Following the Beat of A Different Drummer

by Peter Martinson

Involuntary rhythmic activity in biology is a phenomenon common to every organism studied, and covers virtually every vital process in those organisms. Such processes cannot be ascribed simply to an internal clock-mechanism within the organisms, nor to purely external geophysical or cosmic influences. There is a deeper process at work, which can be approximated by assuming a combination of both causes. This consideration leads directly to not only a broader definition of sense perception, but to implications about the long-term anti-entropic development of life on the Earth, and into the manned exploration of other planets within the Solar System.

Lyndon LaRouche has demanded that fundamental science proceed with the understanding that the universe is composed of three interacting, but hierarchically arranged phase spaces: the abiotic, the biotic, and the noëtic. These phase spaces were established by no later than 1938, by Russian academician Vladimir I. Vernadsky, who had already demonstrated that the world of abiotic physics did not have a monopoly on such deep issues as the construction of physical space-time.[1] No form of fundamental science in the biotic phase (or either of the other phases, for that matter) should ever be allowed to be reduced to abiotic physical explanations. This should be extended to imply that further discoveries in what can be imagined as "abiotic physics," can only be made by coming down from discoveries in biology. The assumption that any investigation into biological phenomena can be explained in terms of what is already known in physics, is as insane as saying that your Mom is no more than a very complicated spatula.

With this in mind, the responsible scientist will recognize that something like the phenomenon of biologi-

1. V.I. Vernadsky, *Problems of Biogeochemistry II: On the Fundamental Material-Energetic Distinction Between Living and Nonliving Natural Bodies of the Biosphere.* First published in 1938 in Russian. First English translation, *21st Century Science & Technology*, Winter 2000-2001, pp. 20-39.

cal rhythms has the potential to reveal not only as-yet unknown domains of cosmic radiation, but also, unknown aspects of radiations that have hitherto been barely contained by their mathematical formulations. For example, what will be seen is that organisms tend to respond to incredibly weak fields, which are apt to be missed by conventional instruments. Those organisms have been responding to those weak fields for billions of years, much longer than humans have known they existed. This opens up the possibility that organisms respond not only to weak fields, but also to extremely long-cycle radiations, on the temporal scale of geological time, which correspond with evolutionary changes in life on the Earth.

Are individual organisms really individual organisms, struggling for individual existence against external waves and particles, or are they better understood as within the category of cosmic radiation itself? Even better, perhaps cosmic radiation must be studied as the prime expression of that higher phase than the abiotic—life—the organisms thus understood as contractions within the field. Hence, the term "sense organ" refers to something fashioned by cosmic radiation itself, in order to mediate an intergalactic system.

Before embarking on a survey of crucial experiments regarding biological rhythms, let us first review the notion of senses, from the perspective of astrophysicist Johannes Kepler.

Kepler

An object that is sensed by somebody, must be able to act in some way on the sense instruments of his body. Thus, the retina of the eye must be able to respond to some disturbance caused by a seen object. The disturbance is caused, in this case, by what we call light, although the light itself is not seen—light is what is generated by the seen object, which can act on the eye's retina. By some as yet unknown path, the soul of the viewing person must be able to judge whether his retina is being affected by an outside object. In this way, the person is not watching the external object, but his own retina. LaRouche has described this paradox as that of the space traveler, within a spacecraft which has no windows, only instrument readings.[2] He witnesses the instrument readings, not what causes those readings. Hence, there is no window between external physical reality, and the soul of the observer, through which the emanations from the observed object pass from out to in. Those emanations essentially stop at the instrument. It is your mind, which creates the image of a viewed external, extended world—this perceived world is not what the "real external world" "looks like."

Humans and other organisms are capable of acting proportionally to what is sensed. In other words, they can judge how long they should do certain activities, how far to travel, how far to turn, etc. Johannes Kepler assembled an exhaustive study of all the constructable visual and auditory proportions in his *World Harmonics* of 1618.[3] He put this work together, after having followed up his initial study of the Solar System (presented in his *Mysterium Cosmographicum*[4]), with the identification of the key parameters of planetary orbits, by focusing on Mars and the Earth.[5] Kepler's goal, right from the start, which he most fully expressed in the *World Harmonics*, was to show that the universe functions on the basis of a pre-established harmony, and that it was composed with the mind of Man, in mind. In other words, Man's mind can comprehend how and why the Creator created the universe in the way that it was, because the universe was designed to be thus comprehended.

Kepler places the motive faculty within the powers of reason, which he bestows only on Man and God. Man recognizes the proportionality, and then decides on appropriate action. Since other organisms also act according to reason, yet do not possess the faculty of reason themselves, Kepler hypothesized an agent to mediate between them and God, which he called "Sublunary Nature"—a soul for the Earth.[6] Specifically,

2. Lyndon H. LaRouche, Jr., "An Election's Terrible After-Taste: The Global Crisis Now at Hand," *EIR*, Jan. 7, 2011. Also at http://www.larouchepac.com/node/16929

3. Johannes Kepler, *Harmonices Mundi*, 1619. English translation: *The Harmony of the World by Johannes Kepler*, trans. by E.J. Aiton, A.M. Duncan, and J.V. Field (Philadelphia: American Philosophical Society, 1997).

4. Johannes Kepler, *Mysterium Cosmographicum*, 1595. English translation: *Mysterium Cosmographicum—The Secret of the Universe*, trans. by A.M. Duncan (New York: Abaris Books, 1981).

5. Johannes Kepler, *Nova Astronomica*, 1609. English translation: *New Astronomy*, trans. by W.H. Donahue (Cambridge, U.K.: Cambridge University Press, 1992).

6. It should be noted, that Bernhard Riemann addressed this same issue when he was still a student. In his writings on *Geistesmassen* (roughly translated as "thought objects"), he referred to the Earth Soul, which uses plants as a form of sense-perception, and can act on the basis of such perceptions.

