The Extraterrestial Imperative
Part 2: Cosmic Rays

The following is the script of the LPAC-TV video of the same title, with a selection of graphics. Michelle Fuchs is the narrator; Chris Jadatz is Specialist 1 and Diana Wong is Specialist 2. Animations by Chris Jadatz, Diana Wong, and Chance McGee. Light and sound effects by Dennis Mason. http://www.larouchepac.com/node/16049. Part 1, "The Mission," can be viewed at http://www.larouchepac.com/node/14690

Neil Armstrong, on the Moon, July 20, 1969: Houston, Tranquillity Base here. The *Eagle* has landed!

Houston: Roger, Tranquillity, we copy on the ground. You've got a bunch of guys here about to turn blue. We can breathe again. Thanks a lot!

Narrator: Mankind's mission to colonize the Moon and Mars poses new challenges to our understanding of man and his relationship to the universe. Before we can think of landing our first settlers on Mars, we have to come to terms with the presence and power of supposedly "weak forces," which have hitherto been considered "negligible" by most modern scientists. For example, what will be the direct effects of prolonged exposure to cosmic space on our space pioneers, biological and otherwise? How will we begin to explore the questions of how to make other planets habitable? What will these questions reveal to us about the role of such "weak forces" on the entire biological and geological history of our planet? And, how will this further reveal the universe in its true nature, as a single, interconnected entity, always in a process of upward, anti-entropic development?

To begin to answer these questions competently, we will examine the dynamic interrelationship of the cosmos as a whole, both in individual living processes, and the entirety of the Earth's Biosphere.

Since the time of Plato, man has come to understand the universe by observing long-term cycles, and investigating hypotheses concerning their astrophysical causes. One of the modern pioneers in the investigation of the relationship between Earth's Biosphere and its surrounding cosmic medium, was Russian biogeochemist Vladimir Vernadsky. Vernadsky saw the Biosphere as a single system, continuously developing anti-entropically, driven not only by the activity of living organisms internal to the Biosphere, but also in a harmonious interplay with forces external to the Earth.

The Sun obviously plays a fundamental role in the processes of life on our planet, this being one of the most evident cycles which we observe, both day to day, and year to year. But even as early as Vernadsky's time, new information was developing concerning a less apparent force: the penetration of cosmic radiation into the Earth.

New evidence of the presence of this weak radiation on Earth, and its effects on living processes, is now available to us to begin to construct a higher hypothesis.

Cosmic Rays and Evolution

Specialist 1: Let's take a look back at the deep, dark history of life on Earth. Paleontologists have been able to read that history by studying the fossil records of living organisms, going back over 500 million years. The first thing we notice is the fact that certain species, which existed during certain periods of that history, seem to suddenly cease to exist, or at least dwindle in number. This processes is usually referred to as mass extinction.

We will also notice something else, something which is much less discussed than the phenomena of extinction: This fossil record also reveals to us distinct moments at which new species suddenly emerge. This process has steadily, and without reversal, led to more complex and advanced forms of life. When we begin to look at this history on the scale of hundreds of millions of years, we begin to see that there are very long waves of both increase and decrease in the number and variety of species on our planet—a rhythm begins to emerge in these cycles of biodiversity!

The most apparent of these regular cycles of rise and fall, seems to occur approximately every 62 million years. However, if we look even closer, we can see that there is also another, weaker rhythm, laid over top of this primary cycle. This weaker, but still significant wave has a cycle of approximately 140 million years (**Figures 1 and 2**).

What could be causing this? Well, let's look at another cycle which researchers have just recently discovered, not by looking at fossils, but by looking at meteorites. Iron meteorites, which have found their way through our atmosphere from outer space, reveal a cycle similar to our longer-wave cycle in biodiversity. By measuring the presence of radioactive potassium in these meteorites, we find a 143-million-year cycle. What could possibly account for these correlated cycles in both isotopic density and biodiversity?

Well, let's zoom out. According to our present knowledge, our galaxy, the Milky Way, has several spiral arms. Our Solar System is orbiting through our galaxy, much in the same way our planet orbits the Sun. We measure years on Earth by the time it takes to orbit the Sun. However, the time which it takes us to orbit the entire galaxy, we could call one "galactic year." During the course of one galactic year, our Solar System makes a journey in and out of each of the Milky Way's many spiral arms (**Figure 3**). The time it takes to travel in and out of each spiral arm, has been calculated to be approximately 135 million years!

