PROCESS-INFORMATION METAPHYSICS AND ENVIRONMENTAL PHILOSOPHY

Marc J.V. Corbeil, May 2003

> "Imagine a chess board set up between us. Now the human who plays is an expert on a set of rules and strategies based on that set. However, the Drac who plays the hum an will win, because the Drac is an expert on standing outside a fixed set of rules. The Drac's first move would be to sweep its opponent's pieces off the board"
> "And, Mitzak, the Timan player? What would his first move be?"
> "The Timan's first move would be to switch games."[1]

INTRODUCTION

We are, in the words of science fiction writer Barry Longyear, rule-bound to our attitudes of substance. We need to think like a Timan chess player; that is, to step outside the game. The alternative I am suggesting is stepping outside the game of substance metaphysics into process philosophy, an attitude focused on change and interconnectedness in the universe. In this paper I develop a process-information philosophy similar to those of Whitehead and Bergson. The dissimilarity will be a focus on notions of information theory strongly related to theories set forth by Gregory Chaitin and Steven Wolfram. This approach leads to a defense of process philosophy relating to the process philosophical step from the discrete to the continuous. Exploration of elements of mathematics will assist in answering this problem/criticism and will relate to what I will refer to as the evolution-entropy dilemma. Chaos theory and process-information philosophy, may offer a satisfactory solution to the evolution-entropy dilemma.[2] Further, I will demonstrate a metaphysic that is practical, consistent with science and one that may serve as a foundation for environmental philosophy. Eugene Hargrove asked that we put "the environment back into philosophy"[3] and this is what I am attempting to do.

Heraclitus, perhaps the first process philosopher on record, was concerned with change and disagreed with both Parmenides' and the Pythagorean's conceptions of the world. He could not fully explain how things can change and yet be the same and therefore rejected the idea of 'the one'. The final alternative was to consider relationship and process. Particularly, to look at the natural world and accurately see what there is to been seen.

Looking out at the world, I observe some thing. "There it is, I have it in my sight." What is meant by this observation? Recall the classic question "Does a tree falling alone in the forest make any noise?" Does existence require an observer? As a solution, Bishop Berkeley, not unlike Descartes, offered the argument that God was the ultimate observer and the objection was resolved thus:

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[1] Barry B. Longyear, *The Tomorrow Testament*, a full novel in volume set *The Enemy Papers* (Clarkston, Ga.: White Wolf Publishing, 1998), pp. 369-70, *The Tomorrow Testament* was firs published as an independent novel in 1983 by Berkeley/Putnam.

[2] Entropy suggests that species on the planet should have become less complex rather than more complex.

[3] Eugene C. Hargrove, *Foundations of Environmental Ethics* (Denton: Environmental Ethics Books, 1994) p. 3.

There once was a man who said, "God
Must think it exceedingly odd
If he finds that this tree
Continues to be
When there's no one about in the Quad."

"Dear Sir:
Your astonishment's odd:
I am always about in the Quad
And that's why the tree
Will continue to be,
Since observed by,
Yours faithfully,
God." [4]

I don't think this answer is good enough. To observe a thing, I direct my conscious focus on that thing. In Whitehead's terminology, I *apprehend* this thing. This relationship of process among entities, as Chaitin[5] and Wolfram[6] suggest, concerns information about those entities. It should also be recognized that we have information about other entities peripheral to our main focus. Whitehead's concept of *prehension* suggests that all entities *prehend* each other. When I look specifically at you it may be said that I apprehend you. If I redirect my attention, perhaps I look away, then I am no longer directly aware of you. But, I still have some limited awareness of you. Other things, far and near, I also prehend; the radio in the background, the cars outside, the stove and wax over there in the corner, and the tree, in extension, falling in the forest. We are at no time independent of one another. This is true especially of the relationship between human and biotic communities:

> No neo-Gleasonian ecological theory of which I am aware asserts that organisms are entirely independent of one another. However individualistic and self-seeking each organism may be, consumers cannot exist without producers and producers cannot exist without decomposers.[7]

No entity can exist without prehensive qualities of other entities. By entity here, I would accept any thing sentient or non-sentient. There are connections between all entities that force a relational understanding when even considering or directly focusing on a single one.

Our existence and our reality do not allow us a complete or absolute objectivism, as Heraclitus hinted. In 1905, Einstein rejected the idea of absolute location and replaced it with location relative to an observer.[8] Einstein and Poincaré, and then Schrödinger, Heisenberg, and Dirac in the 1920s, together offer a contemporary basis to physics: relativity and quantum mechanics. In contemporary physics the idea that one could hold the same thing in at any time or place, even instantaneously, is illusionary: a Laplacian illusion. One cannot, even in principle,

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[4] "God in the Quad a précis of Berkeley," attributed to Ronald Knox.
[5] Gregory Chaitin, *Unknowable* (Singapore: Springer-Verlag, 1999).
[6] Steven Wolfram, *A New Kind Of Science*, (Champlain, Ill.: Wolfram Media, 2002).
[7] J. Baird Callicott, "From the Balance of Nature to the Flux of Nature: The Land Ethics in a Time of Change," in *Aldo Leopold and the Ecological Conscience*, ed. Richard L. Knight and Suzanne Riedel (New York: Oxford Press, 2002), p. 96.
[8] Hawking, Stephen, *A Brief History of Time: From The Big Bang to Black Holes* (New York: Bantam Books, 1988), pp. 23-25.

measure any particular property of a thing precisely.[9] The best that quantum physics can provide, even instantaneously, is a subjective observation over duration of experience.

