

Three reflections on return: Convergence of form with regard to light, life, word

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In this paper, I trace the three-fold essence of “return”—a generating trope of identity and difference, through which formal aspects of the theory of relativity, the movement of language and emergence in evolution might converge. The trope of return is contrasted with the more common two-fold structure of relatedness underwriting differential calculus, propositional semantics and reductionism, which privileges space over time, identity over difference, self over creation. This paper is a tentative metaphysical sketch in which word is to meaning, as light is to matter, as life is to creation.

Setting the stage

Let the term *secular space* stand for a deeply embedded metaphor of scientific thought—an absolute, passive void embedding totality, universe, being. It is the implicit theatre for reductional worldviews that I will call “classical ontology”. Classical ontology is formalized, for example, in the mathematics of Newtonian physics [Huggett, pp107-168] and deconstructed, for example, in *Otherwise than Being* [Levinas]. Secular space presumptively unites heaven and earth, while annihilating creativity, interiority, novelty. It grounds classical ontology, providing a priori conditions for analyticity, particularity and identity. It envelops an ideal, objective observer in the paradox of subjective reflection. Through secular space a universal worldview is constructed whose problems cut to the very core of what is meant by knowledge, truth and creation.

From the margins and gaps of secular space erupts the nameless—chora [Kristeva]—dynamic counterpoint to the absolute inertness of secular space. More verb than noun, chora is energies and rhythms that undermine structure to bring forth the new. Lacking identity or representation, chora presents as *différance/difference* [Derrida, Deleuze], as undercurrent frustrating, while at the same time enabling, the fragile constructs of theoretical discourse. Nothing is said to withstand chora. Chora is the excluded initiative of classical ontology. Where secular space structures analysis, chora is revealed to unground the construction. Herein lies the stalemate of postmodernism.

This project is an exploration beyond the binary extremes of secular space and chora—an attempt to provoke an engagement with the challenge that permeates the contemporary discourse on being and knowing, from the deconstruction of language, to the hermeneutics of physics, to the analytics of evolution. Here three meditations are offered—equivalent reflections on word (meaning), light (matter) and life (genesis). Through these meditations, I explore the trope of a three-fold relatedness, perhaps underlying creation, that might offer fleeting insight into immanent transcendence sustaining our world.

Word¹

Between you and I there is a gap, a rupture, an abyss. These words, these very words, are bridging that gap. As I write, I am offering these words in one place and time and, as you read, you are receiving these same words, but receiving them elsewhere. They are bringing us into proximity, into an intimacy that ruptures space-time, individuality, and context. The words themselves are the mediator, the sustainer, the bearer of this relationship. Through these words you and I are being brought into one, even as we are kept separate and autonomous.

Words summon relatedness. Through their mysterious capacity to announce and yet defer presence, words mean. And by meaning, in their very essence, they defer themselves to an Other. If you look at these words as bits of typography on a white page or as bits of immanent presence totalized under your gaze, you will not fully enter into this relatedness. Words substitute themselves for that to which they refer. Intimate. Transparent. Elusive. The words on this page substitute for an Other. They substitute for my thinking, my interiority, for example. And, in turn, they substitute for your thinking. In this opening, in this gap between offering and receiving, we commune. And in the communion there is an exquisite vulnerability.

We are not alone with these words. Words carry echoes of those not present. We draw from these words and return them again. And like a spring or a well, they overflow themselves in their saying. To dominate words, to totalize their meaning, to deny openness to the Other is illusion. These words, like all words, say more than they say. My thinking does not limit these words and your thinking cannot totalize their meaning. There is

¹ John 1:1

*an openness that weaves a mystery, an indeterminateness to these words.
Call it a gesture, a clearing, an offering ...*

This is not the scientific understanding of language. The scientific reading comes from a classical worldview—the point of departure for the exploration that is this paper. The *world* is a universe, or ensemble, of things, of things-*in-themselves*—delimited, separable, located in a container we call spacetime. The container itself—the *no-thing* which grounds the world—is seen as static, inert, empty and wholly forgettable. To use words, to speak of a thing, is to speak in terms of an idea of the thing, which is well defined and which is distinguished properly from other ideas [Heidegger 1975]. In this way of speaking, both material things and ideas of things are separated and distinguishable. Classical ontology is founded upon categories that “are perfectly fixed and whose boundaries of definition are perfectly sharp” [Pythress 1995]. We conceive a world of ideas as an ensemble of “things” which can be manipulated and this manipulation of idea-things is what passes for thought, in much the same manner as we perceive our world as filled with things which are separate, extractable and available for manipulation. This implicit assumption about *world* structures thinking about things and ideas, which is to say it structures our use of language [Heidegger 1975].