This brings us back to cosmic rays. The density of cosmic ray

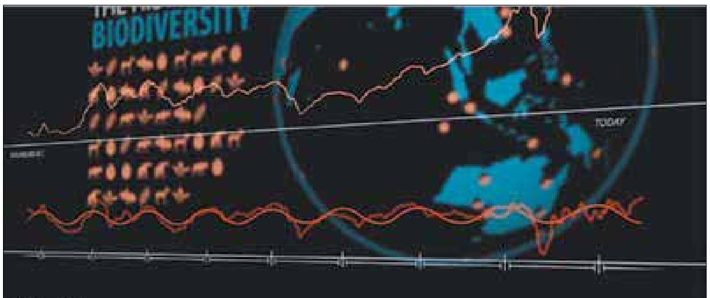

Figure 1
Long-Wave Pattern of Biodiversity

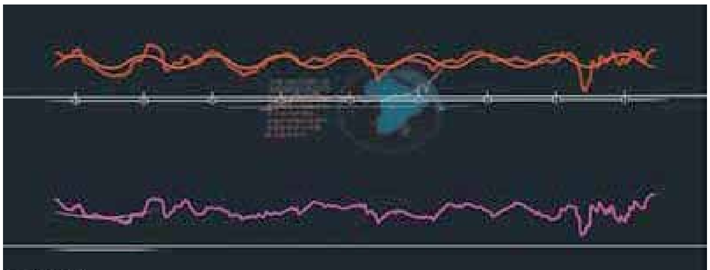

Figure 2
Biodiversity: Long and Even Longer Waves
(Top, 62-Million-Year Cycle; Bottom, 140-Million-Year Cycle)

Figure 3
Our Solar System Travels Through the Galaxy


Figure 4
Volcanic Activity: A 60-Million-Year Cycle

sources in our galaxy is not uniform. Each of these spiral arms is densely populated by both newly forming stars and exploding supernovae. According to what we currently know, these supernovae are the major source for the majority of cosmic radiation. The spaces in between the spiral arms are less densely populated by these supernovae. Therefore, as we make our transit in and out of these spiral arms, we should expect corresponding variations in the cosmic radiation which intersects our planet. This would account for the 143-million-year cycle in radioactive potassium found in meteorites on Earth.

The question remains, though: Could this cycle in cosmic radiation also account for the two long-wave cycles we saw in our planet's biodiversity? Well, let's look at the other shorter-term, but stronger, rhythm of 62 million years. If we zoom out again, and this time look at our galaxy from the side, we'll see that our Solar System "swims" above and below the equatorial plane of the Milky Way, as we orbit the galaxy's center. This oscillation occurs at a different rate then the transit in and out of the spiral arms. In fact, the cycles clock in at approximately 60 million years! If we take into account the likelihood that the density of cosmic radiation differs from one side of the plane of the galaxy to the other, this oscillation and corresponding changes in cosmic ray flux, could account for our 62-million-year rhythm in our Biosphere's species diversity.

Besides fossil biodiversity, this cycle also, interestingly, matches other measured cyclical changes on Earth, which include a component in Exxon-measured sea-level fluctuation, the amount of dry land left exposed as water levels change, reflected in the ratio of Strontium 87/86 isotopes. This points to a relation between tectonic changes and astronomical cycles.

There is also a larger tectonic change, where the age of deposits of igneous rock shows that volcanic activity is on the same roughly 60-million-year cycle (**Figure 4**). So we have a roughly 140-million-year cycle in rise and fall of biodiversity, which corresponds to the motion of our Solar System through the spiral arms of our galaxy, resulting in increases in cosmic radiation flux, as evidenced in the isotopic record of meteorites, and temperature record here on Earth. And a second, roughly 60-million-year cycle, in rise and fall in biodiversity, which corresponds to the motion of the Solar System above and below the plane of the galaxy, where it is hypothesized we receive a higher flux of cosmic radiation on one side of the galactic disc. This also, interestingly, corresponds to geological cycles of volcanic activity and land exposure.