Essence or substance must be a characteristic that is relative to some scale; it is relativistic even beyond the Einsteinian sense. Rather than an absolute substance, we might abstract a relative substance in relation to duration in space-time. Does the object considered in the microcosm, the mesocosm, or the macrocosm, bear properties related to space-time?

As Callicott suggests, the dynamism of stability and integrity of an ecosystem largely depend on assumptions of scale.[10] But let us extend this further. When we take a snapshot of apprehension of some thing, perhaps, as argued by Chaitin,[11] we are making an attempt to locate information rather than material. Whitehead's idea of space-time interrelations is transformed into one of information, where information is "said to be here in space and here in time."

This is no easy step. Space-time is very unlikely to be limited to anything resembling the three dimensions we humans normally understand. A four dimensional space-time concept limits both physics and metaphysics to our scale of reality, and, more importantly, gives a faulty description when we leave the mesocosm. The microcosmic world requires a more complicated space-time. And, even in the mesocosm, I count a minimum of five dimensions: we have three dimensions for space (human imposed length, width, height), one uni-directional dimension for time, and at least another perhaps for probability (sorry Dr. Einstein). Superstring theory and theoretical physics advocate nine p-branes or dimensions. Super-gravity theory, another type of physics, advocates seven to eleven dimensions, and the Sierpinski Gasket, a fractal object, has a 'dimension' that can be calculated to approximately 1.58![12] God only knows the brand of dice with which Stephen Hawking plays when he says space-time is either ten or twenty-six dimensional.[13]

Herni Bergson affirmed that we never really experience a bit of information. Rather, prehension (for him, intuition) must be a process over duration. Seeing, touching, measuring, all are verbs of action in time. The Aristotelian substance doesn't even make sense as a single event, since an event takes some duration of time.

> The duration wherein we see ourselves acting, and in which it is useful that we should see ourselves, is a duration whose elements are dissociated and juxtaposed. The duration wherein we act is a duration wherein our states melt into each other.[14]

This is the idea of information process as the primary characteristic in perception.[15]

> Thus concrete fact is process. Its primary analysis is into underlying activity of prehension, and into realized prehensive events. Each event is an individual matter of fact issuing from an

[9] Ibid., p. 55.
[10] Callicott, "Flux of Nature."
[11] Chaitin, *Unknowable*, pp. 106-07.
[12] Robert L. Devany, *An Introduction to Chaotic Dynamical Systems*, 2nd ed. (Redwood, Calif.: Addison-Wesley, 1989).
[13] Hawking, *History of Time*. See chap. 10 particularly.
[14] Henri Bergson, *Matter and Memory*(New York: Zone Books, 1991), p. 186.
[15] Nicholas Rescher, *Process Philosophy: A Survey of Basic Issues* (Pittsburgh: University of Pittsburgh Press, 2000), p. 45.

> individualism of the substrate activity.… An entity of which we become aware in sense perception is the terminus of our act of perception. [16]

The prehension event, an event of interconnectedness, is the key to how Whitehead understood process. However, if we left substance located in the space-time continuum, there would be a problem of extending these discrete facts to a continuum, the continuum of our seemingly continuous perception of these events. That which is prehended, the entity that "we become aware of in sense perception," I would argue is information. Prehension, then, is an operator or transformation function on information resulting in more or new information. Reality is not *substantive* but *informative* through process. Every event results, essentially, in new events that again are perceived and operated on as an *iterative process*. Cognition over duration of time is an iterative process of discrete information events. [17] This is important if we want to adequately describe reality.

We may think we focus on the one thing, but that is the illusions of the doctrine of Parmenides. We may think that things can be separated out into a very small or atomic unit, in the Ancient sense, as did Leucipuss and Democritus when they first conceived a theory of atomism. For them, a thing can be an indestructible and internally changeless particle, "so small as to escape sensation." [18]

Looking out at the world, I locate some thing. "There it is, I have it in my grasp." As I am saying this remark, a little phrase, usually conspicuously missing from translations of fragment no. 91 of Heraclitus, comes again to mind:

> One cannot step into the same river twice … **Nor can one twice take hold of mortal substance in a stable condition; for by the quickness and swiftness of its alteration it scatters and gathers -at the same time it endures** [19]

Can I truly have the same item in my grasp that I had only a minute ago, or even a second ago? Where is this thing located? Tradition suggests that the thing is located at some point in space, namely in my hand. But is this specific enough? To hold the doctrine of Parmenides despite this evidence is to commit what Paul Weiss calls the "fallacy of essential completeness." [20]

> It supposes that the individual entity is "in a single moment of time and merely inwardly points beyond that moment," so that "it will vanish, as so point, with the passage of that moment. Pointing does not enable an object to persist …." [21]

Whitehead defined simple location as "one major characteristic which refers equally both to space and to time, and other minor characteristics which are diverse as between space and time," [22] thus, an Einsteinian space-time. But just saying space-

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[16] Whitehead, *Science and The Modern World* (New York: Free Press, 1925), p .70.
[17] Bergson and duration of time.
[18] J. Baird Callicott, "Traditional American Indian and Western European Attitudes Toward Nature: An Overview," in *Foundations of Environmental Philosophy: A Text with Readings*, ed. Frederick A. Kaufman (New York: McGraw -Hill, 2003).
[19] Heraclitus, fragment no. 91.
[20] Paul Weiss, *Reality* (Princeton, Princeton University Press, 1938), p. 208.
[21] Weiss as quoted in Andrew J. Reck, "Substance, Process and Nature," *The Journal of Philosophy*, Vol. 55, no. 18 (August, 1958): 762-772, p. 766.
[22] Whitehead, *Science*, p. 49.

time is not merely to describe a combination of space at some time in the traditional metaphysical sense.

