Onward to Mars: The Triumph Of the Weak Forces

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Part I
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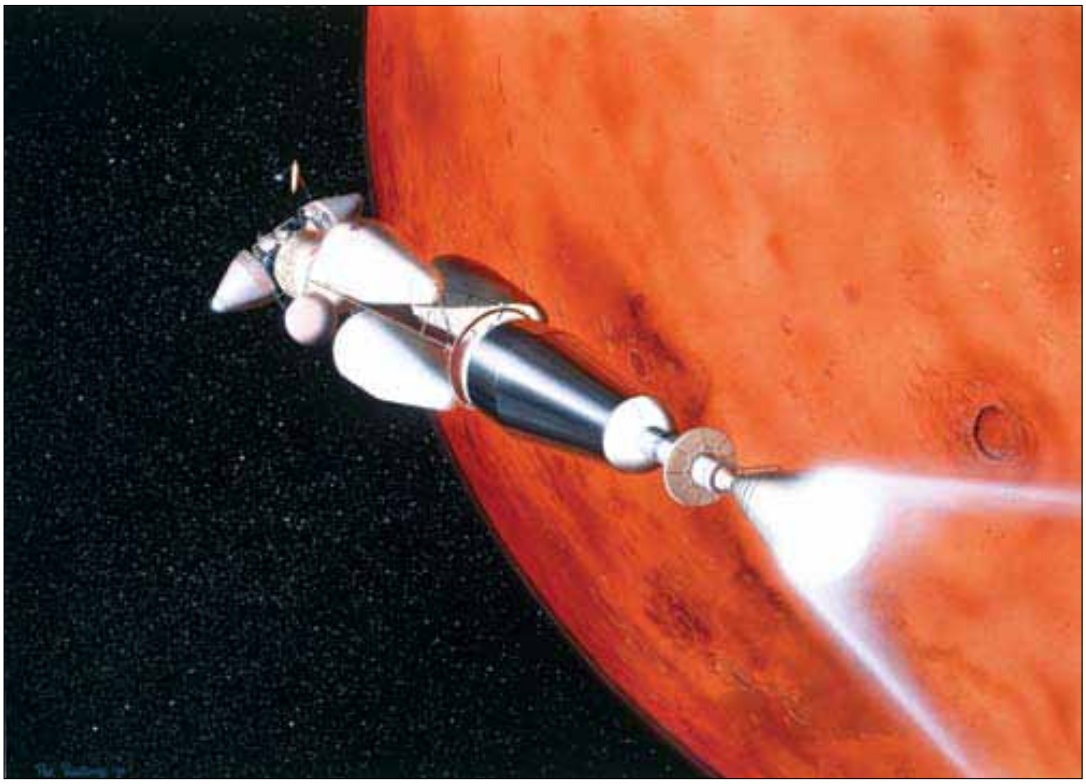


Confronting the challenges of a manned Mars mission today offers the most lawful means for deepening our undertanding of the relationship of electromagnetism to life. Shown: An artist's concept of a nuclear thermal rocket arriving in Mars vicinity, about to insert the transfer vehicle into orbit.

Because of the limitations of our sense organs, we are conscious only of a narrow sliver of the electromagnetic spectrum, mostly in the range of visible light and infrared radiation. While other organisms are adapted to sense different regions of the spectrum, we rely on the use of our extended "technological sense organs" to gain access to the full range of radiation penetrating the terrestrial environment from the Sun and more distant cosmic sources, as well as their interaction with the atmosphere and electromagnetic fields of the Earth.

With this expanded sense apparatus provided by instrumentation, we can "see" not merely discrete objects existing in space, but an active continuum extending within and between all such seemingly separate objects, composed of both the presumed particles of cosmic rays, as well as the various, intersecting electromagnetic wave-phenomena.

In this way, we continually overcome the very real limitations of our physiology, though we remain susceptible to artificial limitations in our thinking—particularly when we allow a naïve interpretation of our basic sense perceptions to dominate our picture of the physical world, whose characteristics in the very large and the very small are revealed by the general phenomena of cosmic radiation.