Naively, within the classical worldview, the relationship between things-in-the-world and ideas-of-things is objective, informational and univocal [Pythress 1995]. Through language, the thinking subject approaches this objectivity inasmuch as the two structures match and are reflected one-in-the-other, in the duality of thinking::being [Levinas 2002]. Everything is laid bare, accessible to a totalizing gaze, and truth is conformity. The *world* is “there” for everyone to see samely, because we, like things, are grounded in a privileged, common and totalizing frame [Levinas 2002]. The *world* is pure objectivity. This objectivity is made possible through assumptions about the distinctness of things. Each thing is seen as a totality, a thing-in-itself and relatedness is derivative [Levinas 2002]. The distinctness of things, in turn, arises from deeply implicit assumptions about the structuring of an “ontological container” in which things are assumed to be situated—space, the void, *no-thing* [Levinas 2002]. And deeper still is an appropriated binary logic grounding the static, passive, inert structuring of *no-thing*.

This binary logic is captured, for example, in the law of the excluded middle, which says that for any statement A, either A or not-A must be true and the other must be false [Heidegger 1975; Levinas 2002; Frye 1990]. It underwrites, in some sense maybe even defines, the differential calculus from which the classical

scientific worldview draws its vision. This logic defines what is meant by “is”, what passes for being, in the classical worldview.

The postmodernists have brilliantly deconstructed the classical worldview [Derrida 1982]. They have shown us the hubris—the belief in a privileged embodied observer who can see the mystery of creation laid bare, totalized under a single human gaze, like the workings of a clock; an observer who would say to God: “Your thoughts are my thoughts”. They have shown us the violence—the belief in the authority to force a common frame-of-reference that leads to subversion and marginalization of incommensurate voices, voices that might undermine the power structures of the privileged. They have shown us the incoherence—the assumption of an inert or indifferent grounding of reality that masks a broken symmetry, a privileging of the same at the expense of the Other, and in so doing falsifies the assumption. But inasmuch as the postmodernists have tended to relinquish the way of Truth altogether, they have been far less successful in re-constructing language(s) for our time. The danger lurking in their wake is a subjective relativism that cannot ransom itself.

Levinas [1969, 2002] has perhaps intimated a way forward through an ethics of responsibility, in which he proposes that (what I have called) *no-thing* is not the passive, inert, negation of being, but rather the Beyond. This Beyond obtains, for Levinas, in infinite responsibility for the Other. Prior to any world, the one-for-the-other is the condition for possibility. The one-for-the-other is *movement* whereby one is brought into proximity and substitutes for the Other. Levinas’ attention is on the relatedness which is, in some sense, prior to the one or the Other. This “relation without relation” becomes an essentializing paradox, or ambiguity, which allows the being of beings to appear in intelligible structures or “worlds”. Beyond these structures is a restlessness which resists resting in being, but nonetheless guides the discourse of being. The movement from Beyond to (what I have called) world occurs through the introduction of a Third Party—the other of the Other, who is also an Other to me. This irreducibly threefold relatedness brings limit, subjectivity and objectivity [Levinas 2002]. Drawing from Levinas, I want to suggest that words and language might be seen as open—windowing the Beyond—through an irreducibly threefold “logos”, rather than closed—reflecting the Self—through the binary logic that characterizes the classical worldview [see also Poythress 1995]. But we need new metaphors, new language, new ways of thinking to explore this possibility. I also want to suggest that perhaps part of what many postmodernists are groping for in words and language, physicists already may have stumbled upon in action and experiment—namely, the extra-ordinary capacity of light to announce and sustain creation.

Light²

Imagine we are looking deep into the expanse of stars in the night sky. What are we seeing? We are not seeing the universe as a totality that exists “now” in the sense of at-the-same-time-as-us. Such a totality is never embodied in time. The presence we are seeing in the here-and-now is of objects as they were when the light from them first began its journey. This presence—which is unique to us, to our particular reference frame—stretches back to the earliest inklings of time as it extends to the furthest recesses of space. And our presence reflects that light back into the future where it might be received, even to the ends of space and time. At every moment we are present with the beginning and the end of creation as much as we are present with our immediate surroundings. We are at the very centre of the origin of the universe even as we are fifteen billion light-years away from that origin [Swimme 1996]. The same is true for any other embodied observer in creation. And because the presenting of light partakes of the absolute, we can say that this worldview is real.