It is enough to understand that the concept of location is merely of information, and one characteristic of this information, at a certain scale of space-time, *appears* to us as substantive. We have the feeling that it is substantive, but our analysis demonstrates that this is not so. It is worthwhile to treat thing as substance, in the same sense that it is worthwhile to apply Newton's laws of motion to a falling object in the Earth's gravitational field. But, in much larger or smaller scales, Newton's laws fail.

Additional information other than location is also possible. Our analysis of things, our apprehension, is a directed perception (or direction prehension) of this information. Often this information lacks relational location, as might a timeless triangle, or the view of the edge of a square where one sees only a line. Characteristics such as color again, from this point of view, are simply bits of information. Aristotelian-type substance is information about matter and form. Substance, as either Aristotle or Descartes might hold, is a projection of information, a mere subset of the actual. Again we see how the concept of substance, at its best, serves us poorly as a basis for metaphysics which in turn is a basis to our physics.

Whitehead, the heavyweight of the process philosophers, clearly opposed "substance-attribute metaphysics" and a "subject-predicate logic. … Instead he urges that philosophy should be based on a logic which gives the primacy to relations or structure and not to the terms or subjects."[23]

I must point out that process philosophy does not suggest process as a replacement for substance in metaphysics. To do so would be too casual an error. Such a metaphysic would make itself open to all the paradoxes of substance by the mere substitution of a single word. [24] It would be circular to remove the 'substance thing' and replace it by "a collection of events occurring in it," seeing that the 'it' must refer to the thing at issue. Process philosophy entirely denies that a thing is simply located or that "an existing thing which [is one] which requires nothing but itself in order to exist."[25] This Cartesian image of things must be completely rejected. But how do we avoid "throwing out the machine along with the ghost?"[26] This is accomplished by going from substance-thinking to event-thinking.

FALLACY OF MISPLACED CONCRETENESS

A primary criticism of process philosophy, or event-thinking, concerns the paradox of unity, as suggested by Gill,[27] the question of how substances survive. Andrew J. Reck claims that "process philosophies that repudiate substance are untenable, and in fact to press the claim that substance in the sense of unitary,

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[23] D. Bidney, "The Problem of Substance in Spinoza and Whitehead," *The Philosophical Review* 45, no. 6 (November, 1936): 574-592, p. 583.

[24] Mario Bunge as quoted in Nicholas Rescher, *Process Philosophy: A Survey of Basic Issues* (Pittsburgh: University of Pittsburgh Press, 2000), p. 33. .

[25] Peter Farleigh, "Whitehead's Even More Dangerous Idea," Open Discussion Paper from the 2000 Conference of *Concrescence: The Australasian Journal of Process Thought* [online cited 1 March 2003], http://www.alfred.north.whitehead.com /AAPT /discussion_papers/farleigh_01.htm ; INTERNET, p. 1.

[26] Ibid.

[27] Marie Louise Gill, *Aristotle on Substance: The Paradox of Unity* (Princeton, N.J.: Princeton University Press, 1989). See chap. 2.

continuant, and independent individuals … must undo the possibility of process, since our awareness of process as well as its reality would be thereby impugned."[28] In anticipation, Whitehead carefully incised substance from the foundations of metaphysics by replacing the concept of substance with "matter without attribute," what he called a 'subject-superject'.[29] In *Process and Reality*, Whitehead writes, "It is fundamental to the metaphysical doctrine of the philosophy of organism [process], that the notion of an actual entity as the unchanging subject of change is completely abandoned."[30] This is clearly a call for a rejection of substance as a basis for metaphysics.

In defense of substance metaphysics, Reck states that "the event is not merely a matrix of qualities and relations excluding substance; it is a center of activity, or energy expenditure, or creativity." Here, Reck demonstrates the common confusion of an event with the attribute of the event, what he thought of as substance. Hume recognized this issue, stating that objects "have a constant union with each other … we commonly regard the compound which they form as ONE thing, and as continuing the SAME under very considerable alterations."[31] Reck claims that an event "must have an atomic moment which it spans, so that the entities that are perpetually becoming and perishing in Whitehead's system are in some fundamental sense of being for a while." As in Quine above, Reck is confusing substance and abstraction. The idea of an atomic moment is inconsistent with the idea of a span of the event or duration of experience. Whitehead identifies this idea as the fallacy of misplaced concreteness.