The Russian biogeochemist Vladimir Vernadsky believed that the pervasive action of the continual range of the unseen cosmic radiations permeating all of space was so significant, that not only the Biosphere—including its transformation by human action into the Noösphere—but even the distribution and character of the chemical elements in the crust, could only be understood as manifestations of cosmic processes.

In *The Biosphere*, Vernadsky wrote that living organisms are "the fruit of extended, complex processes, and are an essential part of a harmonious cosmic mechanism, in which it is known that fixed laws apply and chance does not exist."

Like Edgar Allan Poe's "Purloined Letter," the evidence of the "harmonious cosmic mechanism" is all around us. The vast experimental data on cosmic radiation and its connection to cycles of climate, biodiversity, and mass extinctions are substantial, albeit preliminary, hints at the effects of biological regulation on an astrophysical scale[1]. A rich material-energetic connection binds the Earth with the Solar System and the entire Milky Way galaxy.

Just as important as this *connection*, is the material-energetic *distinction* manifested between non-living, living, and cognitive processes. As the highest expression of material-energetic transformation, both the Biosphere as a whole, as well as individual organisms (the specific expression of what Vernadsky called living matter) provide natural instruments of the most exquisite sensitivity for registering the fundamental properties of material and energetic phenomena. Rather than attempting to build the universe up from its presumed smallest, inorganic parts, we must build downwards from cognitive and living processes. This approach will necessarily lead to, among other things, an expansion of the periodic table of the elements.[2]

A False Dichotomy

Unfortunately, the much-hyped historical division between the mechanistic and vitalistic outlook, has ingrained a false dichotomy in contemporary thought. For example, although the mechanist reduces all processes, including biological ones, to movements of discrete particles of matter, and the vitalist locates causality in some agency acting outside those material parts, typically in some unique form of "energy," both accept the same fundamental assumption regarding the existence of discrete particles of matter as such. Despite the fact that few people today would claim to be either true mechanists or true vitalists, modern science is still shackled by a crude materialism, continued, for example, in the form of the compromise known as the wave-particle duality.

How does scientific thought distinguish the efficient

existence of discrete, whole processes from the physical continua in which they participate? For example, the Earth's Biosphere as a whole represents a singularity within the constant biogenic migration of atoms throughout the galaxy, just as individual organisms represent singularities within the process of biogenic migration through the Biosphere.[3] Do these singularities represent unique manifestations of physical space-time, as Vernadsky hypothesized?

If so, it makes clear the revolutionary implications of interplanetary spaceflight at accelerations sufficient to produce an artificial gravitational field, as contained in the Moon-Mars colonization proposal of Lyndon LaRouche. The consideration of *living processes* within accelerated reference frames amidst the dense radiation fields of cosmic space goes to the heart of the fundamental questions at the root of a true, Unified Field Theory.[4] While the theoretical questions involved are fascinating in themselves, human progress depends on their answer by direct experiment—which a rapid development of Helium-3-powered fusion rockets could easily make possible within this century, and perhaps even within decades.

However, there already exists a vast record of experimental evidence pointing to the unique physical space-time attributes of living organisms, including the biological significance of electromagnetic radiation.

Aside from more energetic biochemical reactions, organisms are highly sensitive to forces operating at apparently much lower orders of magnitude. Such weak forces prominently include low-intensity electromagnetic radiation, producing so-called "non-thermal" effects, that is, operating below those intensities capable of heating or noticeably disrupting living tissue. These effects have been extensively documented, despite historical opposition to the orthodox view of the organism as nothing more than a biochemical machine governed by point-to-point interactions in the small. Typical of such prejudice, is the Linear No Threshold theory, declaring any amount of ionizing radiation to be biologically

Helium-3 Fusion

In all standard forms of power generation, including nuclear fission, a significant percentage of the total energy throughput is lost when the energy is converted mechanically into electricity, usually through a turbine. The lost energy is noticeable as wasted heat.

