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**The Self-Evolving Cosmos: A Phenomenological Approach to Nature's Unity-in-Diversity.** Steven M. Rosen. Hackensack, New Jersey: World Scientific Publishing, 2008, 272 pages, $88.00 hardcover, $48.00 paperback.

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When the new Hadron Collider fires protons at each other at near light speeds, the collisions are expected to approach conditions that existed soon after the Big Bang and to give rise to particles never before "observed." Physicists hope to "see" what some assume to be the basis of dark matter, cutely named sparticles — selectrons, squarks, and so forth. By "finding" still more exotic specks of matter, aptly named "particle physicists" anticipate great breakthroughs in their understanding of matter and cosmogony, and to get closer to unifying the basic forces of nature.

But what if the very notion of a particle and the categorical distinction between particle, space, and scientist, are unjustified pre-suppositions? In his challenging new book, *The Self-Evolving Cosmos: A Phenomenological Approach to Nature's Unity-in-Diversity*, Steven Rosen says physicists, still bunkered down in their fortress paradigm of object-in-space-before-observer, need to transform their metaphysics in order to eliminate the fundamental problems of infinities and discontinuities that plague them. There seems to be a misplaced concreteness here; a confusion of abstraction and reality. Rosen, challenging the assumption of "things" "out there" — the very notion that ultimate reality is determinate — proposes a new philosophical underpinning to theoretical physics, one that transcends the current three-fold division of object, subject, and space "in recognition of their intimate entwinement and transpermeation" (p. 10).

Rosen briefly summarizes the evolution of Western science's notion of space, and the metaphysics underlying our reality, from Plato's potentially discontinuous space to Descartes' continuum of *res extensa*, in which the *res cogitans* casts out (*objicere*) the stuff of space. The subject–object mirroring inherent in this early notion of *prima materia* eventually solidified to a separation. And the subtleties of the original dialectical process "hardened into categorical divisions" (p. 8).

The subject desires to unify the complexity of objects in space and the chief mode of doing so appears to be through the notion of symmetry — when some characteristic of a body or system remains the same despite the fact that a change has been introduced. (Spinning a sphere through some angle does not change the appearance

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of the sphere.) Babies learn the concept playing peekaboo. But far more subtle symmetries have been introduced, where, for example, gravitational interactions are invariant under a change or transformation of coordinates; these same Cartesian coordinates, referents to empty space, we learned in high school. But this space has evolved. Through ever greater mathematical abstractions of symmetry groups, the old separation of object, space and observer has been propped up. Physics, says Rosen, from Newtonian, through relativity, quantum physics and string theory, attempts to maintain this separation, spurning dialectic in order to retain its paradigm, unaware that the very effort thwarts the possibility of unification. Although the symmetry of objects (or relations between them) is empirical, the symmetry of space is epistemological; that is, we abstract "space" to fit our needs. Theoreticians like Kaluza, Klein, Salem, Weinberg, and Hilbert imply dimensionality itself is subject to change. But all the abstractions we impose on space can not prevent discontinuities or ruptures in the "smooth" "fabric" of "space" from cropping up like whack-a-moles. Hilbert space has an infinite number of dimensions. Aren't these abstract spaces the new version of Ptolemy's epicycles? As we bend over backwards in order to insure continuity, large and small begin to lose their distinction; scale breaks down: "Thus in the singularity of the black hole, relativity theory and quantum mechanics come together" (p. 33). Rosen is not talking about similarities, here. The disruption seen at a black hole singularity is the breakdown at the Planck domain.

Does string theory solve the problem? No, says Rosen, it skirts the issue. If strings are not point particles, they are extended and therefore divisible. Yet string theorists assert strings are "uncuttable." How can they be indivisible and divisible? It seems these entities (electrons, photons, strings) belong to the subject rather than the object classification. We've never observed an elementary particle. We conjure rather than catch them; they are more epistemological than empirical. Thus the Standard Model also fails to maintain object–subject separation. In sum, all major twentieth century attempts at unification maintain that separation at a steep price: asymmetry, infinity, and discontinuity. Rather than sweeping chaos under the rug of idealized, abstracted "space," we must embrace the primal pre-distinction state — Aniximander's *apeiron*, Alchemy's *materia prima*, Bohm's implicate order, Merleau–Ponty's lifeworld, Heidegger's Being . . . before unification is possible. A dialectic of transformation is required.