> This simple location of instantaneous material configuration is what Bergson has protested against, so far as it concerns time and so far as it is taken to be the fundamental fact of concrete nature. He calls it a distortion of nature due to the intellectual 'spatialisation' of things. …There is an error; but it is merely the accidental error of mistaking the abstract for the concrete. ...This fallacy is the occasion of great confusion in philosophy.[32]

To think of an event as simply located or an entity as substantive in the Aristotelian sense is to fall into the trap of the fallacy of misplaced concreteness. Rather, the idea of event-thinking is essential to process:

> The ordinary logical account of 'propositions' expresses only a restricted aspect of the role in the universe, namely when they are the data of feeling whose subjective form are those of judgments.[33]

You doubt information about whether one exists or not; you doubt that this chair or this room exists. You reach out and touch the chair and declare, "That seems solid to me." But, what you feel is not truly momentary, for no sensation is atomic or instantaneous as an event. Apart from an abstraction of the moment, your experience

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[28] Andrew J. Reck, "Substance, Process and Nature," *The Journal of Philosophy,* Vol. 55, no. 18 (August, 1958): 762-772, p. 767.
[29] Alfred North Whitehead, *Process and Reality,* corrected ed. (New York: The Free Press, 1978), p. 29.
[30] Ibid., p. 29.
[31] David Hume, *A Treatise of Human Nature,* ed. L.A. Selby-Bigge (London: Oxford University Press, 1955), p. 219.
[32] Whitehead, *Science and The Modern World* (New York: Free Press, 1925), pp. 50-51.
[33] Whitehead, *Process,* p. 25.

is of duration of the event. The substantive quality is exactly that, a quality of the event, not the subject of the event: an abstraction of process.

Do you doubt that something doubts? No, this is where Descartes would say, at the very least, something or someone is doubting. But this doubt itself has changed the manner of the doubter.[34] You have information about the existence of something that certainly doubts. What allowed Descartes to go from a doubter to a thing, a mental substance that doubts? It was a fundamental assumption of substance. It we abandon substance, then information becomes pivotal.

Consider Holmes Rolston's suggestion that the dynamism of life that we should respect is based on information contained within the history of a species, including the information found on the DNA.

> What humans ought to respect are dynamic life forms preserved in historical lines, vital informational processes that persist genetically over million of years, overleaping short-lived individuals. It is not *form* (species) as mere morphology, but the *formative* (speciating) process that humans ought to preserve."[35]

Positing information as a basis rather than substance helps with the paradox of determining what a thing is, and also helps with the paradox of mind-body.

Information prehended, in error or not, seems to travel the mind-body gap without a problem; the very idea of a gap may no longer be problematic. What doubts, in the Cartesian sense, is the collection of information, perhaps with some guiding structure, process, which needs to be something that limits the pathways of this information. Doubting adds information to this complexity of information. But this complexity of information is similar to a community or an ecosystem in that the boundary of being in or out is uncertain. What is this pain I feel? The pain is merely information and the question of mind-body is mute since you cannot properly determine that information is of the mind or body. It is information, data and not substance, which we need to consider in processes. To coin a phrase, *Cogito datum ergo data sum.*

Ushenko claims that it was Whitehead who convinced Russell "to abandon Newtonian absolute time and space, and also particles of matter, substituting systems of events" in 1914.[36] Russell looked to space-time perception and recognized that substance seemed "unperceivable."[37] Bradie also suggested that "the events in this latter space [of substances] are also assumed to by Russell to be spatio-temporally connected"[38] and interrelated to other events in the perceptual [other] space. Russell became trapped in a dualism of perceptual and unperceived space "making inferences from percepts to events which no one perceives."[39] The dualism forced Russell to claim that "in spite of such interferences, we do manage to be aware of the effects of distinct physical objects."[40] "What Russell seems to be saying here is that as

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[34] Ibid., p. 77.
[35] Homes Rolston III, *Environmental Ethics: Duties to and Values in The Natural World* (Philadelphia: Temple University Press, 1988), p. 137.
[36] A.P. Ushenko, "Einstein's Influence on Philosophy," in *Albert Einstein: Philosopher-Scientist*, ed. Paul A. Schilpp (La Salle, Ill.: Open Court Publishing, 1949).
[37] Michael P. Bradie, "The Development of Russell's' Structural Postulates," *Philosophy of Science* 44 (1977): 441-63, p. 444.
[38] Ibid.
[39] Ibid.
[40] Ibid., p. 446.

perceivers we are constantly being bombarded by casual influences or causal chains of events [in Whiteheads words, prehensions]. These events interfere with one another to a certain extent much as fog obscures our vision or static interferes with our listening to the radio."[41] As Bradie points out, this is one the most surprising positions that one would expect Russell to defend. Indeed, Russell may have completely adopted Whiteheads process viewpoint later in life (1954-1960!).[42]

> One of Russell's major contributions to modern philosophy was to provide a theory of relations which made them [relational propositions] as respectable, if not more so, than substances and attributes.
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> He discovered to his chagrin and discomfiture, that the revolution of which he was a prime mover [the overthrow of metaphysical views which he destroyed] had been too thorough; philosophers, having seen the old metaphysics destroyed [and replaced by substance metaphysics of the analytic school], and had no desire to replace them by anything. Thus, a general neglect of Russell's later philosophy by the professional community.[43]

Russell was well known for an unforgiving analytical viewpoint of metaphysics. Nevertheless, he conceded the metaphysical battle to his "lesser contributor" Alfred North Whitehead, also a former positivist. It is notable that two of the greatest analytic Aristotle-style substance metaphysicians, Whitehead and Russell, both seem to have abandoned *substance*.