In a fusion reaction, which produces much greater amounts of energy, this energy-loss also occurs, in the form of the emission of neutrons which are absorbed by the reactor structure, producing waste heat, as well as causing the reactor to decay. Neutrons are particles that are not electrically-charged, and are thus unable to be contained or directed using a magnetic field.

However, if the fuel used in the fusion reaction is helium-3, the percentage of energy-loss is reduced dramatically, to almost negligible. This is because helium-3 fusion reactions can produce more than 90 per cent, and perhaps up to 99 per cent of their energy in the form of charged particles. This means that the energy is already in the usable form of electricity, and doesn't require costly mechanical conversion, which makes it an incredibly efficient form of power generation. It also means that the energy output can be directed and contained by magnetic fields. This means that helium-3 fusion reactors will not require costly extra equipment, for energy conversion or for protection.

Helium-3 is extremely rare on earth, but abundant on the moon. Pictured is an artist's conception of mining the moon, for helium-3.

Luigi Galvani's 18th-Century experiments on the electrical stimulation of frog legs opened up a field of study about he relationship of electromagnetism to life. One of the most dramatic manifestations of electromagnetic regulation in organisms is the phenomenon of regenerations of body parts .

damaging, despite the overwhelming evidence for the benefits of low-dose radiation.

Vernadsky's definition of an individual organism as inseparable in principle from the entire Biosphere, and, by extension, from the cosmic processes which produced it, demands a new understanding of the organism as, essentially, a uniquely organized electromagnetic process. However, this should not imply the New Age vitalism of "life energies" or similar mysticism. Similarly, some investigators in the field of bioelectromagnetism, professing to reject the limitations of a traditional mechanistic view, have relied instead on a cybernetic interpretation of self-organizing phenomena in life, despite the fact that the living processes they study are in principle irreducible to cybernetic concepts such as feedback loops and information theory, derived entirely from the operation of machines.

The Body Electric

As we shall see, confronting the challenges of a manned Mars mission today offers the most lawful means for deepening our understanding of the relationship of electromagnetism to life, a subject of investigation which goes at least as far back as the famous 18th-Century experiments by Luigi Galvani on the electrical stimulation of frog legs. The field of study now includes everything from the bioelectric organs used by sharks to hunt their prey, to the nature of electrical regulation of the human brain and nervous system, to the internal magnetic compasses of birds and fish. One of the most dramatic manifestations of electromagnetic regulation in organisms is the phenomenon of regeneration, the recreation of fully functional body parts which are lost due to injury, the study of which led scientists like Robert Becker[5] to begin the systematic investigation of the relationship between electromagnetism and living systems.

Measurements made in the 1830s first established that small electrical currents are produced around injured tissue in animals. Where does this electricity come from? The discovery of the nerve action potential not long afterwards seemed to solve the mystery, by attributing bioelectrical potentials to the differences in ion concentrations across cell membranes. However, later experiments demonstrated that, while the emergence of direct electrical currents depended on the presence of peripheral nerve tissue, they were not merely secondary effects of the action potential. These direct currents exhibit very distinct behavior during regeneration, a capacity which becomes more prevalent in organisms the lower down the evolutionary ladder one goes.

For example, the planarian (**Figure 1**), a species of flatworm with a primitive nervous system, can regenerate whole organisms from almost any piece of itself that is cut off! Experiments showed that the head-tail axis of the planarian was determined by electric poles established by internal currents, and that artificially reversing the direction of current could produce a head where a tail would normally be found, and vice versa.

However, it was the study of salamanders (**Figure 2**) which first revealed the highly specific behavior of the currents of regeneration. In amputated salamander limbs, the injury current was found to reverse direction a short time after injury, going from positive to highly negative. This reversal in polarity, combined with an increase in its magnitude, is accompanied by the formation of a mass of cells at the stump tip, called the blastema (**Figure 3**), from which the new limb eventually forms (**Figure 4**). As regeneration proceeds, the magnitude of the polarity slowly diminishes, eventually returning to zero. In non-regenerating animals like frogs and even rats, partial regeneration can be induced by mimicking these highly specific polarity and magnitude changes with applied electric current.

