi Hammel of the Association of Universities for Research in Astronomy, and a co-investigator in these recent studies. "These unexpected observations remind us keenly of how little we understand about atmospheric dynamics in outer planet atmospheres," the authors wrote in their paper.

Interplanetary Comparative Cosmoclimatology

All this should be taken as a reminder that we should hesitate before boldly proclaiming that we understand the causes of weather on our own planet. Will we make more progress in our study of weather, and increase the accuracy of our forecasts, if we stop studying each body in our Solar System as a totally unique and distinct place? Should we approach weather in a more systemic way, taking into account the respective differences of each planet, but always the fact that they all interact with our changing Sun and galactic environment?

Of course we shouldn't expect that all the answers we would desire are just a question of analyzing existing data, although there might be interesting discoveries awaiting us there. We should design new missions which seek to answer questions about the role which cosmic radiation might play in driving Solar System-wide weather, as well as comparing cycles in seismicity and volcanism, considerations which have been factored into an upcoming Mars mission called Insight.

Initial comparisons of Earth and recent lunar volcanism appear to show intense activity at roughly the same time. Simply a coincidence? We can reasonably start from the hypothesis that as part of a Solar System, the Sun and its changes may very well play a critical role in all planetary weather, with differences in composition, distance, and other factors determining the magnitude of that effect and its expression.

Let's not close our minds to the possibilities of the science of weather forecasting at this Solar System and even galactic level—it would be a tragedy to block out the study of these forces in the name of blind ideological promotion of the theory of anthropogenic global warming, of which there is scant legitimate evidence at best (not to mention that many promoters of this theory simply view it as a means to encourage depopulation). Let's create a new science—Interplanetary Comparative Cosmoclimatology—the means by which we will improve our weather forecasts, and beyond.

IV. Earth-Moon Comparative Planetology

by Benjamin Deniston

May 31, 2015

As the Solar System has traveled through our Galaxy, it has experienced different galactic environments: the regions north or south of the galactic plane, the central regions of the galactic plane, the spiral arms, various giant molecular clouds, star forming regions, open clusters, etc.

Since evidence is now accumulating to show that different planetary bodies in the Solar System respond (sometimes differently) to these various galactic environments, an examination of the historical experience recorded on (or in) these different bodies can tell us about the Galaxy. Perhaps most interesting are prospective cross-comparisons of the histories of different bodies, looking for indications of when they show certain changes or activity at the same time—indicating they could be responding to the same external influence.

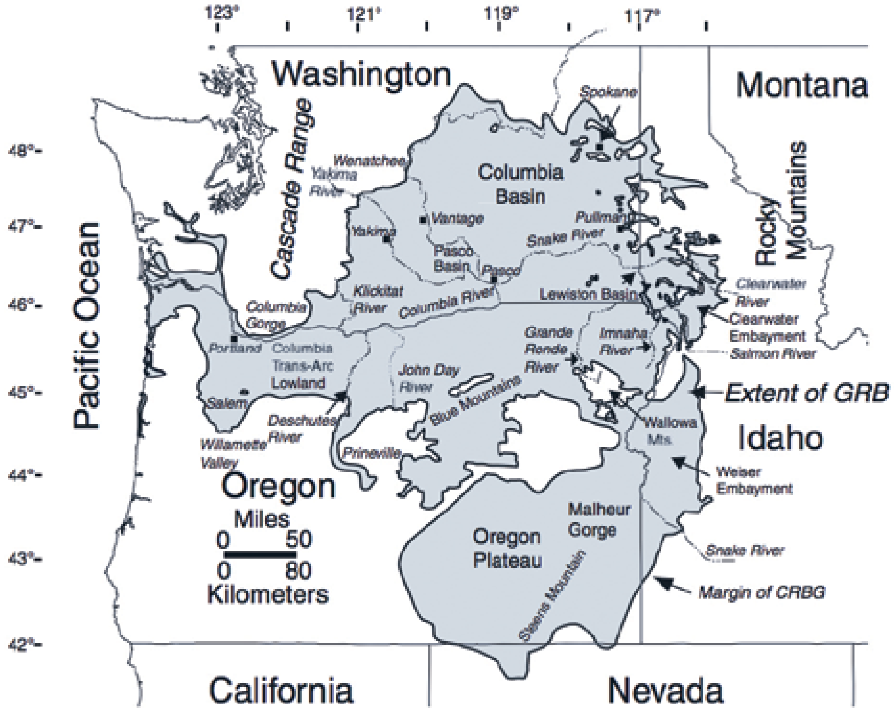


Image Credit:"Eruption chronology of the Columbia River Basalt Group," by T.L. Barry, et al. 2013 Geological Society of America.