Narrator: What we are looking at is an apparent correlation between these galactic cycles and the levels of biodiversity of life here on Earth, a provocative relationship between processes in the astrophysical scale and the processes which we observe within our Biosphere: a resonance between astrophysical cycles and life here on Earth.

However, it's important to emphasize that we don't know yet what the causes are. What does become clear, however, is that what most scientists would simply write off, as a "weak force," when we step back and look at the development of our cosmos over longer spans of time (hundreds of millions of years), cosmic radiation as a "weak force" suddenly becomes more significant and more powerful than the forces which immediately present themselves to our eyes. As we just saw, this cosmic radiation seems like it could be connected with the much more powerful process of evolution, not only of individual living species, but also the Biosphere as a whole.

Life itself, when viewed over time scales of millions of years, is also one of these very powerful, "weak" forces. The investigation of interaction between these phenomena of life and cosmic rays, both as so-called "weak forces," may unlock some new ways of answering our questions. Although we don't yet know exactly how the increases in biodiversity are driven, which contribute to the process of higher states of organization in our Biosphere and increasing specialization of life, we do know that life is very sensitive to various forms of radiation. Contrary to the popular linear-no-threshold idea of destructive effects of any and all radiation, undeniable evidence exists which shows that certain frequencies of radiation, in certain amounts, are indispensable to life processes. Again, these are weak forces which have, up to now, remained mostly "off the radar screen" for most scientists.

Now that we've explored how the larger processes of the cosmos affect the Biosphere as a whole, let's look at how these same types of weak forces determine living processes in the small.

Cosmic Rays and Organisms

Specialist 2: There are many examples of living creatures responding to radiation. The most obvious example is the photosynthetic process by which plants convert visible light into carbohydrates, and thus begin the metabolic processes on Earth. But new light is now being shone on weaker forms of radiation, which occur in smaller quantities, but have unmistakeable qualitative effects for life.

Most living organisms exhibit clear diurnal, lunar, and annual cycles, due most apparently to the Sun and Moon, as are observed in the sleeping, eating, and reproducing habits of plants, animals, and humans. But what about the effects of high-energy cosmic radiation?

In the 1950s, biologist Frank Brown investigated the metabolic cycles of plants and animals, and found indications of the possible influence of forces such as cosmic radiation on the circadian, or daily metabolic, rhythms of plants and animals.

A thought-provoking correlation with primary cosmic radiation began to be uncovered in a study of the metabolic cycles of the oysters of New Haven harbor in Connecticut, where oysters rhythmically open and close their shells with the tides (**Figure 5**). Frank Brown and his associates transported some of these oysters from their home in New Haven harbor, to pans of seawater in a photographic darkroom in Evanston, Illinois. The oysters were kept in lightproof environments, where they were removed from direct visual contact with the Sun.

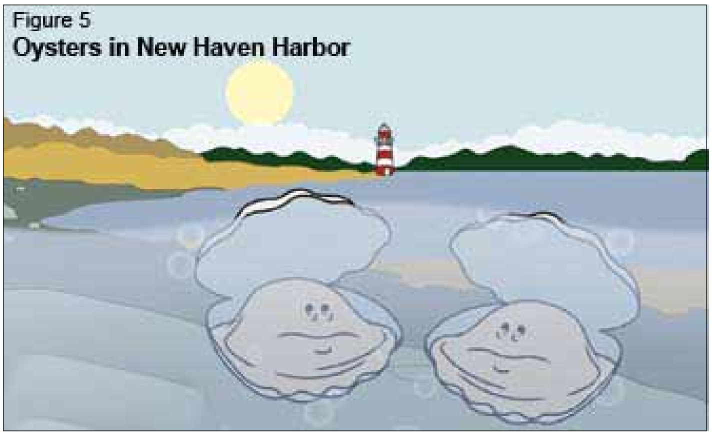

Figure 5
Oysters in New Haven Harbor

Figure 6
Oyster, Newly Arrived in Illinois

Figure 7
Oyster in Illinois, Two Weeks Later

Watch how the animals responded to their new environment: Gradually, they were able re-phase their rhythm of shell-opening over a two-week period from the exact high tide in New Haven, to the time corresponding to the high tide in Illinois (**Figures 6-7**). Obviously, these animals are not simply responding to the tides, nor to visual cues from the Sun or Moon. So what does this tell us about the daily cycles of these animals?

