AUSTRALIAN ALMANAC

Onward to Mars: The Triumph Of the Weak Forces

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Part 2
by Oyang Teng

The Biological Field

The fact that organisms can generate unique fields that play such a significant role in morphology, as during embryogenesis and regeneration, lends strong support to the biological field theory of Gurwitsch, who developed the idea in conjunction with studies of the even weaker mitogenetic radiation detected during cell mitosis. While recognizing the necessity for an "invariant law" to describe the coordinated action of individual cells within the whole organism, he was careful not to limit the biological field to any particular energetic manifestation, but left open the possibility that it could be expressed by any of the known physical field phenomena, or yet undiscovered physical processes.

How might the direct bioelectrical currents be a manifestation of this biological field? Becker drew on the work of Albert Szent-Gyorgyi to hypothesize that these currents operated by a process analogous to semiconduction in solid-state materials. The highly ordered internal structure within and between cells could facilitate the movement of free electrons. Gurwitsch similarly proposed that the primary work of metabolic energy involved the maintenance of highly ordered "non-equilibrium molecular constellations" within the protoplasm-protein complex of cells, and that some of the mitogenetic radiation was connected with these structures. This may indicate one possible link between the highly quantized effects of mitogenetic radiation, and the direct current system operating throughout the whole organism.

The work of Alexander Gurwitsch (left), Albert Szant-Gyorgyi (middle), and Wolfgang Köhler advanced our understanding of the role of electromagnetic factors in biological life.

Unlike Gurwitsch, others saw in the field concept a way to reduce biological processes to strictly physical ones, that the only difference between the living and non-living "is to be found in all probability in more complex fields and more complex molecular structure,"[9] rather than in the unbridgeable distinction of separate, but interacting, phase-spaces. In this sense, the concept of field itself has been reduced to supposedly "real" particles of inorganic matter surrounded by fields, "a remnant of old materialistic conceptions.... As a matter of fact, insofar as 'particles' are known to be fields and field-structures, they fill the volume of a macroscopic object completely, and to this extent the object is a continuum. It is only as a field-continuum that it coheres."[10]

Wolfgang Köhler, one of the founders of gestalt psychology, recognized that the very concept of discrete particles of matter was nothing more than an artifact of a naïve interpretation of vision. As a result, the precepts of both biology and physics were limited by their inability to deal with the ontological reality of functional, self-organizing wholes—the gestalt phenomena of human mental activity.

In biology, the controversy has centered around the problem of whether life processes can be explained physio-chemically or whether "vital" forces must be postulated. Indeed, the properties of life processes with which biology is concerned are not unlike the psychical phenomena responsible for the gestalt problem in psychology. This does not mean, however, that the vitalists' doctrine in biology recommends itself as particularly fruitful, for *their* answer precludes the possibility of success in a search for physical gestalts. The biologists have of course made some attempts at discovering analogies in physics, but thus far little more than vague comparisons with crystal formations has been achieved.... The closest approach between general biology and psychology occurs in the theory of nervous functions, particularly in the doctrine of the physical basis of consciousness. Here we have an immediate correspondence between mental and physical processes, and the demand seems inescapable that at this point organic functions be thought of as participating in and exhibiting essentially gestalt characteristics.[11]

Because the thought and language of physics, consequently carried over into biology, had been based on mechanistic assumptions, a new conceptual foundation for these sciences would have to be built up from the language governing cognitive processes—an approach consistent with Vernadsky's discovery of the subsuming characteristic of the Noösphere over both the biotic and abiotic.

According to the machine conceptions, order in nature can only be imposed by certain fixed constraints, a necessary corollary to the idea at the root of the second law of statistical thermodynamics: that natural processes inherently tend toward disorder. It is true that within any given boundary conditions for a given system, there is a definite tendency toward an equilibrium state describable by the second law. However, the principle of direction in that system can also be attributed to strictly physical (what Max Planck called "dynamical"), rather than statistical, principles, such as the system's tendency to reduce its total potential.[12] The machine conception fails even as a beginning point in reasoning. Within certain boundary conditions, which themselves cannot be defined by the second law, even inorganic systems have the capacity for regulation purely through the interaction of the physical forces inherent in the system.