NON-LINEAR REALITY

One of the most important issues that process philosophers face concerns the non-linear properties of reality. Chaos theory, or non-linear dynamical systems, is a mathematical research area that has caused a great deal of interest and raised some fundamental questions. In terms of process philosophy, per se, the linear non-linear issue can be reduced to the problem of stepping from the discrete to the continuous. This is exactly Reck's and Bidney's second criticism of the removal of substance from the foundation of metaphysics.

Reck states that "Unless the series of particulars [discrete bits] can be compressed into a unity, the thing is pulverized into an indefinite, perhaps infinite set of inconsistent properties."[44] The illusion or abstraction in reality is the idea of moment and not the idea of duration. I can easily point to duration, but, it seems unlikely that I will be able to truly point to a simple moment. Albert William Levi writes that "time and spatial extensions are reflexively definable because they are quantities, continuous and divisible."[45] Definable because they are divisible; A little circular in terms of metaphysics, I think. Magnitude, movement, and time are all continuous only because the succession of now which defines the cutting edge of time is assimilated to a Euclidean imagery of points which defines the infinite divisibility of space. Process reality offers a description of entities in process and relations in a flowing world: Heraclitus' world of flux. Western tradition, as remarked above, requires that we start with a singular substantive object or substance. If entities

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[41] Ibid., pp. 445-46.
[42] Ibid., p. 441.
[43] Ibid., p. 441-42.
[44] Reck, *Substance*, p. 768.
[45] Albert William Levi, "Substance, Process, Being," *Journal of Philosophy* 55, no. 18 (August 1958): 749-61, p. 752.

are not illusions, then the metaphysical issue of discrete objects compared to experience of a reality that seems to be continuous must be addressed. We have a feeling of duration that is continuous.

> But, in man, the thinking being, the free act may be termed a synthesis of feelings and ideas and the evolution which leads to it a reasonable evolution. The artifice of this method simply consists, in short, in distinguishing the point of view customary or useful knowledge from that of true knowledge. The duration *wherein we see ourselves acting*, and in which it is useful that we should see ourselves, is a duration whose elements are dissociated and juxtaposed. The duration *wherein we act* is a duration wherein our states melt into each other.[46]

Bergson suggests that our experience is actually a "succession of phenomena" which is separately distinguishable by scale. We prehend minutia of discrete information; yet we seem to experience reality as a continuity. How can we extricate ourselves from this discrete-continuity problem? Are we any better off than we were with the problem of mind-body?

DISCRETE VERSUS CONTINUOUS

Recall Reck's second criticism of process metaphysics: "Unless the series of particulars [discrete bits] can be compressed into a unity, the thing is pulverized into an indefinite, perhaps infinite set of inconsistent properties."[47] If we accept that Zeno's paradoxes have a solution[48], then we understand that one *can* compress a "series of particulars into a unity." As Reck suggested, this necessitates a conception of the infinite which is more than acceptable and consistent with a process reality. In fact, the point to process is treating relationships and interrelationships as actual. At worst it treats "the one" as the illusion.

Reck seems unaware of contemporary resolutions of Zeno's paradoxes and related problems with the infinitesimal. [49] Reck suggests that process philosophy necessarily needs to depend on "fuzzy logic" or Bergson's "fuzzy character of the real…. The process philosopher has replaced a horror vacui with a horror separationis, being impelled by the paradoxes of Zeno into the conviction that once reality falls apart into disjointed discreteness, not all the king's horses and all the king's men can get it together again."[50] Even Rescher, a staunch process philosopher, states that "Zeno's classical paradox demonstrates the incapacity of stable concepts to characterize the fluidities of an ever-changing reality."[51] D. Bidney's criticism of duration demonstrates the crux of this issue:

> Movement is not the series of static positions of a thing. It is essentially a certain duration of flux. This duration can be analyzed for the purposes of action into a series of stages or

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[46] Henri Bergson, *Matter and Memory*, trans. N.M. Paul and W.S. Palmer (New York: Zone Books, 1991), p. 186.
[47] Reck, *Substance*, p. 768.
[48] See particularly Marc Corbeil, Process *Environmental Philosophy*, MA Thesis, University of North Texas, May 2003 and Wesley Salmon, *Zeno's Paradoxes* (Indianapolis: Bobbs-Merrill, 1970)
[49] For example, see Rescher, "Process Metaphysics," p. 15.
[50] Ibid., p. 40.
[51] Rescher, "Process Metaphysics," p. 15.

> positions, but motion cannot be reconstructed through a series of static positions. When one attempts to do so he becomes involved in all the paradoxes of Zeno.[52]

Bidney's criticism is even more specific than Reck's. It is this call to the infinite that Zeno identified as the problem, but from the point of view of process metaphysics, this is favorable. Once again witness the fallacy of misplaced concreteness; the abstraction of a *duration* into touchable singular or atomic "oneness" is fallacious. Bergson had it right when he said "one cannot touch the instant."

> But the real, concrete, live present – that of which I speak when I speak of my present perception – that present necessarily occupies a duration. Where then is this duration placed? It is on the nearer or on the further side of the mathematical point which I determine ideally [in abstraction, relating also the idea of instant as an abstraction!] when I think of the present instant? … Sensations and movements being localized [prehended and then apprehended] at determined point of this extended body, there can only be, at a given moment a single system of movements and sensations.[53]

Can an extension of process really get us from the discrete to the continuous? Henri Bergson hinted at a mathematical resolution but did not seem to have the inclination to pursue the matter mathematically. I believe that the step from discrete to continuous is possible if we apply the central limit theorem. In addition, applying this theorem to a *Levy flight* will make the important correlation to chaos theory, relating the concept of process-information to the concepts of complexity and stability.