This map shows the main regions of flood basalt exposure, resulting from massive lava flows starting sixteen and a half million years ago.

Cases of weather and climate changes on various planetary bodies were examined in the earlier article.[21] Another example is provided by a 2002 study by Nir Shaviv, "The spiral structure of the Milky Way, cosmic rays, and ice age epochs on Earth," which demonstrates a singleness of convergence from three different paths of investigation.

Path one: Shaviv examined existing models of the motion of our Solar System through the Galaxy, identifying when those models said the Solar System should be passing through the Galaxy's spiral arms.

Path two: Shaviv examined records of major global glaciation events in the Phanerozoic history of the Earth's climate, identifying their periods.

Path three: Shaviv examined iron meteorites, which—before falling to Earth—spent the past hundreds of millions of years orbiting the Sun in interplanetary space, experiencing the changing galactic cosmic radiation conditions of interplanetary space.

The three independent lines of investigation came together to indicate aspects of a single overall picture. On the one side, we have indications of when the whole Solar System may have experienced different galactic

21. "Solar System Weather Changes Challenge Conventional Theories," by Meghan Rouillard, in Part III in this report.

Peter Hartree (Attribution-ShareAlike 2.0 Generic)

The eruption of the Baroarbunga Volcano on September 4th 2014.

environments, and, on the other side, we have records of different bodies of the Solar System responding in their own way to changing cosmic environmental conditions (for the Earth, a response of the climate system; for the asteroid pieces which are to become meteorites, a response in the records of chemical transmutation—through galactic cosmic ray spallation—and the subsequent records told by the radioactive decay of the created elements).

For the response of Earth systems, additional examples (besides climate response) include the potential reaction of life and the biosphere to these varying galactic environments.[22]

Here we will briefly focus on provocative evidence indicating that perhaps records of another type of planetary activity might also be telling us about different galactic environments: the processes underlying large-scale planetary volcanic events and geophysical activity more generally.

While such a relation—showing planetary geophysical activity to be responsive to galactic influences—would be extremely challenging to the current paradigm of stellar-level science, this is not the first time the question has been posed. Here, in addition to identifying existing investigations, we will add another bit of evidence, which, to this author's knowledge, hasn't been posed before: the temporal correspondence between the largest three recent periods of lunar volcanism with the last three major periods of flood basalt events on Earth.[23]

Since the geophysical (or comparable) activity within planetary bodies is currently believed to be an isolated and self-determined product of that planetary body, indications for responses to external influences could point to mechanisms associated with a new galactic-level of science.

Biodiversity, Geophysical, and Galactic Cycles

In 2005 a ~60 million year cycle in marine fossil biodiversity was discovered.[24]

Subsequent investigations into the possible cause of this cycle noted that the period and phase of the cycle correspond very well with the modeled motion of our Solar System above and below the plane of our Galactic System.[25] However, a galactic influence guiding the evolution of life has remained outside the scope of thought of most researchers, because it would require the relation (mechanism) to be expressed though a north-south dissymmetrical characteristic in the Galactic System.[26]

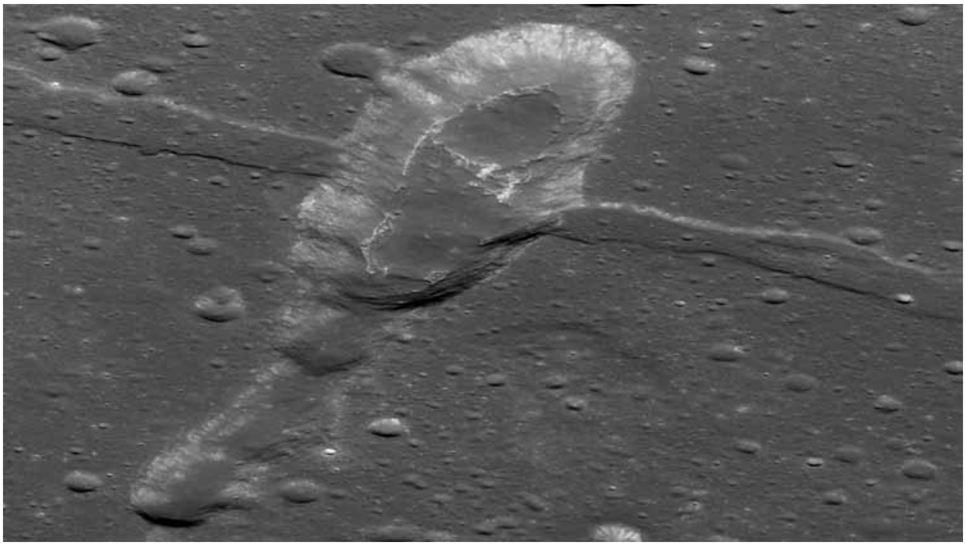
22. See "A Vernadskian Reconsideration of Galactic Cycles and Evolution" in this report.