This is not the common view of space and time. Our sense of spacetime is intimately related to our experience of the earth as a static, immobile presence—a spatially extended reference for movement and change. Take away the earth and we tend to pre-suppose the continued existence of the reference frame—space. Space as an empty container for being(s). Space as the absolute simultaneity of being(s) in an instant of time. This is the classical or Newtonian representation of spacetime. For Newton, the universe is a state—a totality or collection of entities in instantaneous relationship. And space, for him, is a metaphorical rigid body, like the earth—an eternally rigid correlation, to which time is added separately. The universe is a continuous succession of states in space. The complete separation of space and time is foundational [Huggett 2002].

But physicists have shown, through dialoguing with creation, that this Newtonian or classical worldview is wrong, while new hermeneutic eludes their grasp [Bohm 1996; Maudlin 2002]. I want to explore a new path that absolves secular space in a deeper engagement with light.

There is no universe. That is to say, there is no stance in which a universe, in all its being, appears as a unified totality. For any embodied observer, there always remains a hidden aspect, an *elsewhere*, that obscures knowledge of beings, even

² Genesis 1:1-4

as it draws them into an essential relatedness. This incompleteness is not a lack—of knowledge or capacity, for example. It is intrinsic to materiality and embodiment itself [Bohm 1996; Levinas 1969].

There is no underlying separateness. The Newtonian concept of space allows for complete differentiation of one from the other, for the differentiation of materiality into discrete or fundamental elements, for the differentiation of things-in-themselves. Not so in our world. Nothing in creation is totalized or whole-in-itself. There is no particle, no state, no thing-in-itself. The whole is not a totality and the part is not separable [Bohm 1996; Maudlin 2002]. Whole and part are merely the horizons of subjectivity. Like Levinas' ethics, each is for the other.

There is no void. Nothingness is neither passive, nor empty. Creation rests upon a scintillating, bubbling, almost-differentiated-but-not-quite, “sea” of virtual quasi-states. Nothingness is pregnant with reality. More verb than noun, it is a generative power, an unseen ocean of potentiality, which is neither thing nor place [Swimme 1995]. Language-theorists would call it the semiotic; physicists, the quantum vacuum; theologians, the abyss. From this potentiality, creation is brought forward at every moment.

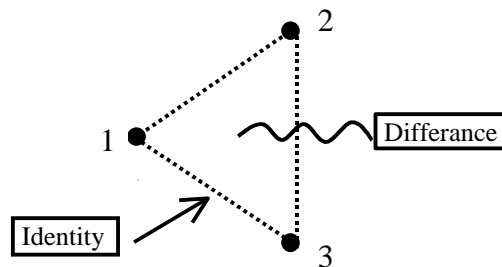
Light is a window on the absolute. It brings forth a relatedness that enables our world to exist. This relatedness is very different from Newton's passive notion of spatiality, which has dominated the classical worldview. The relatedness of light predisposes any possible ontology in a holistic interconnectivity [Bohm 1996]. Through light, objectivity is intricately bound with subjectivity and obtains inasmuch as all frames of reference are inter-related. Embodied observers perceive slices of reality which are incomplete in principle. Objectivity becomes a construct brought about through communication or synchronization between different frames of reference in which exteriority (and interiority) is made possible by virtue of the absolute nature of light [Bohm 1996]. Truth is borne by light. What “stands outside” of spacetime is not a passive void that can support an indifferent observer (the scientific image of God?), rather, it is light which is at the threshold of spacetime, beyond and yet participating in creation at each and every level of order.

Light is proximity. A connector, with no space or time interval, that calls forth immediate relatedness (between source and receiver, for example) even as it veils its own presence. Neither objectivity nor subjectivity, “it is an unframed window on the material world, an opening or clearing in which that world is situated” [Grandy 2001]. Light is dynamic, movement, a restlessness deeper than the passivity of space. Light is in a continual process of substitution, to use Levinas'

language. One-for-the-other. It is a relatedness outside of any system of entities, continually deferring its own presence, and in so doing, granting presence to systems, structures, entities, relationships. It brings forth a fundamentally holistic clearing that animates and maintains the presence of being(s).