LEVY FLIGHTS

Steve Wolfram, in *A New Kind of Science,*[54] illustrates how such an extension is possible through the process of random discreteness of very large sets of discrete entities. Consider a discrete set of information and use the analogy that information represents behavior. What is the outcome of arranging such information? Discrete elements usually result in complex arrangements of discrete behavior. But, in nature we seem to encounter some kind of continuity. Either we are mistaken in the idea that this results from discrete information, or we are mistaken overall in our metaphysics, and the information is continuous.

> To explain our actual experience of the natural world, we need to consider not only how phenomena are produced in nature, but also how we perceive and analyze these phenomena.[55]

If we accept that the individual components of reality are primarily made up of process-information, rather than substance, then even in large systems, discrete information should be characterized by discrete descriptions. But, with *really large* systems of complex information, for example an ecological system or even a human brain, individual information seems to get damped out and these "systems with discrete components" produce "behavior that is smooth and continuous."[56] Rescher

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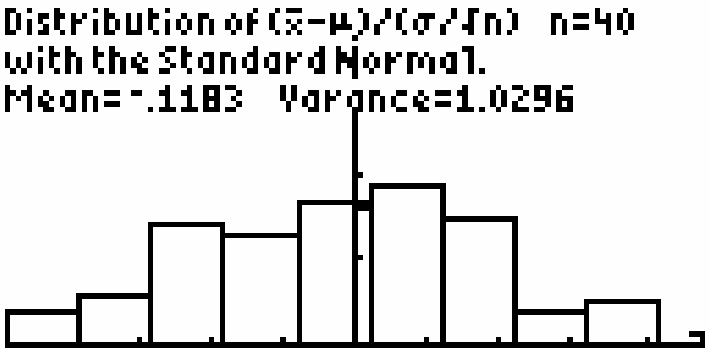
[52] D. Bidney, "The Problem of Substance in Spinoza and Whitehead," *The Philosophical Review* 45, no. 6 (November, 1936): 574-92, p. 578.
[53] Bergson, *Matter and Memory*, pp. 137-38.
[54] Steven Wolfram, *A New Kind Of Science*, (Champlain, Ill.: Wolfram Media, 2002).
[55] Ibid., p. 547.
[56] Ibid., p. 327.

also recognizes that large populations contribute to a truer understanding of the whole.[57] This does not mean that discontinuity is fundamental, rather it may suggest that discontinuity is abstract or simply illusionary.

Wolfram describes large population behavior using the notion of a *Levy Flight*. If we take a discrete particle and then apply a random operator to it, for example a random movement of the particle to the left or right, a distribution of the particle results. This distribution is called a 'random walk'. Applying such an operator to a large group of discrete particles, and looking at the distribution of each particle, results again in a discrete description. Analysis of discrete data should result in a discrete distribution resembling the binomial distribution represented below by a binomial probability histogram



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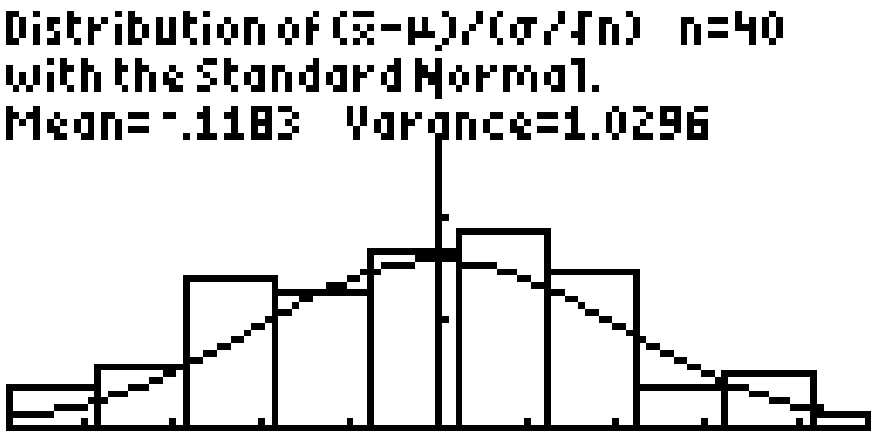
"But what happens if one looks not at the position of each individual particle, but rather at the overall distribution [using descriptive probability] of all particles?"[59] If the number of particles and the number of iterations of the operator is large numerically,[60] the resulting distribution starts to look smooth. These special random walks are referred to as *Levy Flights*. If the diffusion of the distribution gets very large a continuous distribution results. Mathematically, the assumption is that any physical quantity has a Gaussian, or continuous, distribution of probabilities when the iterations are very large. This is stated in the following theorem:

> THEOREM (Central Limit Theorem)
> *For very large n a discrete distribution converges to a normal or continuous distribution.*

This theorem provides part of the step from discrete to continuous. As an example, consider the diagram below of a continuous distribution (over laid on top of the orginal discrete distribution):

[57] Rescher, "Process Metaphysics," p. 22.
[58] These images produced by the author using a TI-86 calculator and TI graph link software.
[59] Wolfram, *New Science*, p. 327.
[60] In terms of biological systems this might still be quite small.