23. Flood basalt events are produced when a massive volcanic eruption or a series of eruptions cover large areas with lava. These can also produce structures called large igneous provinces.

24. "Cycles in fossil diversity," Rohde, Muller; 2005.

25. "Do extragalactic cosmic rays induce cycles in fossil diversity?" Medvedev and Melott, 2007.

26. "A Vernadskian Reconsideration of Galactic Cycles and Evolution," Benjamin Deniston; *EIR*, May 22, 2015.



NASA/GSFC/Arizona State University

The Sosigenes lava flow (irregular mare patch) might be just 18 million years old.

At around the same time other studies showed that cycles in geophysical activity (large scale volcanism, sedimentation, and continental uplift) match this ~60 million year biodiversity cycle quite well.[27]

Could the biodiversity cycles and the geophysical cycles both be expressing a response to the changing galactic environment experienced by the Solar System?

There are two ways this question can be approached.

One approach—which could be called the 1900 approach[28]—states that a mechanism must first be posited to explain how the interaction could occur within the framework of currently known (or possibly accepted) physics, and only then can the question be asked. At least one published study (known to this author) has attempted to related biodiversity cycles, geophysical activity, and the motion of our Solar System through the Galaxy in this way; however their mechanism is unable to account for all the correlations between galactic travels and geophysical activity on Earth.[29]

Another approach—what could be called a Cusian approach[30]—examines such correlations between activity of the lower order system associated with its changing relations to the higher-order system as clues and anomalies which might force the need for a new level of science—a new understanding associated with a higher-order galactic principle (and a corresponding higher-order physics, subsuming present notions).

Corresponding independent responses from different planetary bodies in our Solar System (the Earth and Moon) provide an impetus to force more attention to this second approach.

A Cusian Approach

In late 2014 a study was published showing that the Moon has been volcanically active much more recently than scientists had thought.[31]

While it was thought that volcanism on the Moon ended around a billion years ago, this study showed that multiple lunar volcanic structures are almost certainly less than 100 million years old. The study provided approximate dates for the three largest of these recent structures.

•"Sosigenes irregular mare patch" (IMP), covering 4.5 km^2, is dated to about 18 million years (Myr) ago (+/- 1 Myr)

•"Ina," covering 1.7 km^2, is dated to about 33 Myr (+/- 2 Myr)

•"Cauchy-5 IMP," covering 1.3 km^2, is dated to about 58 Myr (+/- 4 Myr)

In pursuit of a Cusian approach, this author thought to compare these three dates with periods of increased volcanic activity on Earth.

Two sources provide the approximate dates for periods of increased large-scale Earth volcanism (referred

27. "Sixty-two million year cycle in biodiversity and associated geological processes," Rohde, 2006. "60-Myr Periodicity Is Common to Marine Sr, Fossil Biodiversity, and Large-Scale Sedimentation: What Does the Periodicity Reflect?" Melott, Bambach, Petersen, McArthur, 2012.

28. 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.

29. "Disc dark matter in the Galaxy and potential cycles of extraterrestrial impacts, mass extinctions and geological events," Rampino, 2015.

30. *De Docta Ignorantia*, Nicholas of Cusa, 1440.

31. "Evidence for basaltic volcanism on the Moon within the past 100 million years," Braden, Stopar, Robinson, Lawrence, vander Bogert, Hiesinger, 2014.

to as "flood basalt events" or the creation of "large igneous provinces").[32]

As can be seen in the accompanying table, the correspondence with the recent lunar volcanic events is remarkable.