I want to suggest that light supports a fundamental indeterminateness at the core of being(s)—a rupture of objectivity; an *interiority* that is open, adaptive, responsive. This interiority is an essentializing quality of matter and thought. Light frames matter. Light also frames subjectivity even as it frames objectivity in a particular system that references relatedness—a system that is both partial and false-in-itself, although true in its openness to the Other; a system through which the fullness of Being appears only inasmuch as the system itself is transcended. Light becomes the trace that supports and animates creation. Beings and entities do not have an essence-in-themselves, but only exist in relationship to the world in which they are created, the system through which they are perceived, and, most radically, the creator by whom they are sustained (as described by Griffin, for example [Griffin 1988]).

I want to further suggest that the trope of light, like word, is irreducibly threefold—three in proximity, each of which is another to the others and none of which is the same to another. It is this threefold relatedness that manifests the paradox of identity *and* difference as shown in the figure below:



In this figure, each of the three is one-for-another in a continual process of substitution. There are three distinct indices, or origins, labeled “1”, “2” and “3” in the diagram. These three indices correspond to three distinct instantiations.

To see the working of this trope, suppose we establish “1” as the instantiated index, the *origin*. Then “1” is in a relation of proximity with the two others (here

called “2” and “3”). This relation of proximity we can call *identity*. “1” is identical to “2” and “3”, substituting itself for each. However, between “2” and “3”, there is a proximity that is inaccessible to “1” and we can call this *difference*. In the distinct instantiation of the three, there is both identity and difference.

This trope frames interiority through a process of *return*. In return, “1” substitutes for “2” which in turn substitutes for “3” which finally substitutes for “1”. In return there is a traversing of the inaccessible difference that is the proximity of “2” and “3” according to “1”. This gap becomes the gap or clearing in which creation manifests—the *synchronicity* of light and word. Moreover, because “2” and “3” can substitute one-for-the-other in the inaccessible gap, there is an indeterminateness at the core of this threefold relatedness, which is to say, there is interiority.

Within the threefold figuration of light are several important qualities of creation: identity, difference, return and interiority. Through these qualities, I want to suggest, light is able to breathe life.

Life³

Imagine we could follow the arc of cosmic evolution from the beginning to here-and-now, watching creation unfold like petals of a rosebud [O’Hara unpublished; Swimme and Berry 1992; de Chardin 1961]. In the primal singularity, there is light. Pure energy. Light allows spacetime to burst forth, and in spacetime, energy begins to condense into particulate matter—protons. Simple in form, protons coalesce into stars, in whose furnaces they are transformed into more complex forms—the elements. The stars burst, scattering their elements and the elements recombine into new stars. The stars coalesce into galaxies, like our Milky Way, and in the galaxies, stardust condenses and solidifies into planets, comets, moons and asteroids. On our planet Earth, the elements combine to form molecules, the molecules assemble into complex systems bringing forth cells. The cells develop nuclei that can coordinate inter-cellular communication, bringing forth multicellular organisms. The organisms develop complex systems of sentience and cognition, bringing forth awareness. Through awareness comes language and language awakens to the light.

³ Proverbs 8:22-36

This is not the dominant understanding of evolution. Embedded in a classical worldview, evolution is theorized as a struggle for existence among autonomous agents in the natural environment [Darwin 1859; Dawkins 1976; Gould 2002]. Prodded by an excluded initiative—the *drive* to survive and generate—individual agents struggle against the whole, and very hostile, environment. And the environment, in turn, exerts a decisive force on the agents, called natural selection, such that only the fittest survive. Implicitly reductionistic, theories of evolution treat agents as elementary units-in-themselves from which the complex dynamics of life are crafted—the separation of agent (part or self) and environment (whole) is foundational.

Although recognized, what is not fully unpacked in this discourse, is the fact that the very being of agency itself is in question with evolution. The agency of evolution operates through generation. The rupture in identity that happens through reproduction—offspring are *other* than their parents—is crucial to the theory, because it is in these “gaps” that changes occur which enable hereditary lines to adapt to environmental fluctuations [Darwin 1859; Gould 2002]. What endures is not the particular agent (organism or gene), but the continuity of hereditary lines. This makes agency in evolution fundamentally relational, temporal and therefore inconsistent with a classical ontology of reductionism and separateness. What is postulated a priori in evolutionary theory is a fundamental drive to generate—intrinsic to the forming of individual, ephemeral agents—that creates, animates and sustains hereditary lines and matrices. Evolution is concerned with becoming not being. And the continuity of life is embedded in collective obligation to future generation, rather than autonomous survival of individual agents.

