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ROLE OF INFORMATION IN PROCESS METAPHYSICS AS A FOUNDATION FOR ENVIROMENTAL ETHICS

Key: The idea of "information" (as a "duration"?) is the key to the foundations of process metaphysics. Without idea of "information," process metaphysics remains fuzzy (like Bergson), really complicated (like Whitehead) or too weird (like Hartshorne)

This paper attempts to give a foundation for environmental ethics using process metaphysics. Pure substance metaphysics is demonstrably not successful in answer questions that concern complexity. In particular, the doctrine of necessity, the dilemma of determinism and traditional problem of mind and body prove intractable from a substance metaphysical approach, as indicated by paradoxes (Zeno's, sorties, etc. ). Value issues have not worked well within a pure analytic tradition, which in turn has followed from substance metaphysics and simply, this kind of metaphysics just plain fails to adequately describe the reality of the environmental world. A study of the characteristics of relativity, chaos theory, quantum mechanics, evolution and entropy reveals the key of information processes. This introduces aspects of incompleteness, uncomputability and randomness that strongly suggest information process metaphysics is as an alternative to substance metaphysics. Uncertainly becomes a necessary advantage to metaphysics and permits adequate conversation of values in ethics and supports a risk management (chaos theory/ information theory, probability theory) approach to environmental ethics as opposed to the one sided precautionary principle. Such an approach quantifies and qualifies theories in vagueness but requires a complexity approach giving a solid understanding of identity and stability in complex systems.

PROCESS INFORMATION METAPHYSICS: AN INTRODUCTION TO A PRACTICAL PROCESS PHILOSOPHY OF ENVIROMENTAL ETHICS

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# CHAPTER 1

## INTRODUCTION

### The Self-Marginalization of Process Philosophy

The starting pointing of process thinking is, of course, the ancient Greek philosopher Heraclitus, followed about a century ago, on average, by Henri Bergson and Alfred North Whitehead. More recently Charles Harshorne, John B. Cobb, Jr, Nicholas Rescher and David Ray Griffin are stand-outs in the articulation of process thinking or process philosophy. There is now undoubtedly a large body of work in process philosophy, including Rescher's work on process metaphysics[1] and Claire Palmer's 1998 very long and detailed criticism process thinking titled *Environmental Ethics and Process Thinking*[2]. That some success has been achieved is clearly accepted by most philosophers, including Palmer. But, as Timothy Menta points out, there has been relatively little work published on process philosophy and environmental ethics[3]. Menta also notes that much work in process philosophy is seems to be process theology. Note that Palmer's text is published in the Oxford Theological Monographs series.

More of a concern, is the responses of process philosophers to criticism and the self-description of work in their field. Menta, for instance, uses in his title "a Hartshornean Response". In the same journal, which included a forum dedicated to

[1] Rescher PM
[2] Claire Palmer, *Ethics and Process Thinking, OUP 1998*
[3] Timothy Menta, "Claire Palmer's Environmental Ethics and Proces Thinking: A Hartshorean Response, Process Studies, Volume 33.1 Spring-Summer 2004, p. 24.

responses to Palmer's book, Cobb used "Palmer on Whitehead". Whitehead's this, Bergson's that and Hartshorne's probable view point on this other. Is it possible that process philosophy has successfully marginalized itself by relying on a semi-scholastic approach based on a handful of authors? Absolutely insightful and wonderfully novel authors on the twentieth century, yes, but most of the seminal work of these authors occurred in advance, or very early on, in the development of new ideas in physics and mathematics. Whitehead is unlikely to have had the opportunity to appreciate the second and third generation thought in quantum mechanics and Hartshorne's exposure to complex dynamical systems was, if anything, indirect and layman-leveled.

At this point, it is obvious that this work will attempt to depart from the twentieth century process philosophy, and will attempt two very challenging things. First, I will suggest an alternative process metaphysics. Let us call it, for the sake of a name, *process information metaphysics*. This metaphysics will still hold at its focus the idea that process is some kind of primary consideration, but will differ from most 20$^{th}$ century process philosophy in that I suggest a purely Heraclitean approach to the subject-object dilemmas. (? Check this) In addition, I will suggest that information as the relational link of processes. The second challenge will be to actualize the theoretical framework of process information philosophy by attempting to justify a foundation of environmental ethics based on this philosophy.

To chose two difficult tasks when either one seems to have eluded philosophers seems presumptuous. Presumptuous or not, I believe that neither task is possible without deep contemplation of the other. Like mathematics and logic, process thinking and environmental ethics are bedfellows. This is why, I believe, that process philosophers

and process theologists have the tendency to dabble in environmental ethics and vice versa. Scratch a holistic environmental ethicists and you will likely find a process thinker.

## CHAPTER PROCESS INFORMATION METAPHSYCIS

In the modern world, the renaissance of Greek philosophy coupled with the new scientific method developed into contemporary philosophy. Allow me some liberty in loosely describing the two major school of philosophy as Pythagorean and Parmenidesian. Pythagoreans tend to see the world as a plenum, a world of many things whereas the Parmenidesians tend to see the world as a one, a single thing. Consider a alternative view point of the word that holds at its foci process relationships and a suspension of any Aristolean subject-object orientation.

This third viewpoint, originating with Heraclitus, has been marginalized far too long is the viewpoint that the *language of things* is faulty and it is upon the principle of process that we should focus.

ed would allow one to look deeper, or at least differently, into some of the problems of philosophy. This view point would take a bite out of the very foundations of metaphysics but have implications in the pragmatic ethics of the environment. Evidence garnered from metaphysics taken in the context of real life. This is the promise of the renaissance of process philosophy.

Process philosophy has become more widespread in the last few years but remains misunderstood and highly undervalued. In part, this may be due to the wide application of process philosophy and the wide application of process ideas. Complicating things is the speed in which one goes from the practical realm to abstract metaphysics in process philosophy. Yet, this is indeed the strength of this philosophy, especially in dealing with

some of the major questions in philosophy: the connect between the practical and abstract metaphysics exists and can be understood.

In this chapter I will introduce a process philosophy loosely similar to the early 20th century philosophies of Alfred North Whitehead and Henri Bergson. I will suggest a metaphysic based on understanding through process and the primacy of information as an alternative to traditional substance metaphysics. Finally, I will apply process information metaphysics to the evolution-entropy paradox making a connection between metaphysics, chaos theory and information theory.

Introducing process philosophy is not an easy task considering I should cover approximately 2500 years of philosophy, and most of that of the non traditional sort. Fragments of Heraclitus (d. 480 B.C.) are the earliest records in the history of Western process philosophy. An unusual philosopher in many respects, Heraclitus is rumoured to have died after spending a number of days in a manure pile. According to Diogenes Laertios (3rd cn. CE.), Heraclitus was suffering from dropsy, or general swelling, and was attempting to use the heat of the pile to evaporate the fluid of the swelling. Apparently it took villagers some time to discern that Heraclitus was no longer among the living, the final hint being that dogs had pulled his body from the pile and had started devouring him. Not exactly a bell ringer for process philosophy.

The most famous quote attributed to Heraclitus is common enough, "You cannot step into the same rive twice, for new waters are ever flowing upon you … " Typical of the ongoing misunderstanding and marginalization of process philosophy, this quote is so incomplete as to be imprecise, even slipshod. Let us consider the full quote as translated by Dennis Sweet.

> One cannot step into the same river twice, for new waters are ever flowing upon you. 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 as it endures.[4]

[4] Heraclitus, *Heraclitus: Translation and Analysis*, trans. Dennis Sweet (Lanhan: University Press of America, 1995), fragment #91.

From this quote one can start to detect some of the distinguishing features of process philosophy: alteration or change, pairs or opposites and a rejection of the primacy of substance. Parmenides' ideas of the one and the Pythagorean's conceptions of the world in terms of the many both insisted on substance as the final metaphysical bit of reality, that substance is primary. The third feature of process philosophy, the rejection of the primacy of substance, suggests that the "usual" categorization of material things is somehow being misapplied or is inappropriate.