Later, Brown ran more controlled experiments to continue the investigation. Over two successive Summers, Brown grew potatoes in laboratory environments with controlled light, pressure, and temperature (**Figure 8**), measuring their metabolic rate as indicated by their level of oxygen consumption. However, the potato exhibited complicated metabolic fluctuations over the course of any given day, and each day was different. Puzzled, they could not find any fluctuations within the controlled environment which could account for this. Only when they looked outside the controlled environment, did they see that the fluctuations in the barometric pressure outside matched the sporadic fluctuations of the potato's metabolic rate (**Figure 9**).

Soon after these experiments, Brown received measurements of the amount of cosmic radiation the Earth had been exposed to over those two Summers. Seeing that the fluctuations matched with the changes in metabolism of the potatoes, Brown hypothesized that cosmic radiation, which flows right through laboratory walls, may have been giving signals to these organisms (**Figure 10**).

In a similar experiment, this time with animals, fiddler crabs, they too responded to the environment outside the laboratory (**Figure 11**). Comparing their metabolic cycles with the cosmic radiation, the crabs had an inverted relationship, meaning that when cosmic radiation was less present, the crabs were more active.

If forms of unseen radiation can adjust the metabolic cycles of an organism, what other unseen radiations exist that are af-

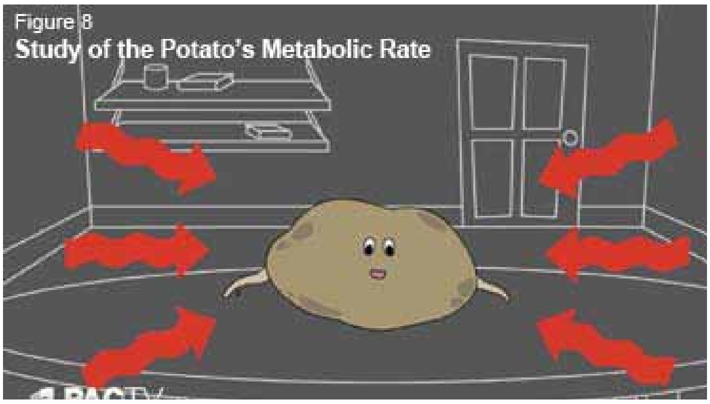

Figure 8
Study of the Potato's Metabolic Rate

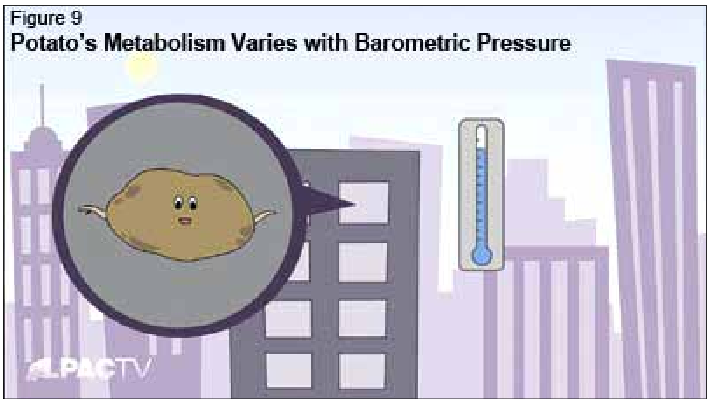

Figure 9
Potato's Metabolism Varies with Barometric Pressure

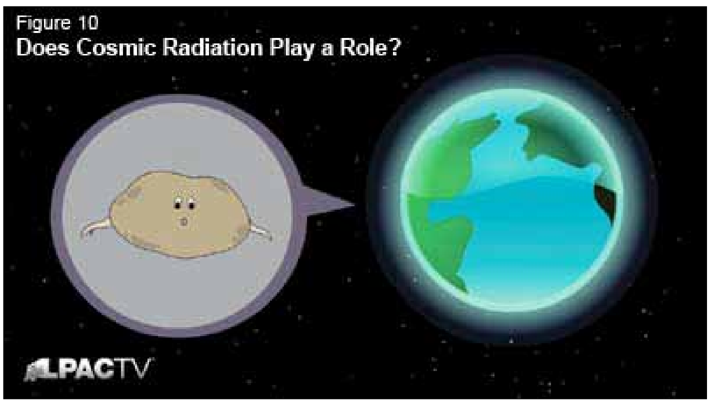

Figure 10
Does Cosmic Radiation Play a Role?