I want to suggest that the *same* breakdown of classical, reductionistic agency can be found at all levels of creation—from protons, to atoms, to molecules, to cells, to animate bodies. Consider classical electrodynamics as a prototypical example. In this theory, elementary particles, such as electrons, possess charges that are sources for electromagnetic fields. Electromagnetic fields, in turn, impact the dynamics of charged particles. This manner of handling particles and fields, however, is not coherent and, at best, can only be approximately valid. The difficulty arises from the fact that a moving charged particle generates a field and the field, in return, affects the motion of the particle *that created it*. This structural relation of return touches on one of the most fundamental aspects of physics—the nature of the elementary particle [Jackson 1975]. Return draws into question the a priori separation of particle and field and thrusts ontology into the arena of indeterminism and irreducibility. In quantum field theory, the (infinite) renormalization of return (more specifically “self energy”) is the formal

mechanism which brings about particles as created from and annihilated into a continuous field—the essence of particle identity as separate and yet interwoven into the field from which it came. It sets limits to the degree to which elementary particles can be defined as separable and localized, thereby forging an essential connection between “self identity” (particularity) and relatedness [Teller 1988].

Likewise consider the molecular level of evolution. Perfectly replicating molecules, in and of themselves, cannot be the agency of evolution because they would eventually consume the raw materials of any finite environment at which point evolution would cease to support their further replication. In order to sustain agency, replicators must be imperfect, recycling their raw material and allowing for adaptation to environmental changes, either externally imposed or caused by their own growth—a cycle of return. However, randomness at the molecular level raises significant problems for molecular stability—the replicators must be safeguarded against random events attaining so much importance that they destroy the statistical regularity of replication [Prigogine & Stengers 1984; Schrodinger 1967]. Unicellular organisms are one of the simplest cases in which the irreducible nature of return is manifested stably. Here DNA molecules are the basic replicators, which alter their immediate environment by coding for and causing the creation and maintenance of a cell. But the cell, in turn, ensures the stability of the DNA molecule in its process of replicating, while also enabling sufficient flexibility or randomness to adapt to change. The cycle of return is completed in the mutual interdependence of the DNA molecule and the cell, neither of which can be an agent of evolution on its own. Return opens up *interiority*, such that the cell, which is different from the environment, forms an organic *whole*. Multicellular organisms are another case. Here cells interact with one another through chemical messengers on their surfaces, altering the expression of DNA within each cell. As a result, an organic whole—the body—is formed in which different cell lines produce organs, tissues, and so on, all from the same DNA backbone. Once again, interiority emerges (the body) to enhance capacity for generation—the multicellular body allows a differential expression of DNA leading to a coordinated functioning of different cell lines [Cole 1996]. Within this irreducible process, “self identity” (of particles, genes, cells, organisms, etc.) is a consequence of a more fundamental dynamical relatedness. The holistic “self” is forged from return.

I want to suggest that through return—the essential ternary trope of light and word—creation unfolds in an emergent hierarchy of increasing complexity [de Chardin 1961]—atoms, molecules, cells, multicellular organisms, sentient bodies. Each level of emergence forms its own holistic “gestalt” which modifies and unifies a collective synergy of pre-existing gestalts, as for example a multicellular

organism unifies a collective synergizing of the cellular gestalt. Emergence is creative. It manifests “in the fullness of time” as new levels of agency come into existence [de Chardin 1967]. The emergent agents do not replace pre-existing ones—the stars, the molecules, the unicellular organisms remain. But each emergent level unites and, in some sense, fulfills the previous one. Through emergence there is *convergence*, to use de Chardin’s language, an inward turning of agency upon itself that deepens interiority and heightens responsiveness. And at each emergent level of complexity, new phenomena appear, as for example the capacity of multicellular organisms to self-regulate cell lines and gene expression.

More striking, at each level there is an ever fuller manifestation of *word*. Elementary particles disclose material *identity*. Replication discloses *information* (copies are materially different, yet identical in their in-formation). Cells disclose the capacity to manipulate information through (DNA) *code*. Multicellular organisms disclose the capacity to manipulate the expression of code to *signal*. Animals disclose the capacity to *communicate* and to manipulate reference through *cognition*. Humans disclose the capacity to manipulate *language* and *thought*.