The blastema itself turns out to be adult cells that have de-differentiated into a "totipotent" state, capable of re-differentiating into the needed new types of cells required by the regenerating limb. So, in addition to the question of the origin of the electrical currents, we must ask: How is it that such currents are capable of initiating the process of blastema

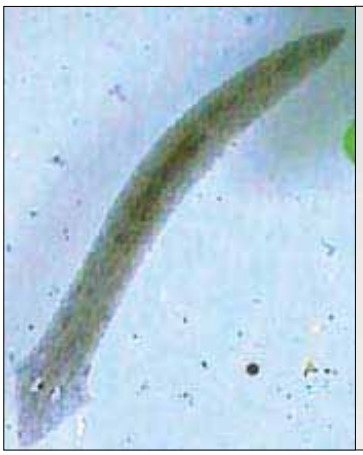


Figure 1

Figure 2

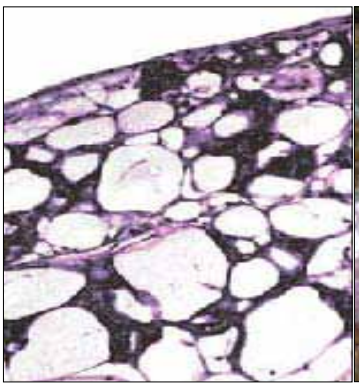


Figure 3

Figure 4

The planarian (Figure 1), a species of flatworm, can regenerate whole organisms from almost any piece of itself that is cut off; in amputated salamander limbs (Figure 2), a reversal in polarity is accompanied by the formation of a mass of cells at the stump tip, called the blastema (Figure 3), from which the new limb eventually forms; the sea star (Figure 4) is growing new legs after the old ones were lost.

formation by inducing specific cells to de-differentiate, and how do they help to determine the form of the regenerated body part? "All the experiments led to one unifying conclusion: The overall structure, the shape, the pattern, of any animal is as real a part of its body as are its cells, heart, limbs, or teeth."[6] What role does electricity play in "remembering" the whole organism, even when the physical parts disappear?

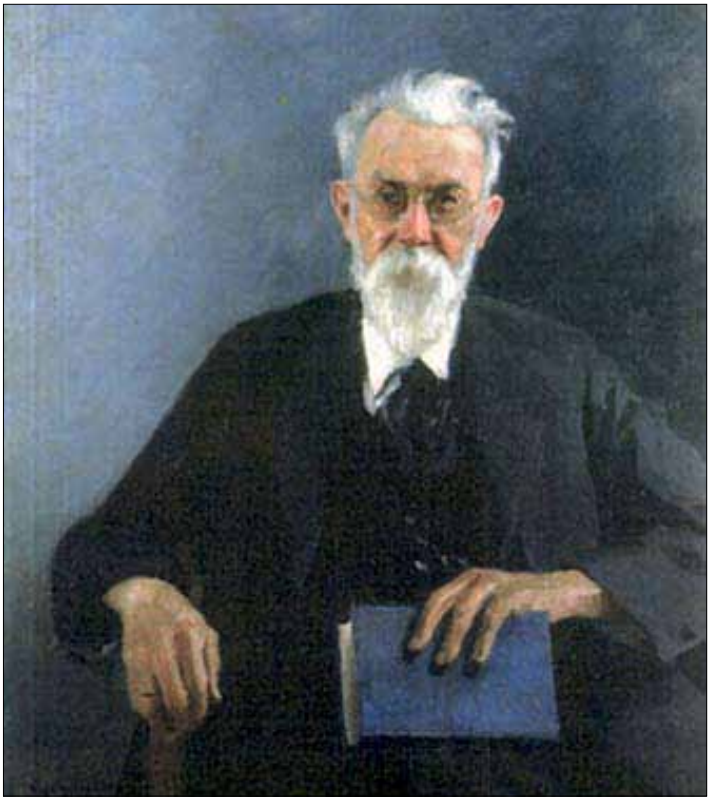
In humans, the closest analogue to regeneration (as distinct from wound healing) is the repair of bone fractures, which is accompanied by the formation of a blastema, and the characteristic polarity and magnitude reversals of the injury current, in regenerating limbs, and which has been found to be accelerated through the application of pulsed electromagnetic fields. The electromagnetic control system for the body as a whole extends from the brain throughout the nervous system and, among other things, regulates the overall activity and sensitivity of the brain's neurons—though the seemingly unlimited capacity for the brain to reorganize itself, generally termed neuroplasticity, seems to defy any simply biological or bioelectric explanation.