As n becomes large, the smooth curve approximates the discrete distribution. As n gets very large it is almost impossible to distinguish the two distributions. If n goes to infinity, the curves will match exactly, i.e., the discrete curve will converge to the continuous curve. The upshot is that Levy flights and the *central limit theorem* allow one to go from discrete to continuous in a definitive manner. This is not an illusion or the appearance of continuity but a convergence relating to an iterative process. This argument is similar to the transformation going from discrete to continuous in the calculus of Newton-Leibniz, what is called the Riemann sum of infinitesimal areas under the curve added up over an infinity of very small partitions of x giving a total finite sum (a convergence of the infinitesimal sum) or area under the curve.[61] It is also similar to the convergence of an infinitesimal sum as in Zeno's paradox. In addition, the iterative process demonstrates the properties of self-similarity and sensitivity to initial conditions characteristic of chaotic dynamical systems. Perhaps this may suggest alternative notions of 'stability' and 'integrity' of such systems.

THE EVOLUTION-ENTROPY DILEMMA

I have suggested throughout this paper than a resolution exists to the evolution-entropy dilemma, as I call it. Before going into depth, some clarification of terms is necessary. There are clearly two distinct meanings of entropy: thermodynamic and logical. The second law of thermodynamics states that a closed system must deteriorate in available energy and complexity. Energy tends to flow and spread: more *entropy* results in less energy for doing work. The term entropy here is being used synonymously with the second law of thermodynamics. This is acceptable as long as entropy is defined as unavailable energy. But a different meaning of entropy, called logical entropy, refers to disorganization or disorder in general. Physicist Richard Feynman defines (thermodynamic) entropy in units joules per degree and (logical) entropy in another section as distribution of order, without units or equations.[62]

Often entropy becomes the focus of criticism of evolutionary theory. This theory seems to violate the second law of thermodynamics since more energy seems to be available as time passes, rather than less as entropy suggests should be the case. The response usually is that the sun, and the earth's core, both provide energy for the

[61] The integral.
[62] Richard p. Feynman, *The Feynman Lectures on Physics* 1 (Reading, Mass.: Addison-Wesley, 1963). Thermodynamic: sect. 44-6 and Logical: sect. p. 46-8.

planet. The earth is not closed in terms of energy. This explains how energy is still available to do work for eons upon eons. But the entropy issue in evolution is not a thermodynamic one; instead it is logical entropy or complexity that is at issue. Life increases in complexity and this seems to defy explanation.

I am considering logical entropy and the unexplained appearance of complexity.[63] John A. Jungerman gives the following exposition of the problem:

> Countervailing the general tendency of the universe toward increased entropy, as specified by the second law of thermodynamics, is the order and decreased entropy produced by complex systems. These systems exhibit spontaneous creativity and unpredictable behavior accompanied by *interconnections* among trillions of atoms. These are all concepts that are tenets of process thought.[64]

Although Jungerman states "specified by the second law," he is obviously referring to the complexity and order issue in this statement and not energy of a closed system, i.e., logical entropy and not the second law at all. He is asking, "How do things in the world in general become self-organizing toward complexity?" Why is there life at all? If we are to accept that life and nature have increased in complexity over the eons as facts, then this planet certainly seems driven towards complexity and self-organization. The evidence is fairly plain, but how can we possibly give a rationale for this?

> It seems that most biological mechanisms of action show that life involves far-from-equilibrium conditions beyond the stability of the threshold of the thermodynamic branch. It is therefore very tempting to suggest that the origin of life may be related to successive instabilities somewhat analogous to the successive bifurcations that have lead to a state of matter increasing coherence.[65]

Substance metaphysics is simply going to fail to explain a reversal of logical entropy. The processes of life via a study of the information contained in life forms, iterated information related to *Levy flights* for example, seem to have characteristics of self-similarity and sensitivity to initial conditions. We know that ecological systems have these qualities, and we know that this sort of information certainly can take discrete probabilistic iterations and quickly generate these patterns. This behavior is surprisingly easy to demonstrate. Process-information metaphysics provides a way.

THE CHAOS GAME

The chaos game, like most approaches to chaos theory, starts simply enough. Take out a pencil and your ruler. If you don't have one, just reach over to the nearest mathematician, and take his or hers from that pocket protector they are supposed to always have. Start by drawing any triangle and label the three vertices as 1-2, 3-4 and 5-6. Randomly draw a point inside the triangle, a seed value. Roll a normal, six-sided, game die and note the number rolled. Place the ruler so that the edge passes through both the seed value and the vertex labeled by the number rolled. Place a point halfway along this line going from the seed value to the vertex that