Relationships and processes are so clearly obvious in the world. Early philosophers suggested four elements, fire, air, earth and water as the were not proposed as the substantive things of the world. Yet, this viewpoint was not consistent for all ancient philosophers. Heraclitus also proposed fire, air, earth and water but not necessarily as substantive elements of things. Heraclitus took fire, air, earth and water pairs of opposites or a range of **characteristics** in process. Water for example, has many states, gas, solid and liquid, and this stumped those interested in the nature of things in the ancient world. Was Heraclitus identifying water as a thing or as a changing relationship of processes? Unfortunately, Heraclitus' expanded ideas of metaphysics, like his ideas of medicine, were 2500 years too early. The record is also very incomplete. So, let us drag ourselves out of the pile and consider some more contemporary alternatives.

To help place ourselves in the appropriate mode of process though, consider a problem of metaphysics, say the problem of location of a thing. First, let us observe a thing, this desk for example. To observe a thing, I need to focus on that *thing, there (point to it)*. I seem to attempt some kind of separation, perhaps absolute in manner, to distinguish between that thing and another, for want of a better word, *object*. By pointing, I seem to be attempting to isolate somehow, this thing. I am the subject observing the object. This is how metaphysics has traditionally described such situations for thousands of years.

Indeed, metaphysicians ask the question, "What kind of things exist, and how?" And, since even before Aristotle's treatment of substance in the Categories, this question has been generally answered with a language dominated by subjects and objects, what one might refer to as *substance-attribute metaphysics*. For example, Aristotle gave the following idea of substance (call it substance-attribute) in the Categories.

> Every uncombined term indicates substance or quantity or quality or relationship to something or place or time or posture or state doing of something or the undergoing of something. … A Unity of matter and form.[5]

The thing is a one, "that which can exist by itself" - an object in itself, located in time and space. But, what happens when I look away? Has not the relationship between me and the thing changed? Is this a change in the properties of the subject or the object? Is the object out there or here in my mind? This object subject language automatically sets a metaphysical basis that makes simple questions difficult to deal with. Substance-attribute metaphysics has inflicted a particular set of rules upon metaphysical questions and we seem rule bound to follow the footsteps of previous philosophers despite a lack of good metaphysical answers. The concept of substance is particularly complicated and is often the major focus of criticism of process philosophy.

In general, process philosophy rejects substance-attribute type metaphysics and embraces a metaphysics based on relationships. According to Whitehead, the idea of location is difficult because the concept of substance is misunderstood. It is claimed that there is no Aristotlean type of substance (substance-attribute), nor are there Cartesian types of primary and secondary properties to cause endless metaphysical paradoxes.

When a thing is directly observed, this is not an act of identifying or viewing a separate entity or substance. Instead, in Whitehead's terminology, I am said to be *apprehending* that thing. If I redirect my attention, I am no longer directly aware of this thing. Even so, I may still have some limited awareness of the thing. I can remember it, see it in the corner of my eye or perhaps just sense it looming behind me. I am loosely aware of many other things, far and near; the conversation in the background, the cars outside, the wax upon the stove over there in the corner and the tree, in extension, falling in the forest. Whitehead called this type of relationship of limited awareness *prehension.* In this sense, all things are either apprehended or prehended in some process of relationships, i.e. we are *informed* about the relationship between oneself and the thing. There is no necessary distance or separation.

Think of how we relate to the world around us. We are at no time truly independent of

[5] Aristotle, *Categories* (Belmont, California: Wadsworth, 2002) [CD-ROM].

one another or independent of every thing. No entity can exist without at least a prehensive quality of other entities. There is always a relationship. There are connections between all entities that force a relational understanding even when considering or directly focusing on a single one.

One might ask, am I not just playing a word game and talking simply of subjects or objects using some new obscurities? If one was to grasp some thing, is it not clearly a substantive thing? Could I not place my hand onto this desk and state "here is it, this is a substance"? Recall Heraclitus' fragment, "Nor can one twice take hold of mortal substance in a stable condition". What might he have meant?

Pierre Simmon de Laplace (1749-1827) once boasted that if given the exact measurement of an object's location in time and space, he could calculate the exact future and past of that object forever using Newton's physics. We now know this to be impossible, since Newton's physics is seriously flawed. Take this table here in front of me and let me place my hand upon it. At what point can one say my hand ends and the table truly starts? If we changed the scale and looked very closely, what would we see? How about if we went very, very close, down to the microcosmic level? Would we see the last atom in my hand touching the first atom of the table? Not likely. One should not think of the atomic world as little bits and pieces as it appears to us in the mesocosmic, or regular scaled, world.

Our existence and reality do not allow us a complete or absolute objectivism. This was made clear in 1905 when Albert Einstein rejected the idea of absolute location and replaced it with location relative to an observer.[6] Newtonian physics, which is based on Aristotlean type substance-attribute metaphysics, was found wanting. Einstein, Poincaré, Schrödinger, Heisenberg and Dirac together presented a new physics of relativity and quantum mechanics. In this contemporary physics one cannot, even in principle, measure the nature of the universe precisely as an object subject thing.[7]

In this sense, I would claim that the idea that one could hold the same 'thing' at any time or in any one place, to "take hold of mortal substance", even instantaneously, is illusionary, a *Laplacian illusion*. There are no little bits sitting on top of one another. The

[6] Steven Haking, *A Brief History of Time* (New York: Bantam, 1988), 23-25.
[7] Steven Hawking, *A Brief History of Time* (New York: Bantam, 1988), 55.

best that physics can provide, even instantaneously, is a subjective observation over duration of experience or a probability event. If there is an essence of substance, it must be a characteristic that is relative to the scale of consideration.

Can I truly have the same item in my grasp that I had only a minute ago, or even a microsecond ago? Where is this 'thing' located? Tradition suggests that the 'thing' is located at some **point** in space, namely in my hand. Yet, we know this to be false. To hold the doctrine of Aristolean type substance-attribute despite this evidence is to commit what Paul Weiss calls the "fallacy of essential completeness"[8], or more simply, the fallacy of pointing.

> 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 pointing, with the passage of its moment. Pointing does not enable an object to persist … " [9]

Existence is duration, and so location cannot be momentary or instantaneous. If so, what "is being located" changes, at least minutely, over duration. Whitehead clearly opposed "substance-attribute metaphysics" and a "subject-predicate logic". [10] D. Bidney states that Whitehead "urges that philosophy should be based on a logic which gives the primacy to relations or structure and not to the terms or subjects".[11] 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" .[12] This Cartesian image of "things" must be completely rejected. But, as Peter Farleigh has asked, how do we avoid "throwing out the machine along with the ghost?".

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

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[8] Paul Weiss, *Reality* (Chicago: Southern Illinois University, 1967), 208.
[9] Andrew Reck, "Substance, Process and Nature," *Journal of Philosophy* vol. 55, no. 18 (1958): 766.
[10] D Bidney, "The Problem of Substance in Spinoza and Whitehead," *The Philosophical Review* vol. 45, no. 6 (1936): .
[11] D Bidney, "The Problem of Substance in Spinoza and Whitehead," *The Philosophical Review* vol. 45, no. 6 (1936): 583.
[12] Peter Farleigh, "Whitehead's Even More Dangerous Idea," *Australasian Association for Process Thought*, 2003 [journal on-line]; available from www.alfred.north.whitehead.com/AAPT/aapt_papers.htm; Internet; accessed 14 November, 2003.

"instantaneous" as an event. Apart from an abstraction of the moment, the event is a duration of your experience. 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.[13] 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. If one abandons substance, then information becomes pivotal. This is accomplished by going from substance-attribute-thinking to event-thinking. Thus, substance should, at best, be understood as an abstraction of an *actual occasion* of a complex event rather than a concrete object thing.

## Fallacy of Misplaced Concreteness

> Process philosophies that repudiate substance are untenable, and in fact to press the claim that substance in the sense of unitary, continuant, and independent individuals … must undo the possibility of process, since our awareness of process as well as its reality would be thereby impugned.[14]

Andrew Reck's criticism of process philosophy relates to the concept of event-thinking. As Marie Louise Gill puts it, one must deal with the paradox of unity, the question of how things survive, in order to confront this type of criticism.[15] (Marie Louise Gill 189) After all, with what exactly does the process philosopher want to replace the concept of substance-attribute?