Earth Flood Basalt Events		Recent Lunar Volcanism	
Columbia River Flood Basalts	15.3-16.6 Myr	Sosigenes IMP	18 (+/- 1) Myr
Ethiopian and Yemen traps	29.5-31 Myr	Ina	33 (+/- 2) Myr
North Atlantic Tertiary Volc. Prov. 2	54-57 Myr	Cauchy-5 IMP	58 (+/- 4) Myr

It is generally assumed that volcanic activity is a product of the internal dynamics of a planetary body acting in isolation from the rest of the Solar System and Galaxy.

Yet here we see evidence of two different bodies coming into activity simultaneously—a temporal correspondence in the three largest recent volcanic events on the Moon, and the three most recent flood basalt events on the Earth—as if both bodies (Earth and Moon) were responding to the same environmental influence. This evidence for coordinated interplanetary activity provides potential support for examining the earlier-mentioned longer-term correlation between cycles in other forms of geophysical activity, and the motion of our Solar System through the Galaxy.

Because we only have three events (and room for improvement in the dating of the lunar events), this points to the importance of developing much more detailed investigations of these and other structures on the Moon (as well as on other bodies, such as Mars, various asteroids, other planets, other moons, etc.), enabling a more thorough comparison of the histories of various components of our Solar System in search of indications of a coordinated response to the higher-order Galactic System.[33] This will be critical to further pursuing this path of investigation of the nature of Galactic System, as expressed in the subsumed activity of the Solar System, and its various components.

32. "On the ages of flood basalt events," Vincent E. Courtillot, Paul R. Renne; 2003. "Time-Series Analysis of Large Igneous Provinces: 3500 Ma to Present" Prokoph, Ernst, Buchan, 2004.

33. Another provocative study, examining a much shorter time scale, showed that moonquakes (measured from 1969 to 1977) preferentially occurred when the Moon was facing a specific sidereal position, prompting the author to ask about a "Possible Extra-Solary-System Cause For Certain Lunar Seismic Events" (Yosio Nakamura and Cliff Frohlich, 2006).

NASA

V. A Vernadskian Reconsideration of Galactic Cycles and Evolution

by Benjamin Deniston

May 20, 2015

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.

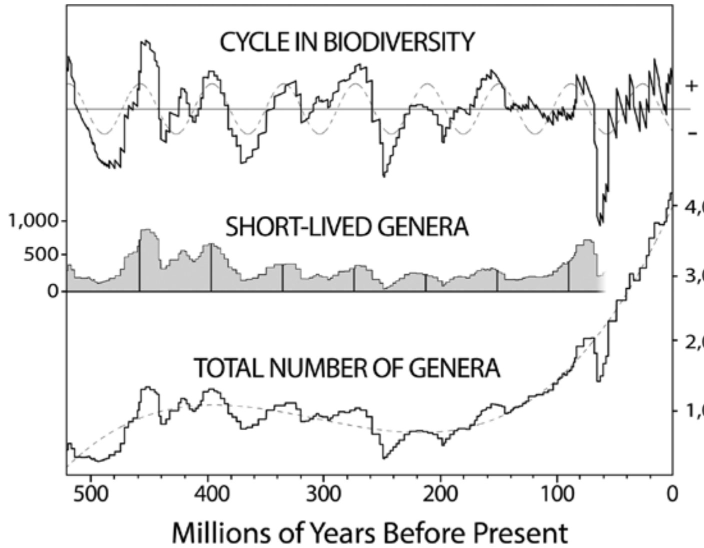
life on Earth and the subsuming Galactic System.

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.

FIGURE 1
Marine Fossil Diversity



adapted from Rohde & Muller, 2005

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]

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

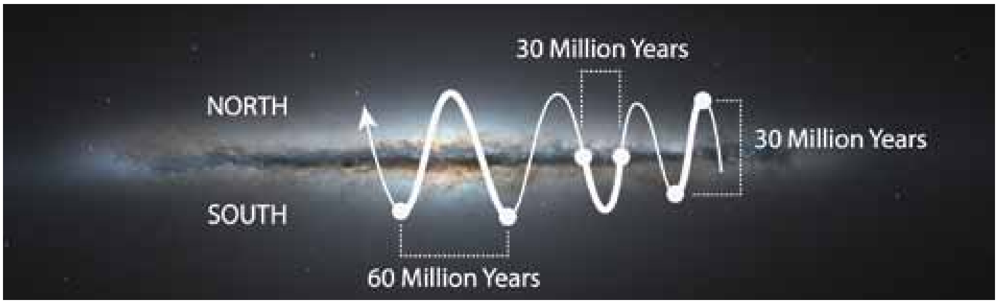
45. See section 11 of "The Study of Life and the New Physics." See footnote 37.