How can this be accomplished? Rosen suggests a new metaphysics, one that can accommodate the dialectic interplay of subject and object, container and contained — existential phenomenology. And he pays particular attention to Merleau–Ponti's "depth" and Heidegger's "time-space."

Cartesian space, a "space without hiding places" (p. 47) having "no folds or nuances" is "beyond all latency and all depth, having no true thickness" (p. 87). Depth is a characteristic of the "lifeworld" which undergirds our subject/object/space construction. Depth is not the usual third dimension; it is primal, "a locality from which height width and depth are abstracted"; it is "the unbroken flow from container to content" (p. 48). Parallel to this is Heidegger's notion of "time-space," a three dimensional fusion of past, present, and future. "The self-extending, the opening up, of future, past and present is itself *pre-spatial*)" [p. 51] . . . (Heidegger's italics). Heidegger and Merleau–Ponty offer us, Rosen says, "a paradoxical unity-in-diversity or continuity-in-discontinuity." In order to unify the forces of nature, we cannot avoid or deny discontinuity; phenomenological dimensionality will be required. In the usual theories of higher dimensions, from Kaluza–Klein with its fifth curled-up dimension, to string theories with 6 or 7 more, the thrust has been "to

maintain the continuity abstraction in a higher-order form" (p. 68). [Here again the epicycles of Ptolemy pop up as in the infinities of earlier quantum theories.] If we could accept the loss of epistemological continuity, and allow the dialectic interplay of object, space, and subject, "then continuity and discontinuity, symmetry and asymmetry and changelessness and change would be dynamically integrated" (p. 69). Rosen aims to do just that.

"Take topological space as a model of being" (p. 70), says Merleau–Ponty. In Chapter 4, "Topological Phenomenology," Rosen considers the Klein bottle, a "bottle" whose outside folds into its inside, a surface one dimension higher than the one-sided Mobius strip. ". . . [T]he true Klein bottle," he says, "actually enacts a *dialectic* of continuity and discontinuity" (p. 72). Thus rather than *modeling* the life world, the Klein bottle *embodies* it. The inside and outside of things, the notion of container and contained, is transcended. "We must recognize that the hole in the bottle is a hole in classical space itself, a discontinuity that, when accepted dialectically instead of avoided . . . leads us beyond the concept of dimension as continuum to the idea of dimension as depth" (p. 77).

The Klein bottle is also an embodiment of Planck's quantum of action, *h*, which in turn emerges from so-called electron "spin." In fact, Rosen sees the Heisenberg uncertainty relations themselves arising from the spin of the electron. He notes that Wolfgang Pauli, along with Heisenberg, used imaginary numbers in deriving matrices yielding the three components of electron spin. Whereas imaginary numbers can be indicated by rotations in the two-dimensional complex plane, Rosen re-introduces the hypernumber epsilon, introduced by mathematician Charles Muses and developed by William Clifford. These hyper numbers can be seen as reflections — asymmetric operators in a four-dimensional space, and of course that extra dimension is identified with "the sub-objective dimension of depth." This 4x4 spin matrix, now expanded to hypernumbers, becomes a foundation Rosen builds on throughout the book.

With this primal notion of spin, he is naturally attracted to vortices (as were thinkers from Plato, through Descartes to Roger Penrose). He also invokes David Bohm's implicate order, a holomovement, in which mind and matter "are different aspects of one whole and unbroken movement" (p. 83). But we must resist the notion of visualizing electron spin, vortex, or Penrose's twistor, in a conventional space, and see it instead as "the quantized vortical action of the depth dimension itself." Space itself ". . . *derives* from pre-spatiotemporal spin" (p. 89, my italics). So we must somehow work at intuiting Heidegger's "time-space," deepened by the life-world of Merleau–Ponty, with vortex-like quantized spinors quickening our currently accepted versions of abstract space. Further, we must keep in mind that the vortical-Kleinian swirlings *include ourselves as well*! Why would physicists submit to discarding their comfortable metaphysics and attempt to re-intuit this dramatic transformation to dialectical phenomenology? Because, says Rosen, there is no other way of unifying the basic forces of nature.