In *Process and Reality,* Whitehead writes,

[13] Alfred North Whitehead, *Process and Reality* (New York: The Free Press, 1978), 77.
[14] Andrew Reck, "Substance, Process and Nature," *Journal of Philosophy* 55, no. 18 (1958): 767.
[15] Marie Louise Gill, *Aristotle on Substance: The Paradox of Unity* (Princeton, NJ: Princeton University Press, 1989).

> 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. (Whitehead, Process 29)

This is clearly a call for a rejection of substance-attribute as a basis for metaphysics. Whitehead carefully incised substance-attribute from the foundations of metaphysics and by replacing it with the concept of substance as matter without attribute, what he called a subject-superject. This appears to agree with what Bergson referred to as a process of perception as duration of the event, a unity related to an actual occasion of an intuition, a concept here which Bergson seems to include both apprehension and prehension.

Reck expands this idea and states that "the event is not merely a matrix of qualities and relations excluding substance; it is a centre of activity, or energy expenditure, or creativity." 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" (Reck 766).

In a sense, Reck's "centre of being" idea posits almost exactly what it claims to renounce. It is a confusion of an event with the attribute of the event, what Reck thought of as substance. That is, some would have us replace the concept of substance with an attribute of an (process) event. Hume suggested this very idea 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. [16]

But, the idea of an atomic moment is inconsistent with the idea of a span of the event or duration of experience and Whitehead identified this as the fallacy of misplaced concreteness.

> 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.[17]

[16] David Hume, *A Treatise of Human* Nature, ed.by L.A. Selby-Bigge (Oxford: Oxford Press), Book 1: Part IV; Sec 3.

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, prehension should be thought of as a process over duration without attribute. Seeing, touching, measuring, all are verbs of action in time, durations. The Aristotelian substance-attribute doesn't even make sense as a single event, since an event must involve 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.[18]

Rejecting Reck's suggestion, we might follow Whitehead and simply abstract a relative substance in relation to duration in space-time. But, as Mario Bunge points out, process philosophy should not suggest process as a replacement of substance in metaphysics[19] (qtd. in Rescher 33). To replace substance-attribute using substance-event, subject-superject or event as an abstraction of a Bergsonian duration would be too casual an error as such a metaphysic might be open to any and all the paradoxes of substance-attribute by substitution of a single word. Instead of positing a subject-superject or any other type of event abstraction, perhaps we might ask ourselves what is primary.

We have a relationship of process among entities and, as Gregory Chaitin and Stephen Wolfram have maintained, this relationship of process is primarily about information of those entities. The key is the recognition that prehension and apprehension are relative details of experience, or in different words, these processes are about information of entities within processes. When one takes a snapshot of awareness, when one apprehends some thing, one is making an attempt to what? Perhaps one is making an attempt to collect information rather than locate material (Chaitin 106-107). The idea of space-time

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[17] Alfred North Whitehead, *Science and the Modern* World (New York: The Free Press, 1925), 50-51, [bold accent mine].

[18] Henri Bergson, *Matter and Memory*, trans. by N.M. Paul and W.S. Palmer (New York: Zone Books, 1988), 186.

[19] Mario Bunge as quoted in Rescher, *Process Metaphysics*, p. 33.

interrelations is one of information, where information is "said to be here in space and here in time." This is not a mere exchange of the words subject object or substance with the words information or process.

A probability event (or probability packet) is a mathematical description in quantum physics that refers to an electron's "position", but really is not a position per se. Similarly, information about a thing's location is not like an atomic part or substantial bit of a thing. Information is not location; it is not a substance-attribute. Nicholas Rescher also argues that information process is the primary characteristic in perception (Rescher 45). Whitehead tried to describe such a concept and this may have been what he intended by subject-superject.

> 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 individualism of the substrate activity. … An entity of which we become aware in sense perception is the terminus of our act of perception. (Whitehead 70)

The prehension event, an event of interconnectedness, is the key to how Whitehead understood process. That which is prehended, the characteristic of the entity that "we become aware of in sense perception" is information.[20] Prehension, then, is an operator or transformation function on information resulting in more or new information. Every event, every prehension of information, results, essentially, in new events that again are perceived and operated on in cycles. This is an **iterative process**: a process that feeds information into itself continually. Thus, cognition over duration of time is a complex and iterative process of discrete[21] information events.[22] **Reality is not "substantive" but "informative" through iterative process.**

It is enough to understand that the concept of simple location, at best, is merely of information, and one characteristic of this information, at a certain scale of space-time,

[20] Careful not to mistake this as a thesis for "knowledge is perception"
[21] Step from Discrete to Continuous is achieved using the central limit theorem.
[22] For Whitehead, the terminology "information event" would have been unnecessary since he essentially understood an event as a prehension of information in nature. I am altering the primacy to fall on information.

*appears* to us as substantive. We have the feeling that it is substantive, but our analysis demonstrates that this is fallacious and the term simple location applies to only an appearance of reality. 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. The term location works in language as Newton's laws works in describing the motion of a rock falling; Functional but not universal. When we leave the mesocosm, one might need to abandon Newton's ideas and expectations of physics. In metaphysics, one may need to abandon what is essentially an ancient idea of substance (substance-attribute) and replace it with the idea of process information.

## The entropy-evolution paradox

In his book, *World in Process: Creativity and Interconnection in the New Physics*, John A. Jungerman points out that a paradox exists between the theories of entropy and evolution.

> 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.(Jungerman 135)

On one hand we have the principle of entropy; A closed system that tends towards simplicity and a reduction of order. On the other hand, we have the theory of evolution. Evolution generally requires an increase in complexity of species over time; a systematic succession of increasingly complex organisms as a natural law. But, how do "things" in the world in general become self-organizing toward complexity when the universe is supposed to become less complex over time according the principle of entropy. The paradox is simple but very serious. The evidence is fairly plain. There is self-organization and even stability in complex systems that also exhibit and satisfy the second law of thermodynamics. Iterated information, or the information contained in extant life forms, 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 behaviour is surprisingly easy to demonstrate using the chaos game (Corbeil 62-72).

If information is what is operated on in evolution, i.e. information found on the D.N.A. of life, and if some randomness is mixed with a numerically large iterative process, chance survival and millions of species and billions of living things, then pattern as a product of this process (complexity) is understandable, even if the general tendency is towards entropy. But, this requires that information is the primary attribute of reality, not substance.

Cleary this chapter is only an introduction. Yet, I feel that Heraclitus got it right after all. An alternative metaphysic based on understanding through process and the primacy of information have great potential as confirmed by the evolution-entropy paradox example. Indeed, a strong connection between metaphysics, chaos theory and information theory has been made. If the relationship shares other concepts, such as stability, complexity, self-similarity, beauty and value, then perhaps we could exploit these connections in other areas of philosophy.

## CHAPTER HISTORY

## HISTORY OF SUBSTANCE METAPHSYICS

In this chapter I will outline the idea of substance in metaphysics as it develops from ancient to contemporary times. In each section particular attention will be drawn to the era's view of metaphysics and other traditions of philosophy that will expose major issues that advance a thesis of process philosophy. Keep in mind Hartshorne's advice that the history of philosophy has been written primarily by historians who have "taken chiefly an account of those philosophers or those systems of philosophy, that have in fact exerted strong influence upon **their** contemporaries and successors."[23] Philosophers poorly or simply misunderstood, marginalized or simply ignored, have the potential of offering the most interesting contribution to the advance of philosophy. Hartshorne says it well: "What we want from the history of philosophy is knowledge not merely of influential views and arguments but of possible ones."