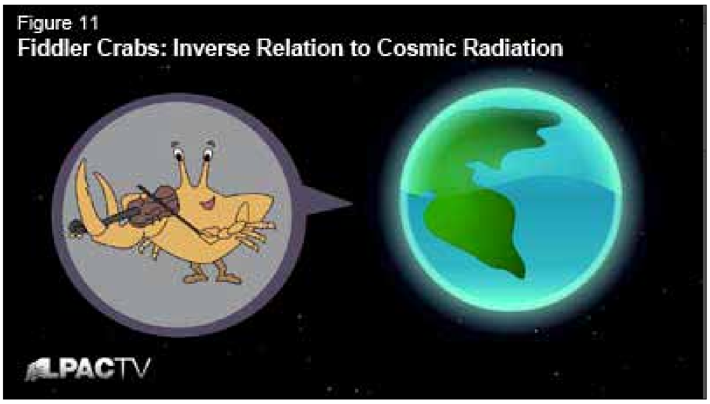

Figure 11
Fiddler Crabs: Inverse Relation to Cosmic Radiation

fecting living processes?

In 1923, Russian scientist Alexander Gurwitch saw that, while the final organization of living organisms is very well defined, the formation and division of the cells that eventually occupy the fully grown organism appear to occur in a random and disordered manner.

Gurwitch chose as a test subject, an onion, which typically grows symmetrically, with similar rates of cellular division on either side, to attempt to detect whether an unseen source of radiation, stemming from the root tip, regulated the division of cells. The onion halves were placed in two perpendicular directions, with one root tip pointing to the side of the other root (**Figure 12**). After allowing sometime for mitosis to occur, he then examined the subject root to see if the rate of division was different from the control root. Gurwitsch observed a 20% increase in cell division in the stem that had been subjected to the other root tip. This established that some form of radiation was being emitted from the onion root, which Gurwitsch called mitogenic radiation, stimulating increased cell division.

But a further experiment was required to narrow down what kind of radiation was causing this development. When Gurwitsch placed a thin piece of window glass between the two roots, the rate of cellular division slowed to normal rates, showing that the mitogenic effect had disappeared (**Figure 13**). When he replaced the window glass with quartz crystal, the mitogenic effect reappeared (**Figure 14**). This signalled to Gurwitsch that mitogenic radiation is an emission in the ultraviolet range, which cannot pass through window glass, but can easily pass through quartz crystal. Gurwitsch had shown that a small amount of ultraviolet energy participates in forming the structure of living organisms.

These are only a few cases of a wide field of investigation which will be elaborated in future presentations. All these areas of study need to be continued, and raise very interesting questions about the fundamental role of specifically tuned radiation phenomena in living organisms.

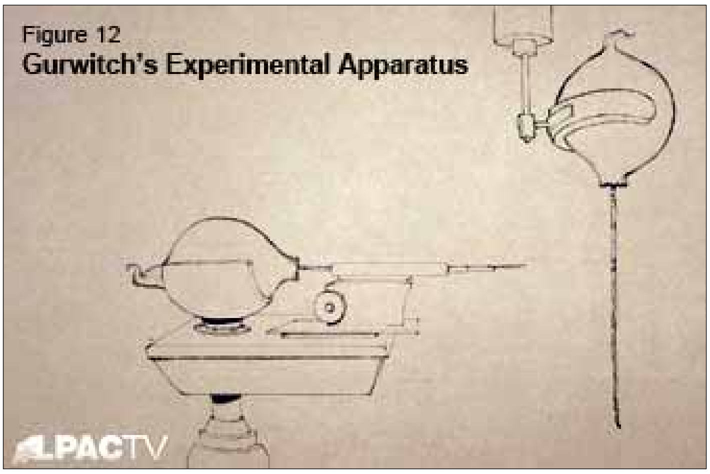
Figure 12
Gurwitch's Experimental Apparatus

The Unseen Realities

Narrator: The power of these seemingly weak forces, reveals to us an unseen reality which makes life on Earth possible. There is still much we don't know about the role of radiation for life here on Earth, including what exactly the nature of cosmic radiation is, that it would affect the development of life.