Sublunary Nature can perceive the apparent angles between the lines of sight to the other planets in the system, including the Moon and Sun, and determine how to react to them. Kepler is careful to make clear, that the perception itself is not what *causes* such reactions. In no way is the emanation from the sense object the direct cause of any action of any organism, including Man. That action is on account of the perceived proportionality, which itself bears no motive force.

Kepler discovered, based on knowable and constructable congruences between the plane figures, which angles, or "aspects," should be more or less influential on Sublunary Nature. For example, opposition and conjunction between two bodies (both equal two right angles, or 180°) are the most influential, while one right angle between lines-of-sight will be somewhat less influential. Most of the apparent angles between any two bodies will not coincide with any influential aspects, which is why Sublunary Nature will ignore them. But, when it perceives the passing of influential aspects, Sublunary Nature acts accordingly, through its organs, including weather systems, volcanic and seismic activity, the tides—and living organisms.[7] What must be added to this, is that complete cycles exist for each aspect, such as from one conjunction to the next, which are the temporal representation of such influences. This will figure in to the regular biological cycles.

Let's apply Vernadsky's three-phase-space criteria. What should be the difference between the responses of humans, and the other organisms on Earth? The responses of organisms should appear novel and creative overall, but should show relatively little variation over members of one species. Humans, on the other hand, should be able to individually change their responses to the aspects, within certain limits. For example, although it exacts a toll on the biological system, humans are capable of performing shift-work. No fruit fly can independently decide to go on night shift, while the others still work days, and vice versa, although the insect can be trained, by humans, to shift its sleep cycle. Humans can decide to act contrary to any of their sense perceptions, although many do not.

In addition, as LaRouche has been trying to tell you, over and over,[8] humans have the ability to recognize that what they think they are perceiving, represents shadows of what they are not seeing, and then, they can respond to the causes of the shadows instead, again, through their own volition.

As will become clear in the examples that follow, organisms typically function in rhythmic cycles which correspond to periods determined by the relative angular positions of the planets in the Solar System, and other relations outside of the system, on galactic and intergalactic scales. Thus, it should be reasonable to hunt for sense faculties within organisms that can respond to appropriate signals from the Earth, which are generated in response to those larger and deeper systems. But, it should not be assumed that those sense functions work the way a physics textbook would imply.

Biological Rhythms

First, let us survey the phenomena of biological rhythms, and then examine how they work in relation to the cosmic sensorium.

Most of the biological cycles studied are about 24 hours in length, and are thus called circadian (from the Latin *circa*, around; and *dian*, a day). This includes wake-sleep cycles, sometimes measured as "locomotor activity" in animals. A rhythm found typically in shore creatures, is a twice-daily cycle associated with the daily tides, and thus, half the lunar day. Longer cycles on the order of a lunar month also exist, such as the average human female menstrual cycle.[9] Even longer cycles, on the order of a Solar year, are seen in the hibernation activities of many organisms ("diapause"), the de-greening and loss of leaves on deciduous trees,

7. Riemann thought that the Earth Soul had, as sense organs, each species of plant in a given region. Based on what was sensed, through these plants, as the conditions of the atmosphere and land, the Earth Soul could decide what to do next, regarding the evolution of life on its surface.

8. Lyndon H. LaRouche, Jr. "A Wedding Anniversary: The Sixth Sense," *EIR*, Jan. 14, 2011.

9. In order to clear some things up: The human female menstrual cycle has a period which varies among women from several days to several months. The average span of the cycle, though, is about 29 days—approximately one lunar month. The question of whether this cycle has a connection with the Moon is complicated by widespread evidence that women who live and work together tend to begin "cycling" together. The cycle itself can also be heavily modified by hormone supplements. Overall, this should be viewed as another case where cycling is inherent in the organism, while being sensitive to external factors.

plant blooming, seasonal flu, etc. Cycles of longer period also exist, which coincide with other cosmic cycles such as the sunspot cycle.

The big question in the study of these cycles has been whether they are caused by some clock mechanism within the organism, or whether the cycles are caused by the external, typically cosmic motions with which they seem to coincide. Evidence has been found on both sides of the fence, and the question becomes somewhat paradoxical.[10] It has been found that organisms, when held in environments that block out the external cycles they appear to coincide with, go into what is called "free-run," where the period begins to deviate from the external cue.

For example, the bean plant opens and closes its leaves on a 24-hour cycle (12:12—12 hours up, 12 hours down). When placed in an environment of constant light intensity, the period will migrate to slightly longer than 24 hours. Early on in these investigations, Wilhelm Pfeffer demonstrated that bean plants grown in complete darkness do not display any cycles—the leaves just stay open. Upon shining light on the plants, though, they immediately begin their roughly 24-hour cycle. The cycles begin and continue, even if only one short period of light is given to the plant, which then lives the rest of its life in darkness.[11] Hence, the plant has the internal capacity to cycle, but responds to cues from the outside.

One problem with experiments performed in so-called constant conditions, is that the only conditions held constant are those that the experimenter assumes are acting on the organism. By definition, this does not block out unknown influences. Thus, the circadian locomotor activity of the fruit fly, which runs over 24 hours in constant light or constant dark, could be attributed to some other unaccounted for external cycle, a bit longer than 24 hours, but which has a weaker influence than the cycle of light and dark. An experiment was proposed to test this. If an organism's cycle is driven by some other external stimulus, then the phase of the cycle should be shifted, if the organism is transported, within an environment of constant conditions, to another longitude.

The results on this were contradictory. Frank Brown showed that an oyster, which responds to the twice-daily tides, if transported from the New England coast to Chicago (where there are no tides), will shift its tide-cycle to match what the tides would be in Chicago, if it had tides (**Figures 1-3**).[12] This would imply an external agent.

On the other hand, another scientist, Max Renner, trained bees in constant conditions to get food at a specific time of day in Paris. If the time-sense were given by external cues, then transporting the bees (holding all other conditions constant) to New York should shift the time at which they hunt for food. Exactly the contrary was shown: They kept coming out exactly 24 hours after their feeding time in Paris, day after day. When the same experiment was done, but the bees could see the daily motions of the Sun, they responded to both their 24-hour "internal clock," and to the local time.[13] Hence, Renner's experiments showed that there is some combination of internal and external timings.