### Ancient Period

Major commentators on the foundations of philosophical attitudes usually split Ancient philosophers into two groups: those before Socrates, and then Socrates, Plato and Aristotle. The 'Pre-Socratics' can be further divided into three groups: philosophers of flux, represented mainly by Heraclitus the Ephesian; philosophers of stasis, represented by Parmenides, and then the group of Pythagoreans.[24] In general, the primary concern of these early philosophers was with the nature of the world and human's place in it;

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[23] Charles Hartshorne, *Insights and Oversights of Great Thinkers: An Evaluation of Western Philosophy*, (New York: SUNY, 1983), p. 1 [emphasis mine]

[24] Fredrick S.J. Copleston, *A History of Philosophy, Volume 1: Greece and Rome-From the Socratics to Plotinus*, (New York: Doubleday, 1993

"speculations about the nature of matter and its interactions with mind."[25] "They were Wise Men, who might make astronomical observations for the sake of navigation, try to find out the one primary element of the universe, plan our feats of engineering, etc., and all without making any clear distinction between their various activities."[26]

It is not surprising that Thales, perhaps the first philosopher from whom we have some fragments of text, concerned himself with the kind of material substance or matter that makes up the world.[27] Thales asked, "What is the stuff out of which the world is made?"[28] In response to this question, philosophers have called this 'stuff' by different names: substance, matter, atom and many more. The meaning shifted wildly from philosopher to philosopher. Anaximander suggested 'air', Zenophanes 'earth and water' and it is often stated that Heraclitus suggested 'fire' as fundamental.[29] The Western philosophical tradition is based on metaphysics that poses and answers the question, "What is this stuff?" Recognize that by just asking the question, an assumption is made, a priori, **that there is a stuff out of which the world is made**.[30] That some 'thing' is atomic; that there exists a smallest definable unit or essence of things – a basic Lego building block of the world.

> In spite of the melancholic side of the Greek, his perception of the constant process of change, of transition from life to death and from death to life, helped to lead him, in the person of the Ionian philosophers, to a beginning of philosophy; for these wise men saw that, in spite of all the change and transition, there must be something permanent. Why? Because the change is from something into something else. There must be something which is primary, which persists, which takes various forms and undergoes this process of change.[31]

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[25] Hargrove, *Foundations*, p. 16
[26] Copleston, *History of Philosophy*, p. 21
[27] Hargrove, *Foundations*, p. 17
[28] W. T. Jones, *A History of Western Philosophy: The Classical Mind*, second edition, Vol. 1., (New York: Harcourt Brace Jovanovith, Inc., 1970) p. 14
[29] Hartshorne, *Insights*, p. 13
[30] Fallacy of complex question?
[31] Copleston, *History of Philosophy*, p. 17

That this tradition has been successful is not denied, but I will argue that this metaphysical basis is no longer serving our understanding of our world and is, in fact, impeding our understanding. This should not be surprising since the Ancient period is replete with philosophers struggling with major problems of their own implied metaphysics[32] and the problem of the "one and the many." Has Western philosophy provided a reasonable solution to these problems? Jones has suggested that "the logical development of Thales' initial premise … gradually led philosophers to a point very far from common sense."[33]

Consider the anti-flux paradoxes offered by Zeno of Elea (approx. 488-439 B.C.E.). Zeno formulated the impossibility of motion as a paradox, a set of statements that leads to a contradiction.[34] He offered a number of paradoxes to which I will add my own version as follows. You are teaching a class to students and wish to demonstrate the idea of Zeno's paradox. You crumple a piece a paper into a ball and throw it at one of you students, perhaps the one sleeping in the back row. You state, "Motion is impossible." "I will prove it even thought we see that the student here in class caught the paper ball (on his ear)." "If the ball is to travel the entire distance, from myself to the student, it must first travel half way." "If the ball is to travel half way, it must also travel one quarter of the way, and so on." You now explain that one can break up or partition the pathway between yourself and the student into parts: one half, one quarter, one eighth, one sixteenth, one thirty second and so on. You ask, "How many partitions are possible?" Dutifully, students answer that an infinite or endless number of partitions are

[32] Hargrove, *Foundations*, p. 19
[33] Jones, *Classical Mind*, p. 21
[34] Jones, *Classical Mind*, p. 22-4

possible. You state that each partition, no matter how small, is measurable. “Fine, no problem,” state your students. You then ask, “What is the sum of an infinite number of measurable segments or partitions?” “Certainly infinite”, suggest the class. But some students are beginning to look a little unhappy with the future state of things. They can see the punch line coming. “If the distance is infinite, and the time for the ball to pass is finite, then it is not reasonable to think that the ball can reach the end of the path at all, is it?” “Motion is impossible – any questions?”

The paradoxes were offered in of defense Zeno’s teacher **Parmenides’** belief in a static and unchanging world. Parmenides (510-450 B.C.E.)[35] asked, “How is it that an object may be permanent but changing?” “The Ionian philosophers were profoundly impressed with the fact of change, of birth and growth, decay and death.”[36] For Parmenides there is one thing: a substance that endures unchanging. This is the ‘doctrine of Parmenides.’ The intentions of Zeno’s paradoxes were to show that fundamental change in the world is an illusion, pushing towards a metaphysic of the ‘one’. If the ‘doctrine Parmenides’ is accepted, there must then two worlds: a world as it seems to be with change and flux, and another world as it really is unchanging with basic unchanging substances. Not only does this approach require substantive consideration of all ‘things’, it also requires a dualistic approach to reality. This is the tradition that western philosophy mainly draws from, an early rejection of a dynamic metaphysics and the acceptance of a static and unchanging one.[37] [38]

[35] Parmenides birth is on record 510, but he was possibly born as early as 515. Some fragments from Plato suggest that he met the young Socrates around 450.
[36] Copleston, *History of Philosophy*, pp. 19-20
[37] Hartshorne, *Insights*, pp. 14-5
[38] Copleston, *History of Philosophy,* pp. 14-19 and p. 59

The second group of Pre-Socratic philosophers, the Pythagoreans, were said to have been founded and lead by Pythagoras of Samos (ca. 580-500 B.C.E.)[39]. They were almost entirely preoccupied with the 'harmony of the world' and stressed that "things are numbers,"[40] and could be equally described either as a cult or as a school of philosophy. [41] [42] While their main interest was in mathematics, they were practical and operated a brisk trade in solutions to problems, never giving a hint of the methods. Their metaphysical understanding was a combination of the unlimited and limited of Anaximander creating a philosophy/religion that took the essence of the universe to be harmonious in both the numeric and musical senses. Part of the rationale of the Pythagorean mysticism was the connection they found between the geometric and the numeric in nature. This mystic mixture of numerical interest in nature and religious passion is a result, in part, of Pythagoras' travels to Egypt, Babbylon and perhaps India. He was certainly exposed to the teachings of Buddha, Lao-Tze[43] and Confucius. Pythagoras helped transform mathematics into a more liberal examination of its principles and theorems resulting in advances in geometry and arithmetic.[44]

Just as Parmenides and his followers had suggested a world as it appears and a world as it should be, the Pythagoreans juxtapose a world of perfection in numbers as it must be and a world as it appears.[45] They "asserted the plurality to practical exclusion of the One – there are many ones" where the doctrine of Parmenides "asserted the One to

[39] Carl B. Boyer and Uta C. Merzabach, *A History of Mathematics*, second edition, (New York: Wiley, 1989), p. 52
[40] Copleston, *History of Philosophy*, p. 33
[41] Ibid., p. 29
[42] Boyer and Merzach, *History of Mathematics, pp. 55-6*
[43] Lao Tze is a Daoist writer around the time or Aristotle.
[44] Boyer and Merzach, *History of Mathematics*, p. 55
[45] Copleston, *History of Philosophy*, p. 35

the exclusion of the many."[46] Both schools, therefore, adopted a dualist viewpoint.[47] Also note that the Pythagoreans "regarded things are being numbers, not merely as being numerable." Thus, a primary problem was the transformation between the limited and the unlimited: essentially the problem of going from thinking in terms of discrete linear to thinking in terms of continuous non-linear.

Does this mean that a dualistic approach must be taken and that we must adopt a static metaphysic? Should the focus of metaphysics be substance when it is the process of change that is most obvious, or at least the most interesting and/or problematic? Jones states "If experience discloses change, it also discloses permanence." We have a paradox of the world as it appears to be and the theory of the world as is must be. The paradox is based on the starting point that the stuff of the world must be things that have attributes, things that are both permanent but somehow changing. Copleston writes "The one-sided doctrine of Parmenides was unacceptable, as also was the one-sided doctrine of the Pythagoreans."[48] So, let us consider now the third Pre-Socratic 'position,' represented by Heraclitus.