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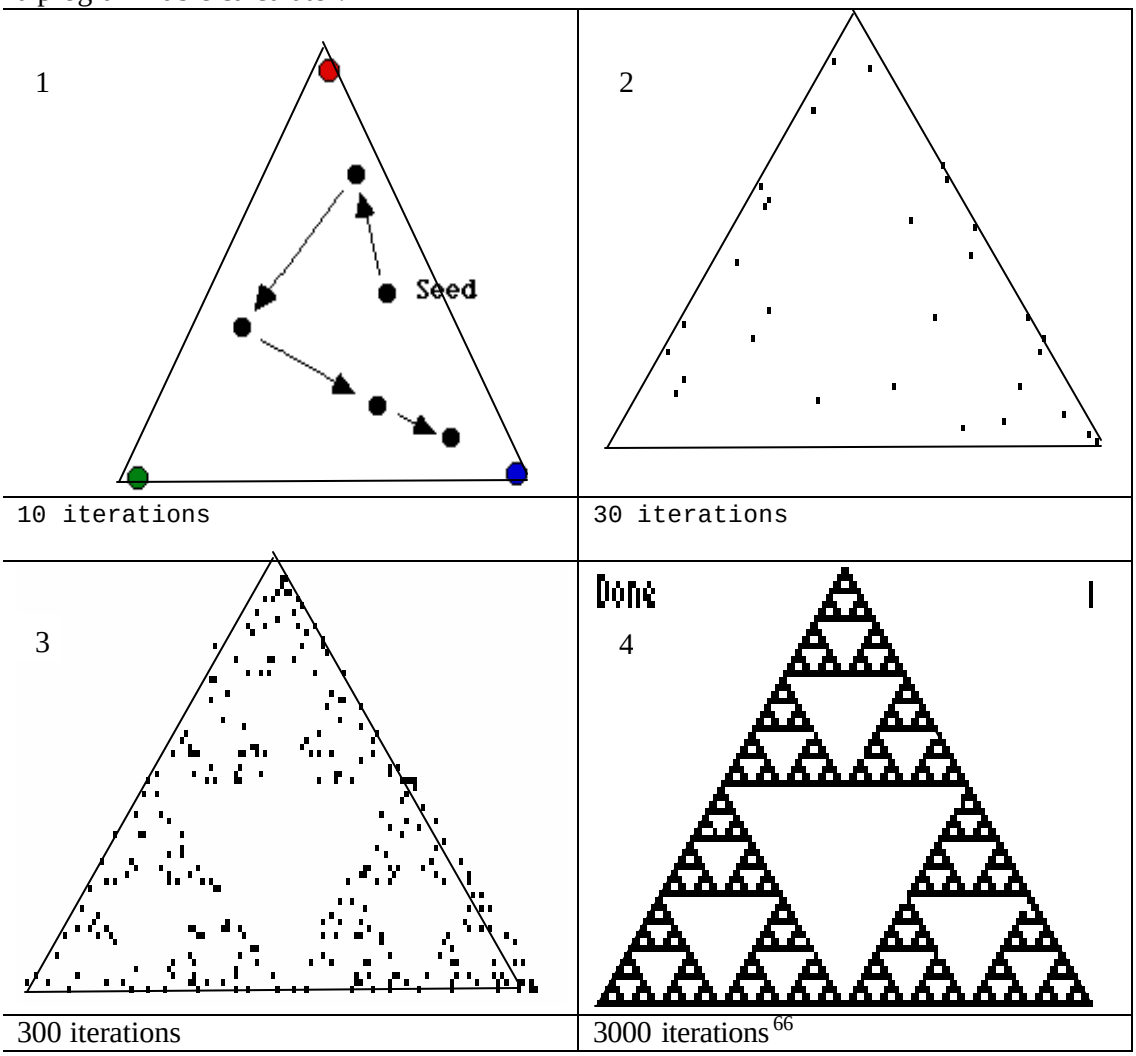
[63] It is not clear from Feynman, Robert Penrose or Ilya Prigogine exactly what is the relationship between the two types of entropy.

[64] John A. Jungerman, *World in Process: Creativity and Interconnection in the New Physics* (New York: SUNY Press, 2000), p. 135.

[65] Ilya Prigogine, *From Being to Becoming* (New York: W.H. Freeman, 1980), p. 123.

matches the roll of the die. This is the first iteration. Roll again. This time place a new point halfway from the last point plotted and the vertex that matches this second roll. This is the second iteration. Continue the game for a very long time, for a great number of iterations. Below, I have re-produced an approximation of the game using a programmable calculator.



The Sierpinski Triangle will appear irrespective of the seed value; pattern emerges out of randomness. Certainly, if information is what is operated on in evolution, i.e., information found in DNA and other living structures dependent on it,

[66] These images are produced by the author using a TI-86 calculator and TI graph link software. Two programs were used, one in TI Basic and the second was written in Assembler, using Assembler studio. The 'discrete look' is a result of using a machine with relatively very large pixilation. If one had an infinite depth to pixels and let the program run for a very long time it would produce a continuous image. The demonstration of this can be found by taking a very large magnification of any portion of the triangle, say a million, and the same identical image will appear to the same limitations of the pixilation. In other words, by definition, any accuracy wanted can be achieved in the image. Discreteness is only an illusion of limited pixilation ability of the device used to display the image. An alternative algorithm to create the triangle is available at http://ejad.best.vwh.net/java/fractals/sierpinski.shtml.

and if some randomness is mixed with a numerically large iterative process, perhaps illustrated by the notions of chance survival and millions of species and billions of living things, then pattern as a product of this process is understandable, even expected. Evolution is possible and relativity simple to demonstrate if process-information is the basic concept of metaphysics.

CONCLUSION

In conclusion, I ask you to consider process metaphysics as an alternative philosophy. In environmental philosophy, problems of complicated environmental systems often will fail to yield results if descriptions are limited to simplistic discrete explanations. Looking at 'things' alone, rather than at relationships and interrelationships, will surely mean that we will fail to understand and, thus, we will fail in environmental philosophy.