To further clarify our understanding he expresses in matrix form the relationships among the nested series of bisected topological surfaces — Klein bottle, Mobius strip, lemniscate, and sub-lemniscate. The elements in this matrix are compared to Pythagorean vibrational modes — the fundamental, overtones and undertones later examined by Helmholtz in his classic treatises on sound, and to the hierarchy of those epsilon-based spin structures of Charles Muses. Later, in Chapter 10, Rosen introduces an expanded matrix of cosmogony stages represented by the sixteen fundamental particles of classical standard model physics. And since this is his aim, he

lays out in detail "a more dynamic intuition of space," one that must now enfold the observer or consciousness. Thus cosmogony entails more than the big bang theory of the Standard Model.

To explain this deeper evolution, Rosen centers attention on Individuation — the drive to be an undivided self, a well-bounded center of identity, not just of an ego, but of "a cosmic organism," a Self (as in the Sanskrit term Atman — which is Brahmin). It is this sense of Self that "propriocieves" (takes in) the lifeworld. As in Kleinian topology, the distinction between inner and outer is dissolved. Rosen speaks of this individuation in three stages of dimensional development. The first is the embryonic stage; no separation between outside and inside, but also, no awareness either of any subject–object orientation. In the second stage separation is made. The subject casts out the objects and the object-before-subject in space comes into being. Self-evolving means the lifeworld "transforms itself . . . [i]t facilitates its own development by moving away from itself." (This calls to mind the Kabbalistic notion of *tsim tsum* — contraction, self limitation — describing the black hole-like birth of the world from the *Ein Sof.*) The third stage is described as functioning *proprioceptively*, by which he means reversing directions; taking the object world into the subject so that subject and object "flow unbrokenly into each other." All of these activities are not merely modeled, but embodied by various topological surfaces and their sections. For example, the clear distinctions of stage two can be signified in the torus with a definite inside and outside, whereas stage three is embodied in the Klein bottle. There is a "synsymmetric" blending; "the depth-dimensional organism is both symmetric and asymmetric." The very notion of holes, ruptures, singularities in space, that so offended Einstein, are embraced here in the Kleinian lifeworld.

With our acquired "phenomenological intuition," we come, in Chapter 8, to the issues of primary concern, the co-evolution of the fundamental forces of nature. As an example of why gauge bosons (the "force" particles connecting fermions — the "matter" particles) can not resemble classical particles, we consider the photon. Light, said Heidegger, is "presence as such" rather than just "what is present." Bosons and fermions, seen as eigenspinors, constitute whole lifeworlds, and so do the forces of nature! Photons — the most fundamental of gauge bosons — are associated with the electro-magnetic field. (The weak nuclear force, responsible for radioactive decay, is associated with the weak gauge boson, the strong nuclear force, with the gluon, the gravitational force, with the graviton.) Light is not seen, it is the seeing; it is the "*inseparable blending of subject and object, of changelessness and change*" (p. 164, Rosen's italics). We can not consider light as an object. We must enter into it, not with our classical analysis, but with our phenomenological intuition. We have to experience it as the dialectic of sameness and difference. (There is strong support of the transcendent nature of light in Arthur Zajonc's *Catching The Light, The Entwined History of Light and Mind.*) Heidegger associates light with Being, the living web from which all relations emerge, i.e., the lifeworld dimension — ". . . quantized action ($h$), the paradoxical phenomenon that gives physical significance to Merleau–Ponty's dimension of depth" (p. 166). The other bosons, ($W$, $Z$, gluon, and graviton) are similarly described.