With Heraclitus we find a profoundly different view of metaphysics that is in strict opposition with most pre-Socratics. This view is later rejected out of hand by Socrates, Plato and Aristotle. Heraclitus (544-480 B.C.E.)[49] was an Ephesian[50] noble whose work we know only from a limited number of fragments. While patchy evidence makes it difficult to recreate a coherent and logical interpretation of any philosophy,

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[46] Ibid.
[47] Jones, *Classical Mind*, p. 16
[48] Copleston, *History of Philosophy*, p. 59
[49] Dennis Sweet, *Heraclitus: Translation and Analysis*, (Lanhan, MD: University Press of America, 1995) p. xi References of Heraclitus will be referred by convention taken by Sweet which follows the tradition of Hermann Diels found in Die Fragmente der Vorsokratiker (1901).
[50] Ephesus was a Greek city on what is now the coast of Turkey.

Dennis Sweet suggests that this did not spoil the style of Heraclitus, which was similar to that of James Joyce. Heraclitus attached importance in forcing a reader into actively participating in unraveling the meaning and truth of his work.[51]

Recall that Heraclitus is said to have posited fire as the stuff of the world. It is Heraclitus' concept of change that is critical[52] and his thoughts relating to fire are grossly misunderstood in a Western tradition that has rejected his general philosophy since antiquity. Fire is not meant as oneness or as a substantive replacement of substance for Heraclitus.[53] Jones and Copleston, criticize Heraclitus for his idea that the world is in flux since such a theory committed him to the idea that "everything changes all the time."[54] Jones writes that pre-Socratics thought that "Things endure, says experience."[55] But Heraclitus denied this permanence outright:

> 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 (combines, unites and continues) and dissolves, approaches and departs.[56]

This is more complicated and requires a notion of change, rather than permanence, as the basic idea or belief. Consider Copleston's interpretation of Heraclitus' 'fire.'

> However, if it be maintained that all things are fire, and are consequently in a constant state of flux, it is clear that some explanation must be offered of what appears at least to be the stable nature of things in the world.[57]

It is clear by Copleston's comment that he means to judge Heraclitus not on the merit of Heraclitus' philosophy of the world, but on his [Copleston's] own.

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[51] Sweet, *Heraclitus*, p. xii-i
[52] Jones, *Classical Mind*, p. 14
[53] Copleston, *History of Philosophy*, p. 41
[54] Jones, *Classical Mind*, p. 16
[55] Ibid.
[56] fragment #91. Notice that most authors like Jones and Copleston quote only the 'river' part of Heraclitus and not the full fragment and this do injustice to the meaning of the passage.
[57] Copleston, *History of Philosophy*, p. 41I

Consider Heraclitus' use of the words 'logos' and 'unity.' Unlike most ancient philosophers, Heraclitus was less inclined to treat the world as a simple place, than as a simple world that has unity and permanence. He considered the world as a **complexity of processes**. "It is only by understanding the nature of change that we are able to grasp the unity and rational order of the cosmos, or the 'logos.' Heraclitus suggests here a persistence of fundamental "regularities."[58] "The primary motive of Heraclitus' metaphysics is the determination of structural unity in a world of apparent diversity and change."[59] By 'logos' Heraclitus implied a "universal order of world as well as the mind's capacity to rationally discern this order – a capacity shared by everyone (fr. 113), but actualized only by those few individuals who posses wisdom."[60] Fire was a transitory idea representing process, the best imagery that Heraclitus could think of in a pre-scientific world. 'Fire' is an example of how we fail to account for the world when we assume that it is based on a "stable nature of things." Heraclitus writes that "fire, having come upon them, will distinguish (separate, pick out, choose, decide and/or judge) and seize all things."[61] "The death of fire is the birth of air, and the death of air is the birth of water."[62] Fire is the process by which things are changed. This is understandable, as fire will change many things, even stone to lava. This does not support the idea that Heraclitus replaced other substantial descriptions with merely another one called 'fire.' It is probable that our modern Western reading of Heraclitus leads us to understand him as making a distinction between one and the many where no distinction was truly intended

[58] Sweet, *Heraclitus*, p. 57
[59] Ibid.
[60] Ibid., p. 58
[61] fragment # 66
[62] fragment #76

by him. “Why not see being as merely an aspect of becoming, which, as Bergson long afterward said, is “reality itself”?”[63] Let us turn to Plato for a possible answer.

Plato (427-347 B.C.E.) offered the analogy of the divided line and the levels of forms. The doctrine of Parmenides[64] plainly plays an important role in his thinking. For Plato, the ‘intelligible’ and ‘knowable’ is achieved by intelligence ‘nous’ or ‘noesis’ or ‘logos,’ as compared to the visible and opinable which consists merely of beliefs and conjectures. The process to enlightenment Plato called the dialectic; a process of search for understanding that proceeds along the divided line leading the highest level, The Good. Copleston states: “To explain the world must at least mean to elucidate the unitary principle behind the seemingly absolute duality of matter and mind.”[65] According to Hartshorne, Plato seems to have adopted both substance metaphysics and dualism. Yet, the form of the Good “must operate through some kind of soul, some process of thinking or feeling”[66] and “the forms are essentially internal items in psychical process,”[67] suggesting that we might understand Plato by understanding his metaphysics in terms of a process. Plato’s matter is that “which is moved” but this involves a confusing dualism, since Plato included both matter and soul as things that can be moved, but with two meanings of moved. Matter can be physically moved as the soul is moved by “deliberation …joy, sorrow, confidence, fear, hatred, love and other primary movements which again receive the secondary movements of corporeal substances and

[63] Hartshorne, *Insight*, p. 15
[64] Copleston, *History of Philosophy*, p. 182
[65] Hartshorne, *Insight,* p. 23
[66] Ibid.
[67] Ibid.

guide all things."[68] He also says that the "self-mover" …"is the source of change and motion in all things."[69]

> But when the self-moved changes other, and that again other, and thus thousands upon tens of thousands of bodies are set in motion, must not the beginning of all this motion be the change of the self-moving principle?[70]

This sounds remarkably like a repetition of Heraclitus. Here Plato is very close to breaking out his dualism but, as Hartshorne states, "it's a near miss." The "frustration of purposes arises and was more than Plato could handle."[71] Hartshorne points out, "There are many souls, hence many purposes; no one purpose can fully determine events since every purpose is (partly) self-determining."[72]

It is with Aristotle that we get the most profound ancient analysis of this stuff of the world, that which Aristotle called "substance." In the *Categories*[73] and *Metaphysics*[74], Aristotle introduced a notion of substance, one that has rarely been challenged in the western tradition. For Aristotle the fundamental determinants of substance are of quantity, quality, relationship and place[75].

> Every uncombined term indicates substance or quantity or quality or relationship to something or place or time or posture or state or doing of something or the undergoing of something.[76]

This primary substance or Aristotelian-type substance is a compound of form and matter.[77] This gives a clue to Aristotle's "first three Categories – substance, quantity,

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[68] Ibid., p. 26
[69] Plato, *The Laws 10* (896, 897) source Kolak, Daneil, The Philosophy Source: Books on CD-ROM, , (Belmont, CA: Wadsworth-Thompson Learning, 2002) Sources from this CDROM we be referred to as Kolak CD.
[70] Ibid.
[71] Hartshorne, *Insight*, p. 38
[72] Ibid., p. 38-9
[73] Aristotle, *Categories*, *In Aristotle's Categories and Propositions (De Interpretatione)*, Translated with Commentaries and Glossary by Hippocrates G Apostle, (Grinnell, Iowa: The Peripatetic Press, 1980)
[74] Aristotle, *Metaphysics in* Kolak, Daneil, The Philosophy Source: Books on CD-ROM, , (Belmont, CA: Wadsworth-Thompson Learning, 2002) Sources from this CDROM we be referred to as Kolak CD.
[75] Aristotle, *Categories*
[76] Aristotle, in Norman Melchert, *The Great Conversation: A Historical Introduction to Philosophy*, fourth edition, (Boston: McGraw Hill, 2002) p. 161

quality, which are intrinsic determinations of an object."[78] Matter, states Aristotle, cannot alone be substance since a substance must be separable or of independent existence. "It [matter] owes what individuality it has to the substance it is the matter of."[79] In *Metaphysics*, Aristotle indicates that an entity is "conceptually primary if it is a definable unity, that is, if it is definable simply in terms of itself and without reference to entities that are prior to it."[80] Form also cannot alone be substance, for "what" would have the form or essence other than some matter.