The array of these physical forces active in biological processes is not a subset of, but rather *subsumes* those found in inorganic systems, and appears to include not only chemical and electrodynamic phenomena, but everything from laser-like biophoton emissions, to nuclear transmutation and superconductivity, processes whose abiotic expression may represent merely "limiting conditions" of their more universal manifestation in life. These processes act to reshape the topological boundary conditions represented by any given physical state of an organism, as in the case of the electric fields governing limb regeneration.

In a machine, the distinction between process and structure is unambiguous; for example, hot gases are conducted through the rigid chamber walls of a car engine. In an organism, the energetic flow required for metabolism literally builds, and constantly maintains, the structure of the organism. Moreover, this energetic flow is part of a continuous process extending from terrestrial, to solar, to cosmic space, posing the question: Are there any strictly inorganic systems for which the second law has universal significance?

Interplanetary travel requires that we learn to "see" the invisible part of the terrestrial environment, which is as real as the oceans, mountains, and atmosphere. Shown: an artist's conception of an astronaut, in a special spacesuit, working on the Moon.

Leaving the Womb

The existence of continual, periodically varying, and interpenetrating electromagnetic fields forms an invisible part of the terrestrial environment that is as real as the oceans, mountains, and atmosphere, though we may forget about such radiations in the same way a deep-sea fish forgets about water. Sources of this radiation include the Earth's magnetic and electric fields, each of which exhibits diurnal and periodic variations in conjunction with the activity of the Sun, as well as larger astronomical cycles; natural changes in the atmosphere, such as thunderstorms; cosmic background radiation such as radio and gamma rays; and man-made sources.

In many ways, the evolution of life on Earth has been bound up with the evolution of the electromagnetic fields of the planet, as through the creation of the atmosphere by which the electric fields of the planet are maintained, or the more extreme case of magnetic field reversals, whose cause remains a mystery, but which have historically coincided with mass extinctions. More interesting is the possibility that the magnetic field itself is either a product of, or at least conditioned in some way by the action of living processes, possibly through the motion of conducting currents in the oceans.[13]

A vast body of experimental work has documented widely varying influences of environmental electromagnetic fields on the behavior and internal vital activity of organisms, including all the known plant, animal, and human biorhythms. Such fields act in conjunction with those produced by the organism itself. However, the very broad measurable parameters of electromagnetic radiation, including its frequency spectrum and modulation, intensity, and orientation, and the fact that organisms can be sensitive to extremely slight variations in any one of these, make the correlation of specific effects with specific forms and qualities of radiation difficult to determine. Add to that, the "corpuscular" cosmic rays and their secondary atmospheric by-products, and the potential functional relationships of various radiations and life appear almost infinitely complex.

Ultimately, determining the specific forms of "resonance" between organisms and the energetic phenomena of their environment will depend on learning more about the way organisms exhibit such high degrees of selectivity, one of the

Molecular biology vs. Gurwitsch's biological field

Einstein spent his life looking for a unified field theory, an overarching understanding that would unite the distinct phenomena of electromagnetism and gravity into a one. Although not successful, Einstein's quest epitomised his scientific method, which was a constant search for universal principles.

Undoubtedly influenced by the breakthroughs in the understanding of electromagnetic fields and gravitational fields, Russian biologist Alexander Gurwitsch hypothesised the existence of a biological field, an invisible force which governed the dynamic organisation of biological processes.