Viruses also respond to radiation: In laboratory conditions, they are turned on and off with the action of ultraviolet radiation. What role do they play in the process of evolution? Conversely, what do living processes require of cosmic radiation, in order even to exist?

If these galactic cycles, and the associated changes in cosmic radiation, do play an integral part in the development of life and the Biosphere, then this could completely transform how we understand life in the universe. For how could these galactic cycles of changes in cosmic radiation play a regular fundamental role in the anti-entropic development of life, unless they share the same quality of anti-entropic character as life and the Biosphere? How, then, are organisms tuned to this galactic harmony? What is the specific quality of resonance which allows this relationship to take place?

Most of what is currently assumed about sources of extragalactic radiation, like the Crab Nebula, pulsars, and supernovae, is purely speculation, extrapolated from our experience on the Earth. But the constant creation of new sources of cosmic radiation, gives us a sense of the creative nature of even the seemingly abiotic universe: a process which appears to be moving and directed, rather than cyclical, and resembles the quality of development of the Biosphere and Noösphere. Therefore, understanding their resonance with life on Earth will give us more understanding of their creative characteristics.

One keystone of this picture will be a new, expanded Periodic Table, expressing the fundamental relations of radiations and matter, including how they relate within living processes. By expanding our view of the role of energetic phenomena in living matter, we will revolutionize fields such as medical technology here on Earth.

Viewed from the top, the Biosphere of the Earth can be considered as a region of transformation. The power of living matter is its ability to harness forces, like cosmic and other radiation, into the evolutionary process of continuous upward development. This takes the form of increasing organization, and higher levels of energy-flux-density. The action of life naturally participates in creation. But what, then, of the contribution of mankind? How much more quickly and effectively has human activity advanced the organization of the universe through its own self-conscious creativity! What will be our commitment to that creative mission now?

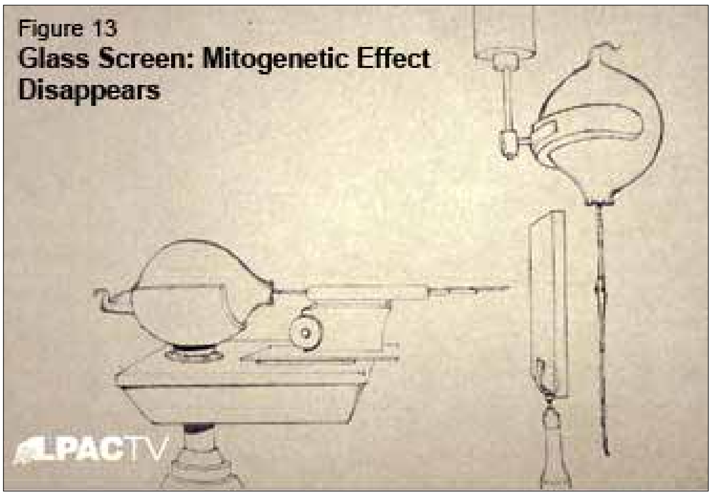
Figure 13
Glass Screen: Mitogenetic Effect Disappears

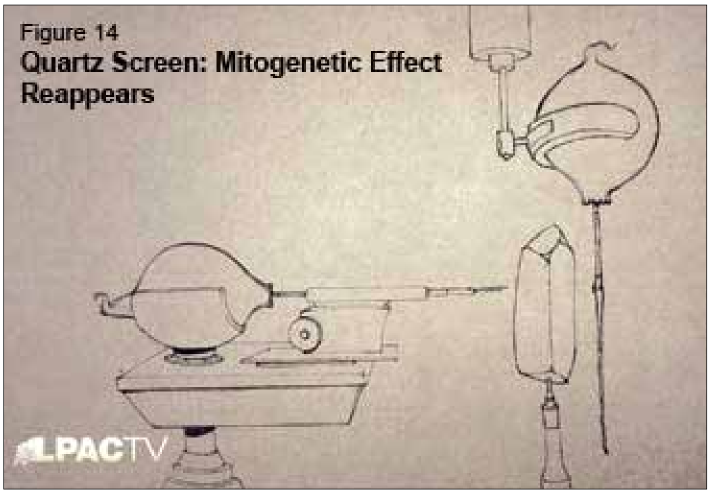
Figure 14
Quartz Screen: Mitogenetic Effect Reappears