Aristotle's conception of substance, and not Plato's, is the one that has pervaded the ages. Hargrove argues that "Aristotelian-style philosophy gradually over shadowed the earlier Platonism."[81] Hargrove[82] and Marie Louise Gill[83] suggest that Aristotle's metaphysics is meant as a solution of Parmenides' problem of change; the issue of the one and the many.

> On one level, change was characterized as the actualization of these potential properties. On another level, it was also characterized as a superficial movement and rearrangement of matter in space. By arguing that matter and form did not themselves change at either level, Aristotle succeeded in producing a credible explanation of change that did not violate Parmenides' arguments that absolute change was impossible.[84]

Gill's exploration of what she calls "the paradox of unity" in Aristotle suggests that a "fresh interpretation" of substance and the "relation between matter and form is

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[77] Marie Louise Gill, *Aristotle on Substance: The Paradox of Unity*, (Princeton, NJ: Princeton U. Press, 1989) p. 5
[78] Copleston, *History of Philosophy*, p. 279
[79] online source: http://faculty.washington.edu/smcohen/320/zeta17.htm
[80] Marie Louise Gill, *Aristotle on Substance: The Paradox of Unity*, (Princeton, NJ: Princeton U. Press, 1989) p. 4
[81] Hargrove, *Foundation*, p. 34
[82] Ibid., p. 21
[83] Gill, *Aristotle on Substance*, p. 7
[84] Hargrove, *Foundations*, p. 21

possible."[85] The unity of material substances, she states, thus "involves a dynamic relation between resistant materials and directive ends." Perhaps, even Aristotle realized that the idea of stuff was not clearly a demarcation of location or position of an object in space. There is possibly much more to the idea of substance. It is clear that Gill is suggesting that the paradox of unity is concerned with the question, "How do substances survive?" What is the attribute of survival which makes a thing a substance? This seems to suggest that the concept of substance is an attribute itself. Substance, even in the ancient Aristotelian sense, is an attribute of something else. Another possibility, may be that the question, "What is the stuff of the world?" is fundamentally flawed itself in some significant way.

What is particularly notable about most Ancient philosophers, except notably Heraclitus, is that they approached natural phenomena with the assumption that the world could be rationally understood with simple ideas. The world, on these grounds, could be deduced and knowledge of the world achieved from first principles: the world was simple, it was ordered and man could easily understand its workings.[86] From Thales' commitment to "the idea that objects encountered in the world were made out of some kind of substance or matter" we get the current assumption that matter or substance is the "element" of our world. [87]

Copleston and Jones' interpretation supports the mainstream idea that while objects may be in a state of flux, they appear and have a property of permanence, because their rate of change is constant. This is the idea of substance in terms of persistence of change. But the basis of this permanence might be incompatible with current thinking, for

[85] Gill, *Aristotle on Substance*
[86] Hargrove, *Foundations*, p. 22
[87] Hargrove, *Foundation*, p. 17

example relativity physics. Our perception of objects is dependent relative to the space-time location relative to the act of perception. Over a long period of time it is less likely that objects will seem unchanged, while over very short periods of time ordinary objects seem permanent. The same holds for space. If one were to view objects very closely, perhaps looking at the subatomic level, at the microscale or microcosmic perspective, one would be hard pressed to find permanence as subatomic particles are in continual vibratory motion. From a galactic point of view, from the macroscale or macrocosmic perspective, one would have difficulty trying to find change, at least from a human perspective. Beyond physics, Baird Callicott has suggested that that scale and duration hold great promise in bringing dynamism to Aldo Leopold's land ethic and thus is also important to environmental philosophy.[88]

## Medieval Period

The Medieval thinkers, mainly St. Thomas of Aquinas and St. Augustine, read and translated ancient philosophy from the context of the Christian faith and significantly influenced the modern world's view of Aristotle. "The primary task of philosophers in the middle and late Middle ages was the reintroduction and assimilation of Greek philosophy, specifically the writings of Plato and Aristotle, into a fully Christian context."[89] Hartshorne adds "The Thomastic doctrine of the soul as the only form in a human body is Aristotelian."[90] This embedded Aristotelian-type substance as something on which one can, so to speak, stick an attribute. Judeo-Christian belief placed substance

[88] 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*, edited by Richard L. Knight and Suzanne Riedel, (Oxford Press, 2002) Chapter 6.
[89] Hargrove, *Foundation*, p. 34
[90] Hartshorne, *Insight*, p. 81

in the context of a mystical world. If a paradox were revealed, religious mysticism could be applied as clarification, thus both essence and substance became confused concepts. Support for this interpretation of Medieval thought can be found in the text of Francis Suárez, a sixteenth century Jesuit. In *De Essentia Entis Finiti Ut Tale Est Et De Illuis Esse Eorumque Distinctione,* Suárez wrote that substances "continue to perdure [persist], though the actual things which embody them have ceased to exist." Thus the "Christian viewpoint" strongly delineated objects in terms of substance and essence. St. Thomas Aquinas reaffirmed Aristotle's viewpoint stating that substance is a composite of form and matter, with the stress on terms like soul for form, and body for matter.

> Note that what composes composite substances is material and its form (human, for example, contain body and soul), and neither of these by itself can be the thing's essence. This is clear enough for anything's material, because … a thing isn't know by its material … but by the way that material is actualized. But neither can form alone be a composite substance's essence, though some think so. ... Clearly the evidence involves both material and form.[91]

The word essence became more fundamental than the word substance in the late medieval period. Essence took on the meaning of "that which is substantial" or 'that which is of substance" but again, with mystical overtones. In Aquinas, substance and essence are differentiated in that substance seems to be meant as a grouping of essences, as sub-substance. Perhaps this is an indication that Aquinas and other medieval writers were becoming aware of the problem of getting down to the level of that Aristotelian stuff of the world.[92] Aquinas became concerned with the problem of God's essence in time and eternity: "How can God know … the condition of a being existing in time,"

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[91] St. Thomas Aquinas, in Norman Melchert, *The Great Conversation: A Historical Introduction to Philosophy*, fourth edtion, (Boston: McGraw Hill, 2002) p. 275

[92] Copleston, *History of Philosophy*, p. 166 Copleston's comment on Aquinas and the distinction between essence and the act of existence with the Scholastics suggests the increased attention that the Scholastics paid to the issues and problems of substance. Also see p. 284.

unless God is outside the order of eternity.[93] While medieval philosophy was no clearer about the relational structure of the world than the Greeks, medieval thinkers provided later others, such as Leibniz and Husserl, with clues.[94] For example, "Husserl's doctrine of intentionality is the medieval idea belatedly posing as the essence of knowing or of givenness." Consider the contemporary angst in trying to nail down that Aristotelian stuff given the present understanding in physics. At the beginning of the twentieth century we had atoms, but that progressed to sub-atomic parts, then quarks and now it appears likely that there is some other smaller essence to be found (coming soon at a cyclotron near you). Have we come much farther in identifying or understanding as compared to Aquinas's "the essence of substance?"

## Modern and Contemporary Attitudes

In the modern era, the three major schools of philosophy, rationalism, empiricism and Kantianism, saw incredible shifts in first principles of philosophy, but the primacy of substance remained essentially unchallenged. Rene Descartes serves as a good model for rationalism. As a rationalist, Descartes starts from first principles understood as certain and proceeded to construct knowledge of or about the world through reason alone. Descartes took his cue from Plato and Pythagoras, who were more "distrustful of sensation," than was Aristotle. What is this thing that Descartes doubts? It is some sort of substance for Descartes. How about the wax brought close to a flame? This wax has qualities that seem to be enduring: smell, colour, taste, shape, solidity. When heated and melted, these qualities seem to also melt away. "Certainly, it could be nothing of all that I was aware of by way of the senses, since all things that came by way of taste, sight touch

[93] Rescher, *Process Metaphysics*, p. 158, further evidence also see p. 190 note 5
[94] Hartshorne, *Insight*, p. 83-4

and hearing, are changed, and the wax none the less remains."[95] Perhaps Descartes description of the qualities of the wax is actually two instances of reality, separated as instances in time and space. Descartes moves the wax closer to the fire and as time passes the wax "changes." Wax before and wax after; a worm-tube[96] of wax realities through time confusing an uncertain mind.