> Rather than being objects contained in space, these string-like particles are the self-containing, cyclonically vibrating spatio-objectivities themselves; as with the photon, each of the force particles is a lifeworld dimensionality unto itself (a "global locality". . .). (p. 167)

Recall the description of microphysical spin as the primordial action from which not only space and time, but all of quantum theory emerge. Ed Witten has recently advocated a theory which embeds string theory in twistor space. What Rosen is advocating is embedding string theory in the "pre-spatiotemporal matrix" of the vortex-like structures associated with the Kleinian/Mobius topology he describes earlier. Rosen notes that the generalization of superstring theory — M theory — involves an eleventh dimension which he identifies as Merleau–Ponty's depth dimension. Here the one dimensional string is generalized to higher dimension membranes — branes. Then string theorist Brian Greene's description of space-time as a "braneworld" is awfully close to "lifeworld." Earlier, Rosen has noted the collapse of scale at the Planck length — the disruption of the very notions of "large" and "small." And this in turn brings to mind Merleau–Ponty's description of the depth dimension as a "global locality." So the Planckian and cosmically scaled branes "can be regarded as the self-same scale-defying brane" (p. 174). As above so below.

What wider turnings can there be "in nature's spiral of creative growth"? What additional dialectic unification of "opposites" is possible beyond inside/outside, continuous/discontinuous, container/contained? Niels Bohr, who used the ta'i chi symbol of yin and yang to symbolize the unity of opposites in his theory of complementarity, meant it to apply to any pair of entities which at first blush seem opposed. Wolfgang Pauli, a patient of, and collaborator with, Carl Jung called out for a unification of science and mysticism. And, indeed, the merging of object, space and observer, Heidegger's time-space, the breakdown of scale: the identity of the sub-Planckian and the cosmic, the Kleinian (w)hole, the lifeworld of the boson, all this, certainly resonates with mystic writings throughout history, albeit the language here is more technical. Rosen, by erasing the boundary between inner and outer, strengthens the bridge between science and mysticism, a bridge which should no longer be an embarrassment to serious academics considering that it appears in the writings of Capra, Bohm, Einstein, Bohr, Schrödinger and Pauli, to name but a few.

In his final chapter, "The Psychophysics of Cosmogony" (Chapter 11), Rosen expands his topodimensional spin matrix to embrace not only Muses' hypernumbers, Pythagoras' over and undertones, the Kleinian surfaces and their bisections, and the bosons and fermions of the Standard Model, but magical thinking, mythic thinking and love. He asks, "Does it seem strange to relate physical events transpiring at the origin of the universe to familiar psychological functions?" (p. 234). It should not. Heisenberg long ago declared the Cartesian split to be invalid. Why should the stuff or vibrations or patterns of our psyche be any different from that of our objective world?

The force of Rosen's argument blossoms when he calls on the work of Evelyn Fox–Keller: ". . . the scientist employs a form of attention to the natural world that is like one's ideal attention to the human world: it is a form of love" (p. 239). And referring to Ernest Shachtel's "allocentric" perceptions — "perceptions in the service of love," he quotes biologist Barbara McClintock, who won a Nobel Prize working with plant chromosomes: "I found that the more I worked with them, the bigger and bigger they got And when I was really working with them, I wasn't outside. I was down there" (p. 240). Fox–Keller again: ". . . McClintock can risk the suspension of boundaries between subject and object without jeopardy to science precisely because, to her, science is not premised on that division" (p. 240). "It is a world," Rosen concludes, "in which the dialectic of difference and identity is enacted proprioceptively" (p. 241). Chromosomes are "global localities," "general things." Rosen could have mentioned other plant scientists, such as George Washington

Carver and Luther Burbank whose works also reflect the dimension of depth, ". . . where continuity and discontinuity, object and subject, mediate one another internally in an encompassing circular flow" (p. 241).

The uni-verse — the one turning was aptly named — from the whirling galaxies, to the spinning fermions arising from the sub-Planckian twisters of Penrose, ". . . the vortical action of the depth dimension itself." The sub-Planckian strings and their higher dimensional cousins, the branes, are separate *and not separate* from the cosmos. They mirror each other. The strings and branes too are "global localities." Rosen's version of cosmogony co-mingles large and small, object, space and subject, container and contained, achieving a "full blown phenomenological rendering of nature's unity-in-diversity" — Coleridge would have called it nature's beauty.

Rosen writes extremely well; each sentence is deep (in the Merleau–Pontyian sense) yet meticulously crafted, as it needs to be — describing a new paradigm is tricky business. This book, then, is not an easy read! It requires perusing in "depth" and time spent in the "hiding places," the "folds or nuances," in order to absorb the imagery. But Rosen's vision, one that he has nurtured for decades, is well worth the effort.