Then again, explanations for many of the most basic processes of biology have proven to be elusive. For example, the formation of the blastema in regeneration is strikingly similar to embryogenesis, the intricate and highly coordinated processes governing the action by which a full organism develops from a single, undifferentiated germ cell.[7]

It is now known that weak electrical currents play a significant role in the formation of the embryo, and just as in regeneration, exhibit highly specific forms of behavior.[8] Experiments on chick embryos showed that artificially manipulating the current in one part of the embryo leads to significant changes in the whole, indicating that the electric field's primary function is not limited to governing local cell migrations, but rather, helping to direct differentiation throughout the entire embryo. The pioneering experiments of Hans Driesch at the end of the 19th Century had already established that an individual cell's fate is dependent on its relationship to every other cell in the developing embryo, a seeming total dependence of the part on some pre-existing whole. Alexander Spemann's work, not long afterwards, showed that the interplay between part and whole was more complex, as certain groups of embryonic cells, which he called "organizers," could determine the fate of neighboring cells.

What means do cells possess to interpret their position within the whole, so important for differentiation? Northwestern University researcher Günter Albrecht-Bühler has shown that cells can emit and detect light pulses in the far infrared range, a kind of cellular "sight" which causes different types of cells to respond in different ways to the same signal. Other experiments established that different cell types also respond in distinctive ways to an electric field. Combined with Alexander Gurwitsch's 1920s discovery of mitogenetic radiation in the ultraviolet range, a "biophotonic" communication process governing mitosis, there appears to be a highly differentiated electromagnetic communication and control system already evident in the earliest stages of an organism's life.

In the same chick embryo experiments, different, asymmetric electric fields were produced by different parts of the developing embryo. When the internal field of one, but not the other, was artificially disrupted, a pseudoembryo developed, possessing the correct, basic external bodily form, but whose internal tissue was an undifferentiated mess. An analogous situation occurred in the formation of pseudolimbs in experiments on artificial regeneration. In these cases, the external form of the organism was not simply the end result of internal tissue differentiation, but seemed to have an independent existence, closely related to the action of the electrical fields. Again, how are these fields generated? And how do they help any given cell know how, or whether, to differentiate?



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To be continued...

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1. Sky Shields, "Kesha Rogers Victory Launches the Rebirth of a Mars Colonization Policy!" http://www.larouchepac.com/node/13802

2. Peter Martinson, "Towards a New Periodic Table of Cosmic Radiation." http://www.larouchepac.com/node/14253

3. Shields, op. cit.

4. Sky Shields, "The Significance of Biological Research in Space for the Development of a Unified Field Theory," Submission to the National Research Council's Decadal Survey for Biological and Physical Sciences in Space, October 2009. http://wwww.nationalacademies.org/SSBSurvey/ DetailFileDisplay.aspx?id=399.

5. Robert O. Becker and Gary Seldon, *The Body Electric: Electromagnetism and the Foundation of Life* (New York: William Morrow and Company, 1985)

6. Becker, op. cit.

7. There also appears to be an interesting relationship between regeneration and cancer. Becker reports on the work of Meryl Rose, who demonstrated in 1948 that salamanders infected with cancerous growths could be cured by amputating a limb and inducing regeneration, implying that "regeneration's guidance system could control cancer," and underscoring that "the state of the *entire* nervous system can affect cancer."

8. Colin Lowry, "The Electric Embryo: How Electric Fields Mold the Embryo's Growth Pattern and Shape," *21st Century Science & Technology*, Spring 1999, pp. 56-70.