One wrench thrown into the gears of all studies, is the fact that the cycles appear, across all organisms, to be independent of temperature. In other words, if an organism, whose temperature is not internally regulated, is cooled down, all of its vital functions tend to slow down, and vice versa, if it is warmed up. If the "clock" were an internal organ or mechanism, then it, too, should speed up or slow down with temperature. Brown,[14] Colin Pittendrigh,[15] and others demonstrated that all organisms were virtually immune, with respect to their rhythms, to changes of temperature. Brown went so far as to take fiddler crabs, whose skin color changes on a daily cycle, and lower their body tempera-

10. Frank A. Brown, "Living Clocks," *Science*, New Series, Vol. 130, No. 3388, pp. 1,535-1,544 (1959).

11. Pfeffer found that he could also use light to force the plants into periods longer or shorter than 24 hours, by alternating light and dark. Antonia Kleinhoonte went further with this experiment, and demonstrated that, if the periods go outside the bounds of 8:8 or 15:15, then the plant would "rebel," and snap back into a roughly 12:12 cycle again.

12. Ibid.

13. Max Renner, "The Contribution of the Honey Bee to the Study of Time-Sense and Astronomical Orientation," *Proceedings*, Cold Spring Harbor symposia on quantitative biologyORPHAN }, Vol. 25, pp. 361-367 (1960).

14. F. Brown and M. Webb, "Temperature Relations of an Endogenous Daily Rhythmicity in the Fiddler Crab, Uca," Physiological Zoology, Vol. 21, No. 4, pp. 371-381 (1948).

15. Colin Pittendrigh, "On Temperature Independence in the Clock System Controlling Emergence Time in Drosophila," *Proceedings of the National Academy of Sciences*, Vol. 40, No. 10, pp. 1,018-1,029 (1954).

FIGURE 1
Oysters in New Haven Harbor

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FIGURE 2
Oyster, Newly Arrived in Illinois

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FIGURE 3
Oyster in Illinois, Two Weeks Later

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ture to freezing, to demonstrate that the cycle remained circadian, although the intensity of color change became fainter and fainter up to death. Thus, either there is still some external driver, or the internal mechanism has a seemingly miraculous way to regulate speed with temperature.

As will be explored in more detail below, one factor in biological rhythms is that organisms respond to very weak magnetic and electric fields. For example, Jürgen Aschoff and Rütger Wever converted two wartime fallout shelters into apartments that gave absolutely no cues as to the time of day. They even went so far as to deliver food and messages via a type of air-lock, to prevent the subjects from having any contact with people from the outside. One of the apartments was shielded from all outside electromagnetic fields, and was equipped to supply artificial oscillating electric fields of low intensity, while the other had no EM shielding. In all cases, the basal temperature oscillations of the experimental subjects free-ran to about 25-hour intervals, as did the sleep schedule. In some of the subjects, though, the sleep schedule became massively decoupled from the temperature oscillations, heading upwards of 50-hour sleep-wake cycles, while the temperature remained on the same circadian clock.

All of the subjects in which decoupling was observed lived in the apartment shielded from all EM fields.[16] Once an electric field was supplied at low intensity (2.5 V/m; the subjects could not feel it consciously), but oscillating at 10 Hz, the sleep schedules immediately snapped back in line with the circadian temperature cycles. None of the test subjects sensed any difference.[17]

16. Rütger Wever, "Human Circadian Rhythms Under the Influence of Weak Electric Fields and the Different Aspects of These Studies," *International Journal of Biometeorology*, Vol. 17, No. 3, pp. 227-232 (1973).

17. All of the test subjects, including those who experienced the 50-hour "days," ate regular meals, three times during their subjective days. It is apparently a common misconception that you get hungry around lunchtime, simply because you've "worked off" your breakfast. It is a

These are just a sampling of experiments that have been done, to give some flavor of the problem. The wrong question would be, "Well, are the cycles driven by an internal clock, or by the cosmos?!" Kepler already demonstrated that there must be some close interconnection between distant, cosmic processes and those of life here on Earth. Review of the paradoxes of the inherent cycles of biology confirms this: that there is something within the organism that can respond according to the cyclic aspects, which means that there must be a cyclic potential within the organism. Both the "external cues" and the supposed internal clock system should be seen as, essentially, external, in that neither is the cause of the cycles. Both cyclic systems (geophysical/cosmic vs. biological) are connected, but not necessarily in a causal relationship. While the cause itself remains unknown, it should be sought through the method that Kepler used in his life's work, the method of *harmonics*.

For another clue in the puzzle, we will now see that the response to cosmic cyclic variations is inherently tied also to the spatial orientation of organisms. In other words, we are, yet again, tapping into the study of physical space-time, which Vernadsky emphasized, held the secret of the distinction between life and non-life.

Let's dig deeper into this aspect.

Cryptic Chemistry

As was seen in the case of bird migration, it is clear that birds somehow sense the geomagnetic field, and that this sense is intimately connected with their sense of vision.[18] Specifically, it was seen that, when their eyes were prevented from receiving blue light, young birds would lose their ability to navigate. Thorsten Ritz and Kurt Schulten proposed that some chemical could be involved that becomes magnetically sensitive after activation by the blue light.[19] The chemical they proposed had already been located in plants, and called cryptochrome.

Plants can be grown in complete darkness. When a sprout begins from a seed, that sprout has to make its way up through the dirt, and then the ground cover of leaves and other things, before it finally reaches sunlight. Plants have a distinct mode of operation under these conditions, called "etiolation," which includes growing longer, thinner stems (the hypocotyl), with smaller leaves (cotyledons) spaced further apart and deficient in chlorophyll. When the sprout finally reaches light, it stops the rapid lengthening of the hypocotyl, pops out new leaves that are closer together, and begins to turn green from chlorophyll. This is called "de-etiolation," or just "greening."