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.

VI. Singularities and Supermassive Black Holes

by Benjamin Deniston

Adapted from an April 2014 research report

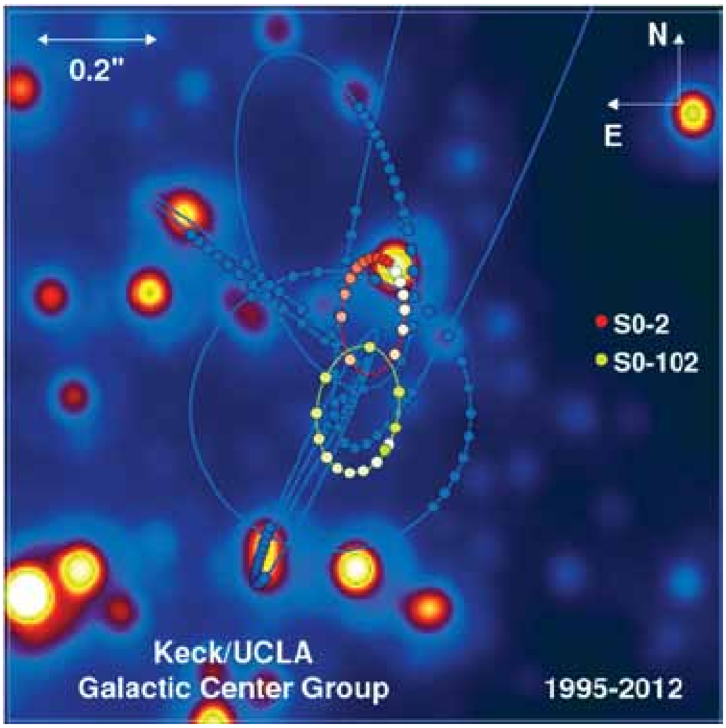
Stepping away from studies of what changes and activity in the Solar System tells us about the Galaxy, we can also look at certain categorical aspects which appear to be features of all galaxies as a class. Here we will focus on a characteristic supermassive phenomenon thought to be at the center of each galaxy, the immense energetic activity associated with that phenomenon, and how the mass properties of that phenomenon are intimately tied to global features of the entire galactic system.

Perhaps we can say that we now look at the phenomenon referred to as "supermassive black holes" as scientists of the early Nineteenth Century looked at the Sun.

Then, in the 1800s, it was clear the Sun had been burning for a very, very long time. But what was it burning to be able to sustain itself for so long? If it was some form of chemical combustion there is no way it could sustain that level of energetic output for hundreds of millions or billions of years! Yet records were showing that advanced life had been sustained for a half billion years by a consistent and vigorous output from our star, and that our star has bathed our planet in its warmth for even much longer. This was a paradox—one unsolvable in the scientific framework of the Nineteenth Century. It took a complete revolution, overturning the fundamental understanding of the scientific nature of the Universe to provide the framework to begin to understand the Sun.

Today, we ask, "what is a supermassive black hole and the associated phenomenon of an active galactic nucleus?"

Image 1



Prof. Andrea Ghez and her research team at UCLA; based on data sets obtained with the W. M. Keck Telescopes

The orbits of stars within the central arcsecond of our Galaxy. The orbits have been inferred from images taken with the primitive technique of speckle imaging (1995 - 2005) and with the more sophisticated adaptive optics (2005-2012). While several stars can be seen in their motion through this region, only two stars (S0-2 and the newly discovered S0-102) have been traced through a complete orbit. They are the most tightly bound to the black hole and therefore comprise the most information about it. S0-2, which has an orbital period of 16 years, proved the existence of a black hole. The addition of S0-102, with a period of 11.5 years, will for the first time allow us to test the warping of space and time this close to a black hole.

A Singularity

As was recognized not long after their development, the Einstein field equations of Einstein's general theory of relativity showed that if an object was massive enough and small enough, it would cause the spacetime metrics to run off to infinity—creating a mathematical gravitational spacetime singularity. But what would actually happen here? The equations say as the gravity becomes infinite, time stops, and space becomes unintelligible, but would actually happen in the real Universe? No one knows, as the entire framework of the mathematical physics literally breaks down.