Gurwitsch's idea was an affront to molecular biology; in fact, his ideas have gone on to be derided as "pathological science" (loosely defined as discovering what you want to see). Molecular biology is *reductionist*—living processes are broken down into their component parts, i.e. cells, and treated mechanically, eg. DNA is regarded as similar to storing information on a computer hard disk. Molecular biology doesn't differentiate between living and dead cells. Immediately before and immediately after dying, a cell still contains the same molecules and structures.

For a competent scientist such as Gurwitsch, as for his fellow countryman Vladamir Vernadsky, such a view is deeply flawed, because the presence or absence of life in a cell makes all the difference. So if the molecular structure of the matter of cells couldn't explain life, it was necessary to go outside such constraints, and look for the governing principle of the whole. Gurwitsch hypothesised his biological field after conducting an experiment in which he subjected an embryo of just a few cells to disruption in a centrifuge. Afterwards, the embryo reorganised itself into its proper arrangement, and developed into a normal organism. Later, in his more famous onion experiment, Gurwitsch demonstrated mitotic cells, that is, cells undergoing cell division, emitted very weak photons (biophotons) of light in the ultraviolet range of the electromagnetic spectrum, which communicated with mitotic cells in other organisms. He called this mitogenetic radiation.

In Gurwitsch's time it wasn't technically possibly to directly measure biophotons, but in the 1950s Italian astronomers developed a very sensitive photo multiplier, to make seeing distant stars possible. When used on living samples, such as leaves, corn, germs of wheat, beans and others, it detected the emission of a constant but weak light.

clearest expressions of the unique physical space-time of living matter. At the nuclear scale, this includes not only what specific chemical elements an organism will utilize, but also which isotopes. At the molecular scale, this includes not only the elemental and isotopic composition of molecules, but also their *structure*, discovered by Louis Pasteur, as the presence of a principle of dissymmetry, reflected in the ability of left- or right-handed molecules to rotate polarized light (electromagnetic radiation).[14]

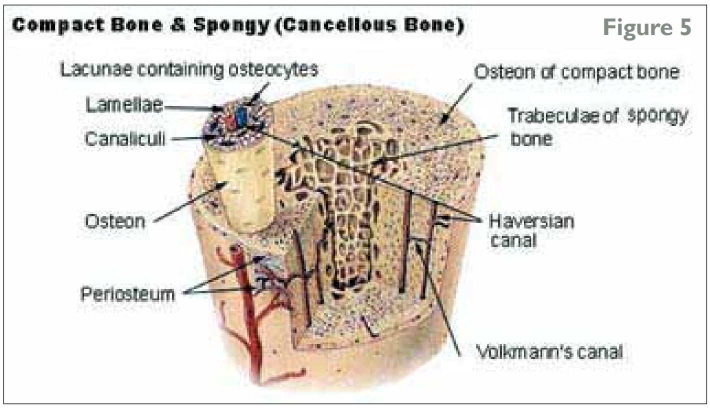
Bioenergetic phenomena, in general, should be considered in light of Pasteur's and Pierre Curie's work on the principle of dissymmetry, which Vernadsky believed was one of the most important avenues for scientific exploration into the physical space-time manifestation of directionality in living processes.

In general, the cyclical character of the relationship of organisms to energetic phenomena must reflect that of organisms to matter: They are utilized and transformed by the organism as part of the continual process of the biogenic migration of matter-energy through the Biosphere, in its evolution to higher states of development. Defining this selectivity with respect to electromagnetic radiation may help to actually redefine the electromagnetic spectrum itself, with which "Living systems may be playing an unimaginably huge concert ... creating a completely new category of phenomena outside classical electrodynamics."[15]

Perhaps we won't fully appreciate the subtle, but crucial, nature of our dependence on an appropriate electromagnetic "diet," until we are forced to create it ourselves from scratch—beginning with the first lunar bases, and then, en route to and on the surface of Mars.

One example, related to the overall bioelectromagnetic control system first revealed by regeneration, suffices to demonstrate that frontier research in space is no luxury, but rather, an absolute necessity.