It was found that de-etiolation doesn't require the entire spectrum of light. Normal plants will turn green under either blue or red light, or both. Scientists believed that this meant there were two pathways, initiated by two distinct sets of photoreceptors, that led to the same result. The photoreceptors for the red-light response were found and called phytochromes. The blue-light photoreceptors were apparently more difficult to hunt down, and were thus called cryptochromes. Using the model genetic plant,[20] *Arabidopsis thaliana* (thale cress), scientists were able to isolate a strain that was immune to blue light—i.e., they would only de-etiolate under red light, not blue.

In 1993, Margaret Ahmad and A. Cashmore identified the section of DNA that differed between one of these blue-immune strains, and normal *Arabidopsis*.[21] They found that the protein that corresponds to this DNA section bore a strong resemblance to a protein called photolyase, which can be induced to repair ultraviolet-damaged DNA, but only after being activated by violet/UV light.[22] They argued that they had found the

circadian timing! The 50-hour subjects spaced their meals proportionally throughout their subjective day, which meant they would have breakfast around the same time as you would, but would start feeling lunch-pangs around the time after you had already completed your dinner!

18. See the report on bird magnetoreception by Ben Deniston, elsewhere in this issue.

19. T. Ritz, S. Adem, K. Schulten, "A Model for Photoreceptor-based Magnetoreception in Birds," *Biophysical Journal*, Vol. 78, pp. 707-718 (2000).

20. The term "model organism" is a bit of a misnomer. On the face of it, it refers to an organism chosen to be the standard, upon which scientists around the world will perform and report on experiments. The organisms are usually extraordinary in some way, which makes them amenable to experimentation—such as the extremely rapid reproduction of *Drosophila melanogaster*—and are thus not exemplars of the rest of the living world. Each organism is a whole, and not assembled out of pieces from model organisms.

21. M. Ahmad and A. Cashmore, "Seeing Blue: the Discovery of Cryptochrome," *Plant Molecular Biology*, Vol. 30, pp. 851-861 (1996).

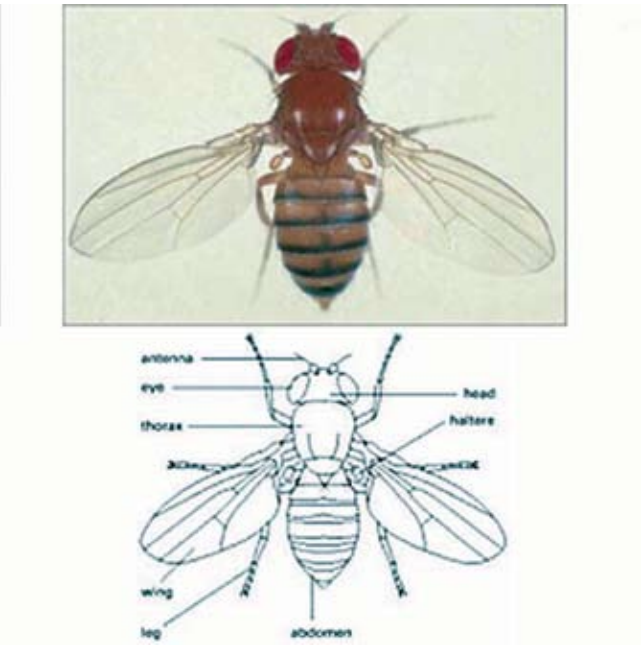
22. It is interesting to allow the mind to veer here, for a moment. Photolyase and its relative, cryptochrome, appear to be ancient chemicals. They are both present in just about every organism studied. If photolyase goes all the way back to before the existence of the ozone layer, before the Great Oxygenation Event, then it was "repairing" DNA when there was nothing to prevent Solar and other ultraviolet radiation from

Arabidopsis thaliana

elusive cryptochrome pigment's gene, which was then found in many other organisms.

In a fascinating 2007 experiment, Ahmad and others tested the hypothesis that cryptochrome was related to the magnetic sense of birds.[23] They took the two strains of *Arabidopsis*, wild-type and cryptochrome-deficient (blue-immune), and tested for response to a magnetic field. Both plants exhibited a little greening under only dim red light, but only the wild-type showed greening under dim blue light (as was expected). Then, they turned on a 5 Gauss magnetic field,[24] aligned with the local geomagnetic field. The plants under red light showed no extra response, and developed as before, while the wild type under dim blue light became greener at a faster rate. The cryptochrome-deficient plant still showed no greening under blue light and the magnetic field. The researchers concluded that cryptochrome was, indeed, part of some mechanism that responded to magnetic fields, but only when activated by blue light.

Two other experiments were performed on the fruit fly, *Drosophila melanogaster*, the model genetic



Drosophila melanogaster

insect. Cryptochrome had already been found in a variety of insects and other animals, and was present within the eyes of the fruit fly. In 2008, Robert Gegear and others used the fruit fly to test whether cryptochrome was, indeed, a magneto-sensitive photoreceptor.[25] They trained a number of fruit flies to associate food with a 5 Gauss magnetic field. They provided a travel tube for the flies, one end of which had a 5 Gauss magnetic field, the other end being magnetically neutral, and watched which direction the flies would travel. As expected, most traveled in the direction of the magnetic field. When they put a filter in front of the light source, which cut out all light bluer than 420 nanometers (nm), the fruit flies lost their sensitivity to the magnetic field, which seemed to imply that the flies were, indeed, relying on some kind of signal from their cryptochrome system. When the researchers

reaching the ground. The point is that repairing DNA and constructing are very similar, and both, through photolyase, act through various parts of the ultraviolet band. The existence of a chemical that has the capability of repairing DNA, when acted on by a form of cosmic radiation, becomes a very provocative vector in the process of evolution via cosmic radiation.

23. M. Ahmad, P. Galland, T. Ritz, R. Wiltschko, W. Wiltschko, "Magnetic Intensity Affects Cryptochrome-Dependent Responses in Arabidopsis thaliana," *Planta*, Vol. 225, pp. 615-624 (2007).