While this was treated as a mathematical construct for years, at some point there arose the actual prospects for the discovery of physical objects massive enough and small enough to meet the mathematical criterion which would supposedly lead to such a singularity. These are generally referred to as black holes.

Theoretically, if a star is large enough, supposedly at the end of its life-cycle, it should be able to collapse on itself with enough force to compress the core to these singularity-generating conditions. Today there are astronomical candidates for such stellar-mass black holes.

However, here we're interested in another type of so-called black hole, a supermassive black hole, like the one at the center of our Galaxy called Sag A*. Being four million times the mass of our own Sun, this couldn't have come from the collapse of a single star, and is part of this other, supermassive, class.[58] Using adaptive optics on the Keck telescope, astronomers have been able to observe entire stars tracing out clean elliptical orbits around a point in space at the very center of our Galaxy where nothing is seen (taking as little as 16 years to do so). This is the most solid observational evidence for the existence of a supermassive black hole (**see Image 1**).

But what is it? What is happening there?

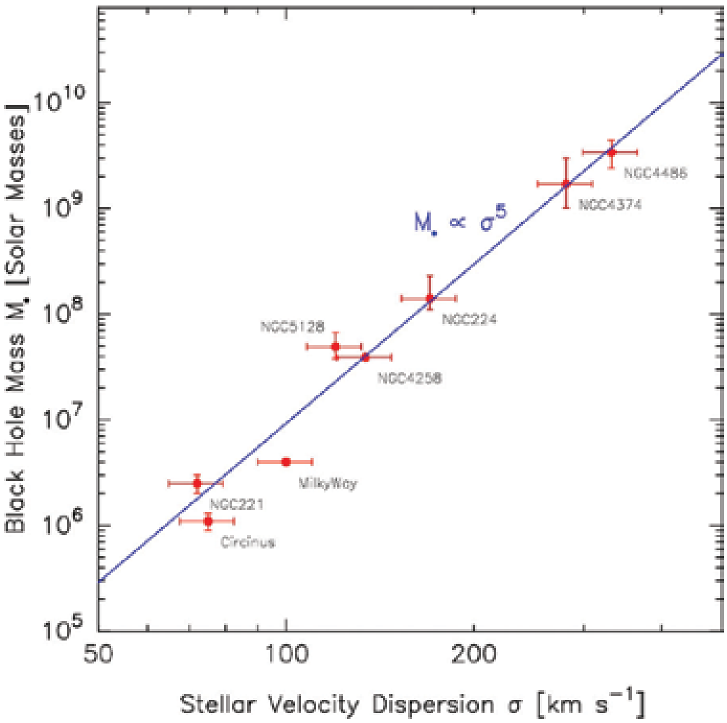
Before considering this question, let us first ask if there are any other places where mathematical singularities arise in the investigation of physical processes, and if these cases, comparing a mathematical infinity with a physical reality, provide any general insight for how to approach such questions?

A useful case might be Riemann's work on the acoustical shockwave.

Long before the advent of supersonic flight, it was calculated that as the speed of sound is approached, the density of sound waves would continuously build up, increasing asymptotically as the speed limit is approached, creating a physical barrier. The mathematical interpretation says the density of sound waves goes to infinity, creating what appeared to be an insurmountable singularity. Yet Riemann was able to forecast that—in physical reality—this barrier could be transcended, a solution that many claimed had some neat mathematical tricks, but which had no bearing on physics. In reality, exactly the opposite was the case.

Perhaps this provides a conceptual reference point for how to think about the relationship between mathematical singularities in the Einstein field equations, and the observational evidence for something we tend to call "supermassive black holes." The mathematics go to infinity, but that may just signal a phase shift in the physics—in this case, likely a higher-order domain.

Image 2



Msigma at English Wikipedia

Black hole mass plotted against velocity dispersion of stars in the galaxy bulge [a measure of the mass of the bulge]. Points are labeled by galaxy name; all points in this diagram are for galaxies which exhibit a clear, Keplerian rise in velocity near the center, indicative of the presence of a central mass. The M-sigma relation is shown in blue.