> I observe also in me some other faculties such as that of change of position, the assumption of different figures and such like, which cannot be conceived, any more than can the preceding, apart from some substance to which they are attached, and consequently cannot exist without it; but it is very clear that these faculties, if it be true that they exist, must be attached to some corporeal or extended substance, and not to an intelligent substance, since in the clear and distinct conception of these there is some sort of extension found to be present, but no intellect at all. [not sure this is the best quote on D/C's two sorts of substance]

This seems to assume that the wax is one thing, one substance, the mind another type of substance. This is not a positive outcome and does not move significantly to answer the problems and paradoxes of the ancient philosophers. If anything, Descartes entrenches the problem into the disease of the mind-body dualism that permeates most philosophy after Descartes.[97] Descartes' system of doubting, while epistemologically intended, had a profound impact on the idea of substance and matter metaphysically. If we can doubt our own existence, we therefore can doubt the existence of matter or substance in general. This is a main principle of empiricist philosophers.

Empiricists rejected certainty as the basis of their philosophy and looked instead to direct experience. John Locke posited two sources for ideas, sensation (simple) and

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[95] Descartes, *Meditations*, p. 188

[96] Wormtube – think of a sphere propagated in space-time, for each second the sphere moves and occupies a new three dimensional location but over time you get a number of these creating a volume of spheres or a tube.

[97] Hargrove, *Foundation*, p. 34, par 3 Hargrove suggests the permeation. I suggest that this permeation is a disease.

reflection (complex).[98] Locke used his idea machine as a methodology in tracing complex ideas of sensation back to simple, atomic ideas that fill the empty mind.[99] For Aristotle and Aquinas, we use substance as something we know precisely. With Locke, certain distinct and clear ideas simply appear together and we can not understand them otherwise.

> that a certain number of these simple ideas go constantly together; which being presumed to belong to one thing, … we are apt afterward to talk of and consider as one simple idea, which indeed is a complication of many ideas together: because … not imagining how these simple ideas *can* subsist by themselves, we accustom ourselves to suppose some *substratum* wherein they do subsist, and from which they do result, which therefore we call substance. … we have no other idea of it at all, but only a supposition of we know not what *support* of such qualities which are capable of producing simple ideas is us.[100]

Thus, for Locke, understanding is based on epistemology, on how it works and what materials is works on. With experience as the source to all our ideas, substance is reduced the cause of these ideas: sort of a platonic unmoved mover or self-mover. The act of cognition is an **active** working on these **passive** materials of perception, an activity which creates the complex ideas, which for Locke include both mental and material substances[101], a manufactured finished product of higher cognition. This conception of an active mind was also held by Immanuel Kant, who drew on both the rationalists and the empiricists.

Kant specifically rejected the basis of epistemology of both rationalist and empiricists who were concerned with how objects in the world could be known by the mind. In other words, how can the objective (the substance) be known by the subject (the mind). Kant started by assuming instead that knowledge 'is possible' and then attempted

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[98] John Locke, in Norman Melchert, *The Great Conversation: A Historical Introduction to Philosophy*, fourth edition, (Bostion: McGraw Hill, 2002) p. 379

[99] Tabula Raza or blank slate of the mind, see Locke, *An Essay Concerning Human Understanding*, Book I – Neither Principles nor Ideas Are Innate, source Kolak CD.

[100] Locke, in *Great Conversation*, p. 379

[101] Just like Descartes move to two substances.

to show 'how' it is possible. Kantianism also generally held that something, a category, served as the basis for irreducible substance. Kant's response to Hume is to say, "if knowledge is possible" then it looks like this. The resulting idealism generated by Kant, seems to suggest that the external world exists but the certainty of knowing is transcendental to our knowledge. We can't quite know it.[102]

## Quine's Last Stand: Fallacy of Misplace Concreteness

It is apparent how the substance metaphysics has been held as a paradigm of thinking in the Western world time immortal. World views and paradigms change, but has there been any real paradigm shift in the conception of what is the stuff of the world? For most of us, I think not. Michael Slote's work on essentialism[103] is an example of the overly analytic tradition of this century based on Aristotelian type substance metaphysic that can lead to grandly erroneous conceptions of 'process.' For example, Slote argues that process is merely an extended property of an object: "In many or even most cases, an object can have properties essentially without having the property of existence essentially, without being a necessary existent."[104]

The misinterpretation of the object is all too common in what Rescher considers the "revolt against process."[105] In *Word and Object* (1960) ,[106] Willard Van Orman Quine elaborates "the standard position among recent writers on ontological subjects"[107] once again reaffirming an object-oriented viewpoint. Quine's last stand for this object-orientated viewpoint comes from a wonderful analysis of language. The words that give "evidence" to objects are words that help differentiate meaning in reality. "Any realistic

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[102] Hargrove suggests that "this lunacy was finally put effectively to rest at the end of the nineteenth century we G.E Moore" but it is possible that the idea is still alive and well. See Hargrove, *Foundation*, p. 37

[103] Michael A. Slote, *Metaphysics and Essence*, (New York: NY University Press, 1975) p. 3

[104] Slote, *Essence*, p. 1

[105] Nicholas Rescher, *Process Philosophy: A Survey of Basic Issues*, (Pittsburgh, University of Pittsburgh Press, 2000), p. 33

[106] Willard Van Orman Quine, *Word and Object*, (New York: Wiley, 1960)

[107] Rescher, *Process Philosophy*, p. 33

theory of evidence must be inseparable from the psychology of stimulus and response, applied to sentences."[108] This is a masterful study of the abstract complexities of language and object, but Quine's treatment of objects makes the classical error that Whitehead calls the "fallacy of misplaced concreteness."[109]

Consider the issue of identity using the sign "=". For Quine, "identity is intimately bound up with the dividing of reference."[110] Between things like two rocks, the reference of one object relationally to the other is the determination of the identity between them. Indeed, how can one measure the relationship of what is, in essence, one thing, in one location. The aspect identity of an object, the one and same object, either changed in time or space, can be extended by relaxing the difference between time and space. In terms of Einsteinium space-time, we already have the treatment of time as space and occasionally space as time. But notice that this already assumes that the object is one: The distance in space-time between 'locations' is based on the thinking that the object is the same. Perhaps, suggests Quine, this is only an informative treatment of identity in language and not completely adequate for our purposes. He invites us to recall Heraclitus' words "you cannot step into the same river twice, because of the flowing of the water."[111] First notice that Quine does not complete the quote, so let us complete it here (again) for fair consideration.

> 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 (combines, unites and continues) and dissolves, approaches and departs.[112]

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[108] Quine, *Word and Object*, p. 17
[109] Whitehead, Science, pp. 50-1
[110] Quine, *Word and Object*, p. 115
[111] Quine, *Word and Object, p. 116*
[112] fragment #91. Notice that most authors like Jones and Copleston quote only the 'river' part of Heraclitus and not the full fragment and this do injustice to the meaning of the passage.

Quine will first ignore the full meaning of the quote, i.e. that Heraclitus is not necessarily worried about the 'flow' of the river. Quine will instead concentrate on the identity of the river(s) as a separation of referenced things.

> This difficulty [confusion of identity] is resolved by looking to the principle of division of reference belonging to the general term 'river'. One's being counted as stepping into the same river both times is typical of precisely what distinguishes river both from river stages and from water divided in substance-conserving ways.[113]

Yet, it this is not the question a process philosopher like Heraclitus is considering. It is not the act of 'stepping into the river' that creates two references to the river. Nor, is it the action of perception or action that creates two references to a thing. What Quine believes is confusion between a sign, the name of the object, and object, the object itself, through references in space-time is actually Quine's own confusion of what language identifies as an object or thing, but what is in reality a set of changing references in space-time, i.e. a process. Calling it, this thing, a 'process-object' or 'process-thing' does little to resolve the issue. Thus Quine, and others who reject a process relational theory[114], explain as an issue of time. Action and activity result from "the idea of paraphrasing tensed sentences into terms of eternal relations of things to time"[115] Quine discounts change using "process-object" required via space-time, but then rejects action and activity as change because these are references of objects located in space but over time.