24. Ahmad and others typically measure magnetic field strength in either micro-Teslas (μT) or Gauss. One hundred μT equals 1 Gauss. The geomagnetic field averages about 0.3-0.5 Gauss, which equals 30-50 μT. Therefore, Ahmad's experimental magnetic field was about ten times the background geomagnetic field.

25. R. Gegear, A. Casselman, S. Waddell, S. Reppert, "CRYPTOCHROME Mediates Light-Dependent Magnetosensitivity, *Nature*, Vol. 454, pp. 1,014-1,028 (2008).

tested fruit flies bred to be cryptochrome deficient, they found that these flies could not be trained to respond to the magnetic field, even when they got full-spectrum light.

In another experiment on the fruit fly, performed in 2009, Tiashi Yoshii, Margaret Ahmad, and Charlotte Helfrich-Förster tested whether the magnetic effect could carry over to biological rhythms, too.[26] The locomotor activity of the fruit fly cycles between moving and standing still over a circadian period, which, under conditions of constant light or dark, will extend to a little over 25 hours. Jürgen Aschoff had shown that increasing the intensity of constant light will extend the waking periods of the flies, until a certain maximum is reached, at which point the flies go arrhythmic, and that this effect could also be produced with just blue light. Hence, by increasing the intensity of constant blue light, the waking period for the fruit fly will extend to arrhythmia.

Yoshii et al. used wild-type fruit flies, and also *Drosophila* mutants that were bred without cryptochrome, and created a chamber that could immerse them in either red or blue light of such weak intensity, that their waking periods were only a little longer than if they were in constant dark conditions. As expected, the fruit flies deficient in cryptochrome acted as if they were still in constant darkness when the blue light was turned on, although all flies responded normally to the red light. Then, they nailed the flies with 1.5, 3, and then 5 Gauss magnetic fields (3, 6, and 10 times the geomagnetic field, respectively), aligned with the local geomagnetic field. Under red light, nothing special happened, while under blue light, the wild-type flies stayed awake even longer, while the cryptochrome-lacking flies went back to sleep. In the flies affected by the field, the periods also got longer, the stronger the magnetic field.

These experiments demonstrate that, whatever faculty within the organism responds to external cyclic phenomena, is intimately tied to the faculty that responds to magnetic fields and spatial orientation. Therefore, what we are dealing with is not simply a "time-sense" or a "space-sense," but something deeper, which goes to Vernadsky's space-time distinction of the biotic phase of the universe. As will be seen in the following section, this space-time characteristic extends into other, and perhaps all, aspects of cosmic radiation and behavior.

But, first, now is the time for adding an important disclaimer, because of how scientists tend to discuss this class of phenomena. "Cryptochrome" is the name for a correlation found within plants—plants that don't turn green properly under blue light were found to also lack a section of DNA which corresponds to a complete protein, which happens to have some similarities to the protein photolyase. Matching DNA sections have been found in other organisms, such as *Drosophila* and birds, and have been associated with navigating according to the magnetic field.

As has become typical, yet not quite responsible, the discovery of a physical object was then announced and given the name cryptochrome. Does this object really exist as such? The protein that corresponds to this system was then mass-produced, crystallized, and the "molecular structure" was then "solved" through typical techniques of X-ray crystallography. Several aspects of the molecular structure suggested similarities to other chemicals, with similar molecular structure, which were associated with magnetic effects after being activated by electromagnetic radiation—so-called "spin chemistry" effects. Then, experiments were performed with several organisms that displayed characteristics suggesting the presence of the physical cryptochrome molecule within them.

Cryptochrome should be taken as a type of code word for the phenomena described through these experiments, not the causative factor. It is a danger for conclusions to be drawn on the basis of theories of spin chemistry and the crystal structure of cryptochrome; the healthier route is through more experimentation from hypothesis. In these experiments with organisms, it is clear that there is a phenomenon that has been caught between electromagnetic radiation, on the one side, and magnetic fields on the other. To assume that the cause lies somewhere in the strange, ad hoc hypothesis about the spin of an electron, is backwards. It were more honest to assume that we don't yet know what is happening on the molecular level in these creatures, since there may not, actually, be a molecular level here.

The effects are organism-wide effects. The phenom-

26. T. Yoshii, M. Ahmad, C. Helfrich-Förste, "Cryptochrome Mediates Light-Dependent Magnetosensitivity of Drosophila's Circadian Clock," *PloS Biology*, 7(4): e1000086. doi:10.1371/journal.pbio.1000086 (2009).

enon called "spin" really does exist—there are clear chemical and atomic properties that are related in an ordered way to magnetic fields. But, that the ordered array of experimental results are solved by enumerating them, and attributing them to a particle's rotation, and then asserting the rotation of that particle to be the cause of the results, is not good science. Hypotheses that solve what "spin" was supposed to address should come from what must be necessary, in order to fulfill the properties observed in life.

Unknown Radiations?

Let us look at another series of experiments, which aim at the discovery of new principles, while laying open the space-time character of life.

Frank Brown and his collaborators built an apparatus to measure the metabolic cycles of a variety of organisms. The apparatus consisted of a big Erlenmeyer flask, into the which the subject organism could be placed. The flask could then be closed, and the oxygen input and output measured via chemical reactions within another vessel, connected by a tube. The changes would then be translated into the mechanical motions of a pen on a rotating drum of paper.

The apparatus was also designed to be able to maintain constant levels of illumination, pressure, and temperature within the flask. The researchers measured the oxygen consumption from a potato, for example, for several months under constant conditions, and found that the potato retained its response to atmospheric pressure, even though it was shielded from any variations in pressure: Its oxygen consumption went up when the pressure outside the chamber rose, and vice versa (**Figures 4-5**). There was not just a response to pressure, but the response also appeared to correlate with pressure events that occurred, on average, two days into the future.[27]

To be precise, Brown noted that local pressure variations are largely affected by local weather shifts.