Bone loss in astronauts in space has long been recognized as a major problem, and it is one that appears closely related to osteoporosis on Earth (**Figure 5**). However, it cannot be fully accounted for by the mechanical "unloading" of bone stress due to microgravity, and undoubtedly involves an electromagnetic component. Becker proposed one possible means by which bones might respond to external electromagnetic fields in space.



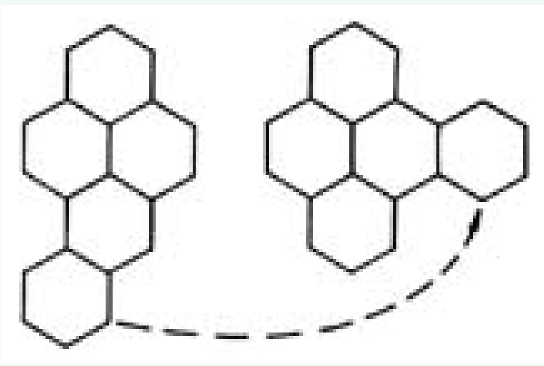
Bone loss in astronauts in space has long been recognized as a major problem; the relationship of ionizing radiation, which is more abundant outside the protection of Earth's magnetic field, to the rate of both fracture healing and bone loss in reduced gravity environments is being studied, although primarily in Earth-bound laboratory conditions.

Bones are able to reshape themselves according to mechanical stress, creating more growth in areas that bear greater compression loads, and compensating by eliminating bone material in other areas. This self-regulating system of growth and loss is governed by electrical signals, and the piezoelectric property of bone may allow it to generate the necessary electrical currents by mechanical stress. Human bone is an intricate structure composed of a matrix that includes tiny apatite minerals of calcium phosphate bound to interwoven collagen fibers, as well as trace elements like copper. Becker found that the trace atoms of copper might act as a kind of electromagnetic "peg," holding the collagen and apatite together, which could be loosened through a disruption of the body's internal electric fields.

Gurwitsch's work was re-examined in the 1970s by German biophysicist Fritz Popp, who was investigating the complexity of the organisation of life forms. Consider the complexity of a human body:

Every cell produces some million molecules per second.

The average human consists of approximately 10 trillion cells (generated by 43 successive rounds of cell doublings—1 into 2, 2 into 4, 4 into 8, 8 into 16, 16 into 32, and so on).



Virtually identical benzpyrene molecules, 3,4 benzpyrene (left) and 1,2 benzpyrene (right).

However, there is constant turnover: every second, approximately 10 million cells die, and must be replaced, quickly, in order to stop decay.

When a cell will die is unpredictable, but the body has to be finely tuned, because if the replacement rate drops or rises, the body will die quickly.

Fritz Popp calculated that the intimate coupling of cell-to-cell communication required to coordinate this harmony could only be possible at the speed of light—chemical or molecular transmissions of communication would not be sufficient. From research he conducted into cancer, Popp found the carcinogenic benzpyrene 3,4, from coal tar and cigarette smoke, which is virtually identical to the harmless benzpyrene 1,2 , was different only in the fact that benzpyrene 3,4 has a strong absorption/emission anomaly in the ultraviolet range. Popp posed the question: could this quality of the molecule be the cause of its carcinogenicity, rather than an assumed chemical effect?

Popp devised a photomultiplier to measure weak light from cells. He experienced the very real political repression of science seen today in the climate change debate, when his application for a grant was rejected because the scientists on the grant board completely rejected the possibility that cells could emit light. Only when he adjusted his application to say he wanted to prove cells *didn't* emit light was his grant approved! With his photomultiplier Popp not only proved cells did emit light, but also that the light varies by cell type and in intensity, and often comes as a photon explosion, especially when the cells are irritated by outside means.