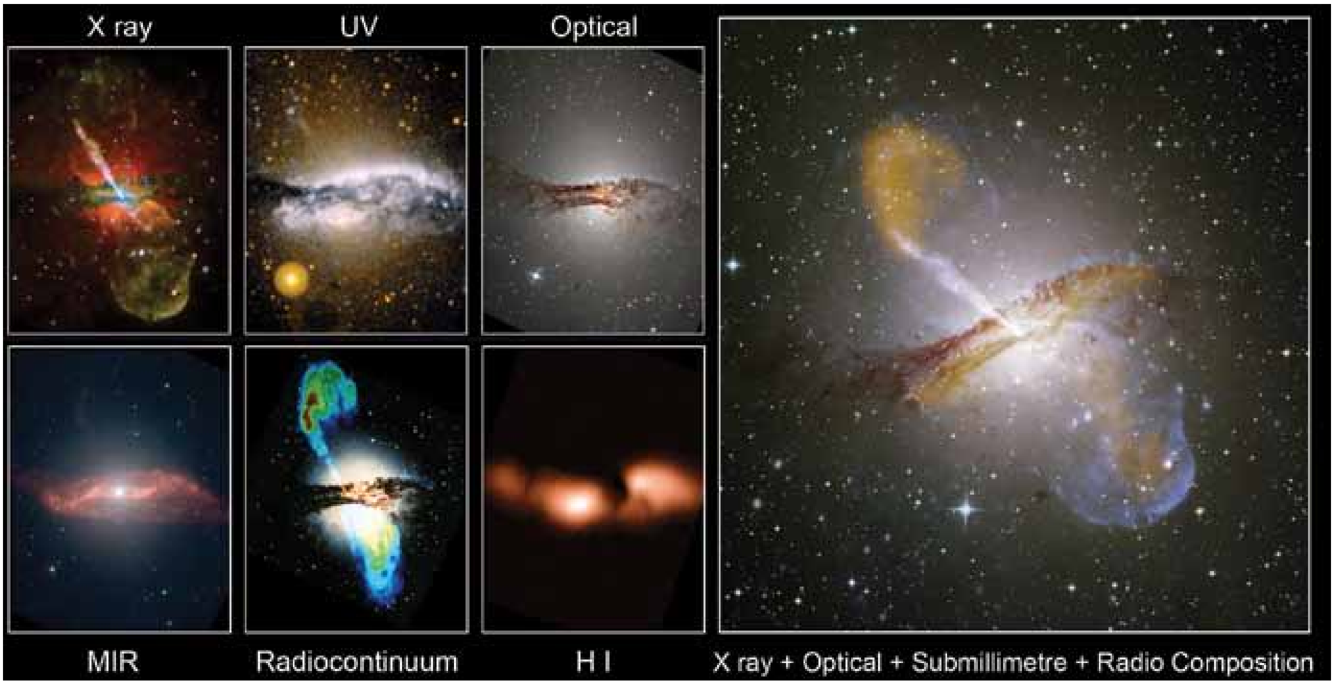
Unified Structure

Every galaxy is thought to contain one supermassive black hole in its center. This brings us to a most interesting phenomenon referred to as the "m-Sigma" or black hole-bulge relation (**see Image 2**). This is an empirical observation, showing that the mass of the spherical bulge of a galaxy is always the same proportion greater than the mass of the single supermassive black hole at its center. This holds for smaller galaxies and for larger galaxies.

This is a major challenge to explain in the current

58. It is thought every galaxy has a supermassive black hole at its center. It's assumed that a supermassive black hole is produced by the accumulation of many stellar black holes (and other material), but the lack of any black holes in size ranges in-between (so-called intermediate class black holes) poses a challenge to that assumed idea of the origin of supermassive black holes.

Image 3



Centaurus A is a giant elliptical galaxy - the closest active galaxy to Earth. This remarkable composite view of the galaxy combines image data from the x-ray (Chandra), optical (ESO), radio (VLA) [and more] regimes. Centaurus A's central region is a jumble of gas, dust, and stars in optical light, but both radio and x-ray telescopes trace a remarkable jet of high-energy particles streaming from the galaxy's core. The cosmic particle accelerator's power source is a black hole with about 10 million times the mass of the Sun coincident with the x-ray bright spot at the galaxy's center. Blasting out from the active galactic nucleus toward the upper left, the energetic jet extends about 13,000 light-years. A shorter jet extends from the nucleus in the opposite direction. Other x-ray bright spots in the field are binary star systems with neutron stars or stellar mass black holes.

framework of a stellar-level science. Despite its immense mass, a supermassive black hole should not be able to act to determine the mass of the entirety of the galaxy or its bulge, or vice versa—especially with such consistency.[59]

It would make sense that there is a general relation, with larger galaxies generally having larger supermassive black holes (and vice versa). But the observed proportion between the bulge mass and the supermassive black hole mass is too precise and narrow to find acceptable explanation so far.