FIGURE 4
Study of the Potato's Metabolic Rate

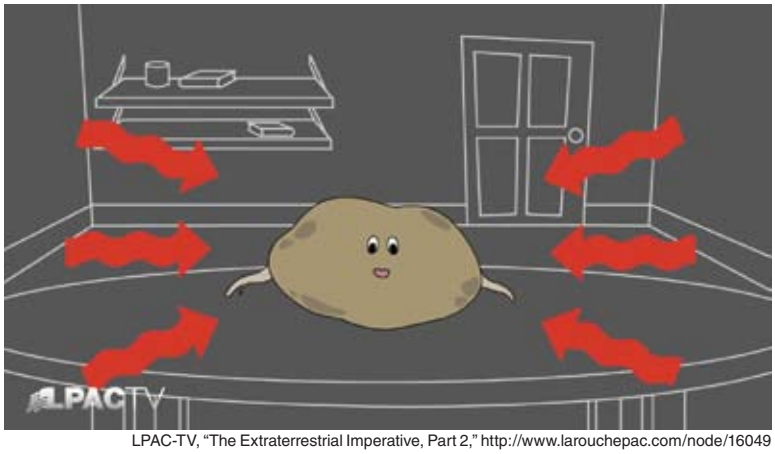


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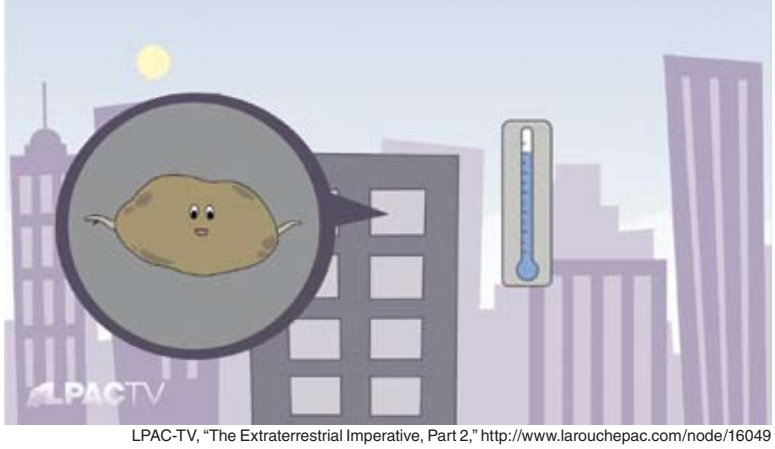
FIGURE 5
Potato's Metabolism Varies with Barometric Pressure



LPAC-TV, "The Extraterrestrial Imperative, Part 2," http://www.larouchepac.com/node/16049

The potato did not respond, minute to minute, to these changes. But, if the metabolic response of the organism was measured from about 4-7:00 a.m. every day, those changes would correlate with the average pressure over a three-day period, usually centered on two days into the future. Since Brown knew that this seemed pretty outlandish, he repeated the experiment with almost a dozen other unrelated organisms. Each one demonstrated the same ability to "forecast" what the average temperature would be sometime in the future. The rat demonstrated the best ability, correlating with an astounding seven days into the future. In other words, the rat's metabolic changes were virtually identical with three-day averages of the outside

27. F. Brown, H.M. Webb, E. Macey, "Lag-Lead Correlations of Barometric Pressure and Biological Activity," *Biological Bulletin*, Vol. 113, No. 1, pp. 112-119 (1957).

barometric pressure, centered on seven days ahead.

Brown did not know what the potatoes, or the other organisms, could be responding to, since the cycles were not purely circadian or lunar, and therefore not endogenous, yet the potatoes were being held in pressure-constant chambers. And, it couldn't be simply an annual cycle, because the responses at corresponding months over two years were inverted. In other words, in May 1955, O_2 consumption went up around 6:00 a.m., but in May 1956, O_2 consumption went down at the same time. What accounted for this pattern? He and his collaborators recognized that the cycles appeared to coincide with an unlikely cosmic cycle—the ebbs and flows of cosmic-ray flux into the Earth's atmosphere.[28]

Brown was cautious here, though. He did not say that the cosmic rays were causing the pattern in the potatoes and other organisms, but that they coincided. Perhaps, what was causing the fluctuation in the potatoes was also causing the fluctuation in cosmic rays. He proposed that variations in the geomagnetic field could account for some of what was observed, since cosmic-ray flux is mediated in part by such changes. It should be that cosmic-ray flux is affected by many things, including the activity of sunspots, the Solar wind, and other galactic phenomena, with the Sun's activity appearing to dominate.

Brown embarked on a series of experiments to determine whether organisms can sense weak magnetic and electric fields.[29] Remember that this was in 1960, before magnetonavigation had been demonstrated! Brown placed a variety of organisms into special corrals, such that they could begin traveling in a specified compass direction, but then be free to turn in any direction after exiting the corral. Brown could then measure the direction of turn. His apparatus could also be equipped with an electrostatic field, oriented at right angles to the corral path, and with a magnet that could be oriented however he wished, within the plane of travel of the organism. Over a period of more than a year, he tested several organisms, from the paramecium up to the snail, in all four compass directions, and found definite patterns that varied over time, and could be modified with the artificial electric and magnetic fields.

His results proved, conclusively, that all organisms tested were quite sensitive to both weak magnetic and

Planarian

weak electrostatic fields, but that their response to the fields depended on the time of year. For example, if a planarian is initially oriented north during the late morning, between September and March, it will turn left around new Moon, and right near full Moon. During March and April, however, the response becomes somewhat random, and by the end of April, the planarian begins turning right around new Moon, and left near full Moon. This persists until about July, when the patterns become somewhat random again, and reverses by September. Brown showed that he could easily alter these results with very weak (0.17-4 Gauss), artificial magnetic fields. At the same time, the pattern goes through about a 360° oscillation during a 24-hour period.