Relinquishing the classical worldview implies a radical shift in our understanding of God’s relation to his creation. Newtonian physics, based on an implicit assumption of an underlying timeless, static “world”, invented a notion of Absolute space that drew heaven and earth into the same passive container and united the laws of heaven with those of earth. At the same time, it adopted a notion of relatedness that cast God in the role of unaffected, ideal observer standing outside of creation. In totalizing being and world as static and pre-determined, the laws of the universe became physical laws, which are complete in themselves, deterministic and void of spiritual significance. I want to suggest that a new image of creation is emerging that supports a fundamental relatedness and engagement of God at the core of being(s). All of cosmic evolution is Life, brought forth from the primordial Light, and created through the Word.

References

Bohm, David. 1996. *The Special Theory of Relativity*. New York: Routledge.

Cole, R. David. 1996. The molecular biology of transcending the gene. In *Religion and Science: History, Method, Dialogue*, eds. W. Mark Richardson and Wesley J. Wildman. New York: Routledge

- Dawkins, R. 1976. *The Selfish Gene*. Oxford: Oxford University Press.
- Darwin, Charles. 1859. *The Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life*. Edison, New Jersey: Castle Books [published in 2004].
- de Chardin, Teilhard. 1961. *The Phenomenon of Man*. Transl Bernard Wall. New York: Harper and Row.
- Deleuze, Gilles. *Difference and Repetition*. Transl Paul Patton. New York: Columbia University Press.
- Derrida, Jacques. 1982. *Margins of Philosophy*. Transl Alan Bass. Chicago: University of Chicago Press.
- Frye, Northrop. 1990. *Words with Power: Being a Second Study of "The Bible and Literature"*. Toronto: Penguin Books.
- Gould, Stephen Jay. 2002. *The Structure of Evolutionary Theory*. Cambridge: The Belknap Press of Harvard University Press.
- Grandy, David. September 2001. The Otherness of Light: Einstein and Levinas. *Postmodern Culture*. Vol 12(1): available <http://www.kalpakjian.com/Grandy.html>
- Griffin, David Roy. 1988. Introduction: Postmodern Spirituality and Society. In *Spirituality and Society*, ed. David Ray Griffin, 1-32. Albany, New York: SUNY Press.
- Heidegger, Martin. 1975. Language. In *Poetry, Language, Thought*. Transl. by Albert Hofstadter. New York: Harper Colophon Books, 189-210
- Huggett, Nick. 2002. *Space from Zeno to Einstein*. Cambridge: MIT Press.
- Jackson D. 1975. *Classical Electrodynamics*. 2nd edition. New Jersey: Wiley.
- Kristeva, Julia. 1986. Revolution in poetic language, In *The Kristeva Reader*, ed Toril Moi, 89-93. New York: Columbia University Press.

Levinas, Emmanuel. 1969. *Totality and Infinity: an Essay on Exteriority*. Transl by Alfonso Lingis. Pittsburgh: Duquesne University Press.

Levinas, Emmanuel. 2002. *Otherwise than Being or Beyond Essence*. Transl by Alfonso Lingis. Pittsburgh: Duquesne University Press.

Maudlin, Tim. 2002. *Quantum Non-Locality and Relativity*, 2nd edition. Oxford: Blackwell Publishers.

O'Hara, Dennis. Unpublished.

Poythress, Vern S. 1995. Reforming Ontology and Logic in the Light of the Trinity: An Application of Van Til's Idea of Analogy. *Westminster Theological Journal* Vol 57(1):187-219.

Prigogine, Ilya and Stengers, Isabelle. 1984. *Order Out of Chaos: Man's New Dialogue with Nature*. Toronto: Bantam Books.

Schroedinger, Erwin. 1967. *What is Life? The Physical Aspect of the Living Cell*. Cambridge: Cambridge University Press.

Swimme, Brian. 1996. *The Hidden Heart of the Cosmos: Humanity and the New Story*, New York: Orbis Books.

Swimme, Brian and Berry, Thomas. 1992. *The Universe Story: From the primordial flaring forth to the ecozoic era—a celebration of the unfolding of the cosmos*. New York: HarperSanFrancisco.

Teller, Paul. 1988. Three problems of renormalization, In *Philosophical Foundations of Quantum Field Theory*, eds Henry R. Brown and Rom Harré, 73-89. Oxford: Clarendon Press.