Max Planck and Albert Einstein called for the development of a new concept of causality, rather than the statistical indeterminacy imposed by the quantum mechanists. Here, Planck presents Albert Einstein with the Max-Planck medal, Berlin, June 28, 1929

Space osteoporosis may result from unnatural currents induced in bone by a spacecraft's rapid motion through the Earth's magnetic field, with a polarity reversal every half orbit, or, it may be a direct effect of the field reversal. This abnormality, which may change the activity of bone cells directly, would be superimposed on abnormal responses of bone's natural electrical system, which is almost certainly affected by weightlessness. The unfamiliar external field reversals could also weaken the copper pegs, at the same time that the bones are in a constant state of "rebound" from their Earthly weight-induced potentials, producing a signal that says, "No weight, no bones needed." We know that the more even distribution of blood caused by weightlessness registers in the heart as an excess; as a result, fluid and ions, including calcium, are withdrawn from the blood. However, the effect probably isn't due to weightlessness alone, for the Skylab astronauts did rigorous exercise, which would have supplied plentiful stresses to their bones. They worked out so hard that their muscles grew, but decalcification still reached 6.8 percent on the twelve-week mission.[16]

Such possible effects, which point to the more general electromagnetic properties of biological regulation, can only be tested by experimenting with artificial electromagnetic fields on astronauts in orbit. In addition, current space biomedical research indicates that bone fracture healing is impeded in reduced gravity conditions. The relationship of ionizing radiation, which is more abundant outside the protection of Earth's magnetic field, to the rate of both fracture healing and bone loss in reduced gravity environments is being studied as well, though primarily in Earth-bound laboratory conditions.

Again, these relationships can only properly be investigated outside of the pervasive electromagnetic and gravitational fields of the Earth. Far beyond the specific effects on bone and other organic tissue, such studies could lead to a new understanding of the broader relationship between ionizing radiation, electromagnetism, and gravitation.

Indeed, radioactive decay itself, a property of the inner structure of atoms once thought immutable, and a source of ionizing radiation, has been shown in some cases to correlate with astrophysical cycles.[17] This further underscores that the fundamental properties of even inorganic matter cannot be studied as the isolated phenomena of "particle physics," and calls to mind Vernadsky's emphasis on the role of cosmic processes in shaping the inherent character of all matter. Here lies the true value of a science-driver program for space exploration, in forcing the combination of fusion and nuclear research, with astrophysics, biology, and physical chemistry, to allow seemingly paradoxical observations to be compared and analyzed across a wide range of experimental domains. This becomes crucial as we confront the prospect of supporting human life outside the "womb" of the Earth.

A New Causality

In a sense, we are faced today with the same complex of paradoxes that arose with the simultaneous emergence of atomic science, relativity, and quantum physics, in the first decades of the 20th Century. Seemingly continuous processes, such as energetic phenomena, appeared to be organized in the very small as discrete processes. Likewise, discrete phenomena, such as matter, could be represented by continuous processes.

Max Planck and Albert Einstein called for the development of a new concept of causality, rather than the statistical indeterminacy imposed by the quantum mechanists. In this respect, it is worth recalling the words of Planck's student Köhler, that "Max Planck once told me that he expected our approach [in gestalt psychology] to clarify a difficult issue which had just arisen in quantum physics if not the concept of the quantum itself."[18]

Vernadsky, at the same time, recognized that, for the truths of science to be universal, the standpoint of the "naturalist" had to be adopted, in order to study the full scope of physical phenomena and their expression in all three universal experimental domains of the abiotic, biotic, and noetic.

The basis for this new science of dynamics, as LaRouche has called it, will rest on a mobilization of the scientific and economic means necessary to secure an interplanetary future for mankind, including a full mastery of the entire electromagnetic spectrum and its use to sustain human life throughout the Solar System. This approach will define the meaning of science for the next century, if we have the wisdom to let that knowledge guide our actions in the present.

The author can be reached at oyang@gmail.com.
For additional references: http://larouchepac.com/node/14423

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