What this means, is not just that organisms are sensitive to magnetic fields. It also means that the magnetic field interacts not only with the sense of direction for the organisms, but also with the clock-sense. Recall the experiments of Aschoff and Wever, where removing the influence of all known magnetic and electric fields radically changed the sleep-timings of the subjects, but that creating a varying magnetic field immediately put them back on circadian rhythms. Hence, we are dealing with a space-time phenomenon in organisms, not simply time or orientation.

At issue here are both the space-time organization of life, and the potential that organisms, already demonstrated to be extremely sensitive to very weak fields, are responding to as-yet-unknown radiations, or un-

28. F. Brown, "Response of a Living Organism, under 'Constant Conditions' Including Pressure, to a Barometric-Pressure-Correlated, Cyclic, External Variable," *Biological Bulletin*, Vol. 112, No. 3, pp. 288-304 (1957).

29. F. Brown, "Response of the Planarian, Dugesia, to Very Weak Horizontal Electrostatic Fields," *Biological Bulletin*, Vol. 123, No. 2, pp. 282-294 (1962).

known aspects of already recognized fields. Thus, it should be very likely that oscillations in motion, and timings within organisms, would coincide with things like cosmic-ray flux, which also is very sensitive to changes in the geomagnetic and interplanetary magnetic fields.

Brown went further, and showed that organisms also respond to the influence of gamma radiation. Here again, an extremely weak source of radiation was used (~6 times the background radiation), which cannot be construed to be "hurting" the organism (no animals were harmed in the experiments). Brown tested the organisms with his special corral, placing the gamma source first on their right side, then on their left side, to see how they would orient with respect to it. He found that, when initially oriented towards the north or west, the organisms would turn away from the gamma source, while if initially oriented south or east, they would turn toward the source. These responses also exhibited daily and monthly periodic variations.

Again, a response to extremely weak radiation, which is exhibited not only in spatial orientation relative to the weak geomagnetic field, but also temporal oscillations on the order of one Solar day and one lunar month.

What can be concluded from this series of experiments? From Brown:

> The primary value of this study lies in its description of some of the intricacy of the organism's relationship to its subtle environment. The study provides further experimental evidence for an almost incredible "time-space organization" of terrestrial creatures. Within the organism it seems probable that the mechanisms of the biological clocks and compasses merge into a single functional system.[30]

All of these phenomena demonstrate the high sensitivity to very weak fields, in both direction and intensity, of a variety of organisms. Only a limited number of radiations have been tested, which leaves open, and in fact demands, that the organism be sensitive to numerous other cues in the environment.

30. F. Brown, H.M. Webb, "Some Temporal and Geographic Relations of Snail Response to Very Weak Gamma Radiation," *Physiological Zoology*, Vol. 41, No. 4, pp. 385-400 (1968).

The Space-Time of Life

Another way to look at this, is that life in the Biosphere is not separate from its radiative environment. Instead, the Biosphere should be thought of as a "filled space-time." If organisms can sense and respond to very weak fields, such as less than half the geomagnetic field of 0.3-0.5 Gauss, or as little as 6 times the background gamma radiation, then we are awash in a sea of influential radiations from numerous sources.[31] Considering that these radiations apparently govern the majority of not only basic biological timings, but also spatial motions and orientations of organisms, these incredibly weak radiation fields are also incredibly well structured, such that animals such as pigeons and monarch butterflies are able to migrate, accurately and on time.

Recall how Kepler thought. In his world, the rays of light from the planets, intersecting at the Earth to form the aspects, carry absolutely no motive force within them. It is through a process of reason, while regarding those aspects, that corresponding actions within life occur. Discard any notion that organisms are being pushed or pulled by radiations, including gravitation. Response occurs in a non-kinetic fashion. The organisms on the Earth, the geological and atmospheric motions, and cycles of the cosmos, exist within an harmonic universe. Organisms act in correspondence with those other processes through the medium of harmony, not through a thermodynamic, ricochet accident.

This also opens up another area of research, already referenced elsewhere in this report: the long-term development of life on the planet, as related to long-term cycles of changes in geological activity, climate, atmospheric composition, geomagnetic field strength and orientation, radioactive decay rates, cosmic-ray flux, changes within the Solar System and the Sun, the motion of the Solar System through the Milky Way galaxy, and the changing relationships between our galaxy, the local group, and local supercluster of intergalactic space-time. As has already been noted, there is a marked cycle of biodiversity of about

31. Recently, scientists working with NASA's Fermi Gamma-Ray Space Telescope, have detected flashes of gamma-rays produced by terrestrial thunderstorms, which apparently generate streams of antimatter. They estimate that at least 500 terrestrial gamma-ray flashes occur per day, worldwide. http://www.nasa.gov/mission_pages/GLAST/news/fermi-thunderstorms.html

FIGURE 6
Long-Wave Patterns of Biodiversity

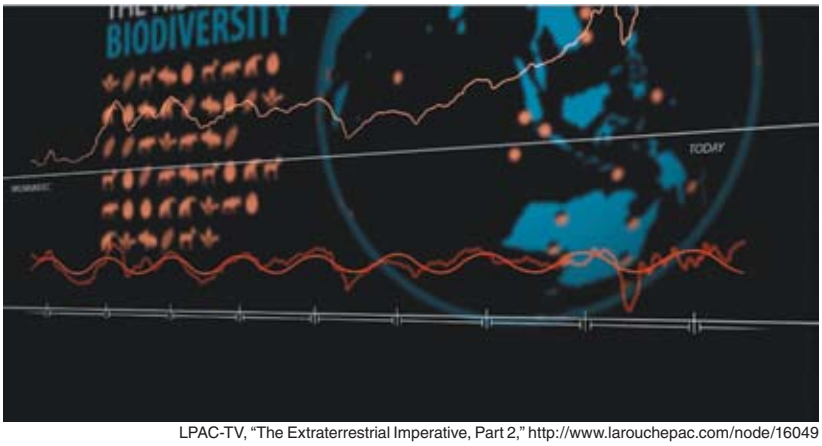


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FIGURE 7
Biodiversity: Long and Even Longer Waves
(Top, 62-Million-Year Cycle; Bottom, 140-Million-Year Cycle)