It would be comparable to discovering that the height of the largest mountain on every continent is always exactly one five-thousandth of the size of that continent. Or if we noticed that every planet has one moon that is exactly one ten-thousandth the mass of the planet. We might expect some very broad relationships, but finding anything so precise would be very strange and surprising.

With the supermassive black holes and their host bulge, it is that precise. We can find analogies in the natural world, but only when we look to living (instead of non-living) processes. For example, this galactic scaling relationship is more like how the size of a heart will scale with the size of an animal. That makes sense for animals, because we recognize animals as single entities which grow, develop, and change as a unity. In contrast, the current scientific paradigm assumes the development of galaxies to be a product of the accumulations of actions of individual parts with no single principle governing the whole—an assumption that appears, even from just this evidence, to be false.

What more can we know about this fascinating phenomenon of the supermassive black hole?

Energy Flux Density

Another phenomenon associated with some supermassive black holes is known as "active galactic nuclei." A small percentage of galaxies have extremely

59. It is thought that there are some interactions. A host galaxy is thought to provide the material by which its supermassive black hole grows, and it is thought that the energetic output of a supermassive black hole could affect star formation. But why such interactions would produce a tight proportional relationship in the mass is a mystery.

bright and active centers, emitting energy across the electromagnetic spectrum, shining more brightly than the entire surrounding galaxy (containing billions of stars), and sometimes ejecting massive amounts of material out of the galaxy.

These active galactic nuclei are the most energetic (while sustained) phenomenon known in the Universe.

Some active galactic nuclei—such as Centarus A, the closest active galaxy to us—shoot out "jets" or "lobes" of plasma, which can extend well beyond the reach of the galaxy itself (**see Image 3**).

To power such incredible powerhouses of activity, our mysterious supermassive black hole is brought back into the equation. There is simply no source of energy—within the current paradigm of stellar-level science—which can sustain the observed activity of the active galactic nucleus, other than the gravitational singularity.

The current theory is that the immense gravitational attraction of the supermassive black hole pulls gas, dust, stars, etc. into a concentrated spinning disc of material spiraling towards the event horizon (creating an accretion disk), and this pre-event horizon disk of activity is so intense that it radiates energy, jets of material, and everything else that we observe with an active galactic nucleus.

However, this is all theory, and an unstable one at that. A recent study with data from NASA's WISE space telescope appears to overturn key elements of this theory.[60]

Yet we do observe active galactic nuclei, and their jets and lobes, with all their splendor. And we do have observational evidence for something (a so-called supermassive black hole) which appears to approach the criterion of the mathematical singularity, where the current paradigm of mathematical physics breaks down. And we have reason to believe there is a connection between the two—the phenomenon which exists beyond the boundaries of current science, associated with the most energetic activity currently known in the observable Universe.

60. "NASA's WISE Findings Poke Hole in Black Hole 'Doughnut' Theory," May 22, 2014.

Prometheus holding Hercules' Galaxy, adapted from "Prometheus Brings Fire to Mankind," by Heinrich Friedrich Fuger, 1817.

A Hypothesis

As the solution to the Nineteenth Century mystery of our Sun depended upon a revolution in our understanding of some of the most fundamental conceptions about the nature of the Universe (matter, energy, space, and time), we must open our minds to the possibility that a similar revolutionary shift will be needed to understand our Galaxy.

The tight relationship between a supermassive black hole and its galaxy provokes considerations of a causality which is not mediated through the available mechanisms provided by the current stellar level of science.

Perhaps these investigations challenging the boundaries of known physics in the very large will equally couple back to the anomalies and limits in the very small.

The unmatched energetic output from a region where current mathematical physics reaches a singularity (breakdown) causes us to wonder about new reactions and processes which could be as outside of our current understanding as was $E=mc^2$ in 1850.

How would such a subsuming physics of the Galaxy subsume and reshape our concepts of energy, space, time, and matter? Of causality? And, perhaps most interesting, what would such a leap bring for mankind?

As the energy density of nuclear reactions leaped orders of magnitude beyond that of chemical reactions, we are left to ponder the capabilities provided to mankind wielding a Galactic Principle.

Somewhere, deep in the Universe, Prometheus awaits our arrival, holding the fire of an active galactic nucleus in hand.