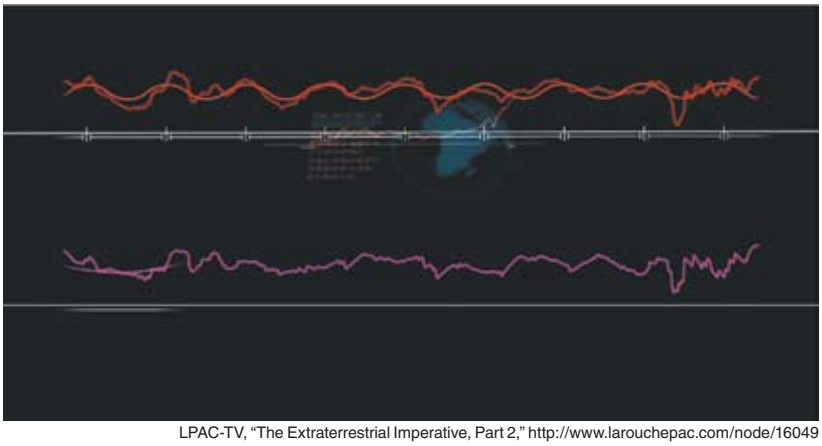

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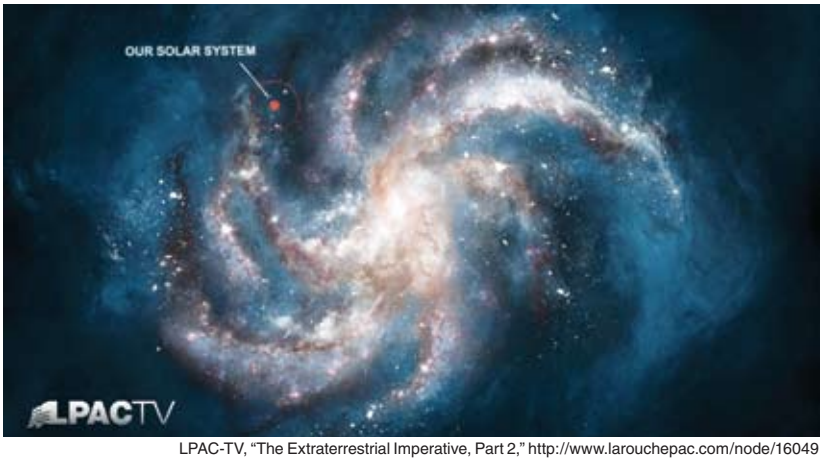
FIGURE 8
Our Solar System Travels Through the Galaxy



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62 million years on this planet (**Figures 6-8**).[32] The emergence of recognizably human cognition appeared roughly 62 million years after the last great transformation of the Biosphere's life (the "K-T Extinction"). This cycle of changes includes shorter cycles that have similar relations to biospheric changes, such as the periodic magnetic pole reversals.

The apparently much shorter cycles of biological rhythms reviewed here are properly recognized as subsumed aspects of much longer cycles. Responsible scientists involved with studies related to what has just been described, will be open to the discovery of new types of cosmic radiations, but also new properties of known radiations.

For just a small example: If organisms are so sensitive, in such a quantized space-time manner, to radioactive decay radiations, would such a sensitive dependence be observable in the fossil record? If so, would such an observation establish variable rates of decay, over long periods of time? If so, since recent studies have suggested that decay rates have some dependence on distance to the Sun, would long-observations through such a fossil telescope reveal echoes of ancient interplanetary perturbations, including perhaps dating the explosion of the missing planet between Mars and Jupiter?[33]

On the other hand, introducing Man onto the stage of space travel opens yet another possibility, which demands yet more study of the relation between the long and short biological cycles. Soon, after construction of the North American Water and Power Alliance (NAWAPA) has become a reality, we

32. LaRouchePAC video, "The Extraterrestrial Imperative, Part 2," at http://www.larouchepac.com/node/16049. Transcript in *EIR*, Oct. 41, 2010, p. 5.

33. See video, "Decay Rates and Time," at http://www.larouchepac.com/node/16224

will begin moving masses of people into both Arctic and Antarctic regions. Both of these areas will become robust biological research laboratories, certainly because of the unique radiative environments, but also because of the long periods of constant daylight.[34]

Let us keep in mind that NAWAPA, as LaRouche has discussed it, is the true launchpad back into space. We are already in a position to observe the effects on organisms in our orbiting International Space Station, of rapid travel through our magnetosphere, and of exposure to cosmic radiation impossible to synthesize on the Earth's surface. Once we take the Biosphere with us, once again to the Moon, and then beyond the lunar orbit, we will enter a domain that is apparently free of the typical diurnal, lunar, and annual cycles. How will organisms respond to such conditions? Up to now, we have only been able to shield organisms from known forms of radiation, but we are still prisoner to other radiations that exist for the orbiting Earth. From deep in interplanetary space, we will not only be able to create novel radiative conditions, but also be in a position to delve deeper into how organisms interact with the cosmos, and vice versa.

For example, from the perspective of a colony of NAWAPA-graduated scientists and engineers on the surface of Mars, the typical Martian day is closer to what has been observed as the terrestrial "free-run" of the human daily sleep cycle, around 24.5 hours. However, the Solar year will be almost twice as long; the two tiny moons orbit the planet within a day; and there is only a faint signature of an apparently fossil magnetic field. How will the persistent rhythms of organisms respond to such cues? Will we find that some of what we had considered purely terrestrial cues, are actually not bound to the Earth's regular periods? We will certainly discover more about how the biological timings and motions function, and perhaps discover new forms of cosmic radiation, which will in turn enrich our understanding of how life functions as an integral part of our intergalactic system.

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34. See Sky Shields, "Unheard Melodies: Electric and Magnetic Senses in Humans," in this issue, for more on the radiative environment of the Arctic. Also, watch the LaRouchePAC video "The Extended NAWAPA, Arctic Development," at http://www.larouchepac.com/infrastructure