> Physical objects, conceived thus four-dimensionally in space-time, are not to be distinguished from events or, in the concrete sense of the term, process. Each comprise simply the content, however heterogeneous, of some portion of space-time, however disconnected and gerrymandered. What then distinguishes material

[113] Quine, *Word and Object, p. 116*
[114] Rescher, *Process Philosophy* p. 35
[115] Quine as quoted by Rescher, *Process Philosophy*, p. 35

> substances from other physical objects is a detail: if an object is a substance, there are relatively few atoms that lie partly in it (temporary) and party outside.[116]

This of course misses the point by a wide margin. Quine suggests that from Zeno's paradox follows the realization that infinitely many periods of time can just as well add up to a finite period of time. But this assumes some kind of atomistic 'period' of time, though infinite in number. What Zeno's paradox induces is a consideration of a unit length of time infinitely portioned into smaller and smaller periods or randomly sized periods. This set of infinite partitions still sums to one unit length of time (or space ). It fails to show the equivalence of space to time in that time flows. As Rescher points out, language references for identity of object substances are a poor approach.[117]

> Once we put the temporal extent of the river on a par with the spatial extent, we see no more difficulty in stepping into the same river at two times than at two places. Furthermore the river's change of substance, at a given place from time to time, comes to be seen as quite on par with the river's difference in substance at a given time from one count than on the other.[118]

Could it not be possible that the river changes both in space and time? Each atom of the river is changing in space-time and even the atom itself would be a hard item to hold down unchanging in even a short period of time. "There is an error; but it is merely the accidental error of mistaking the abstract for the concrete"[119] This is called the **fallacy of misplaced concreteness**. The idea of simple location of an object in space time is confused by Quine. The object of river as something that is unchanging is a very abstract consideration. It is, in Whitehead's words, among other "entities left corresponding to

[116] Quine, *Word and Object*, p. 171
[117] Rescher, *Process Philosophy*, p. 38
[118] Quine, *Word and Object*, p. 171
[119] Whitehead, *Science*, p. 51

the entities we talk about, yet these entities are of a high degree of abstraction."[120] To call the river a substance and to 'afford the quality' of the abstraction to locations in space-time is treating river as a concrete object when it stands as a far abstraction of consideration. In Quine, as in others[121], the fallacy is made more evident when one is asked to make the 'sophisticated recognition' that 'water' and 'red' are "stuff of the world."[122] There is a sufficient designation in language to separate the concrete from a higher abstraction which even Descartes accepted. Quine misplaces concreteness of an abstract idea and calls it an object. In language we might call it an object, but to this we mean an abstraction and not a thing concrete or substantive. An abstraction cannot be a substance and thus the theory of process-objects is not acceptable.

Quine's slighting of process is only the forerunner of many writers on ontological subjects.[123] Ordinary language philosophers Nelson Goodman and P.F. Strawson, according to Rescher, both endorse a paradigm of 'object' that includes the assumptions that 'thing' is the only appropriate paradigm for discussion and that "even persons and agents … are secondary and ontologically posterior to proper … things."[124] 'Change' and 'time' are then "downgraded in ontological consideration to the point where their unimportance is so blatant that such subordination hardly warrants explicit defense." In *Individuals: An Essay in Descriptive Metaphysics*[125], Strawson particularly rejects what he calls 'revisionary' metaphysics. He rejects the idea that the world is more than the 'thing' we see and touch daily, that most contemporary descriptions are overly complex,

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[120] Ibid., p. 52
[121] See Rescher, *Process Philosophy*
[122] Quine, *Word and Object*, p. 121
[123] Rescher, *Process Philosophy*, p. 33
[124]Ibid., p 34
[125] P.F. Strawson, *Individuals: An Essay in Descriptive Metaphysics*, (London, Routledge Kegan & Paul, 1979)

for what seems to him, to be rather simple. Everyday language matches the every day world or as Rescher puts it, Strawson's fundamental thesis is "identifiably-dependence constitutes the appropriate criterion for ontological priority."[126] Thus we have two errors: one is that the concept of 'substance' is far too simple to give an adequate metaphysic, the other is that it leads to an overly complex ontology to support itself.

The criterion for determining ontological priority, according to these ordinary language philosophers, is based on language practices, ignoring all other alternative priorities. This reduces ontological questions to the simple methodology of asking, "What is the linguistic identification of this thing?" As Rescher points out, description-dependence and explanation-dependence are only two of many other alternatives. More importantly, it is possible that "processes are ontologically prior to physical things, since the existence of (given) material objects can be fully accounted for only in terms of the processes that lead to their realization."[127] "Even *identification* is itself a (cognitive) process, and we generally identify existing things by means of *instructions* as to what one is to do to establish contact with the item at issue."[128]

What is common among these ordinary language philosophers, Quine and others is the need to belief that ontological identity itself results in a simple identification. Strawson asks "whether there is reason to suppose that identification of particulars belonging to some categories is in fact dependent on identification of particulars belongings to others, and whether there is any category of particulars which is basic in this respect?"[129] This supposition itself breaks down the properties of the 'thing' being

[126]Rescher, *Process Philosophy*, p. 38
[127] Ibid., p. 40
[128] Ibid.
[129] Strawson, p. 40-1

identified as belonging strictly to a category or not. This point assumes this is possible, i.e. that a categorical is atomically complete. I mean to say, that the 'thing' being identified can be separated from all other 'things,", in space or time, in that has property A that results in its association in category 1. That 'things' might never be separable in relationship to other 'things' is exactly the point that process philosophers want to embrace. So, one alternative to the identity question posed by Strawson must be that one cannot determine ontological priority beyond priorities within relationships, that ontological priority can result in an increase of complexity of description rather than a simplification.

We have seen how the idea of substance in metaphysics has developed from ancient to contemporary times. Next I will consider some paradoxes that result from our Western dependence on Aristotelian-type substance and consider the further difficulty of scale and object.

CHAPTER

# DESCARTES, NEWTON AND CHAITIN

When is a thing not a thing? ... Always!

Zeno's paradox may well have a solution, that substance cannot be ideal or be simply located,

When is a thing not a thing? The background to this discussion must start with Rene Descartes but will end in tragedy for the substance metaphysician with Gregory Chaitin. The underlying issue is certainty. From whence can we have any certainty? Plato would claim that certainty must come only in limitation to humans but we can work down the path to be illuminated by the knowledge of the form of things. We need to reflect on Newton's discovery of the Calculus and Laplace's claim about certainty of physics, a mathematical challenge from Hilbert resulting in Godel and Turing's mostly unwelcome revelations and the recent demonstration by Chaitin.

We have asked the question, "What is a thing?" Is substance a representation of the atomic things, things indivisible that have attributes? Is substance just something I am aware of? What is this thing of which I am aware? Qualities? Sensations? John Locke claimed that we "have no experiential contact with substances as such: we experience only their (putative) effects."[130] In a sense, it seems that we are identifying information about some thing. When I say I am aware of substance, then, I am saying that I am aware of information. I do not mean a mystical je ne sais quois. This is not some illusion. Hume identified sensation, but I want to suggest a fundamental awareness of knowledge in a much stronger sense. You may doubt this information, but would you think that the

[130] Rescher, *Process Metaphysics*, p. 53

information came from within “yourself” your mind, or is this information from the world, from the senses, your ears and eyes, of your body? Either way, your self has been changed and is constantly changed by new information.

In fact, in a Cartesian sense, what is this “thing” you doubt? You doubt information about whether one exists or not, you doubt that this chair or this room exists. This is mere information about what “you’ think is the case. Do you doubt that something doubts? No, this is where Descartes would say, at the very least, something or someone doubts. But this doubt itself has changed the manner of the doubter. As suggested by relativity physics, there is no purely objective observer. Now you have information about the existence of something that certainly doubts. It is information that changed the I. This means that information seems to serve as a basis for knowledge rather than substance and the paradox is extended; is the horse leading the cart or the cart leading the horse? By positing substance as a concreteness and information as an attribute or abstraction of substance, we have become trapped in the Cartesian dualism.

Let us explore still further. I can have some certainty about information. First, I can know that I am either aware of the information or not. I can also determination the proximity of this information via a method or set of standards of verification and testing of the information. At the very least the quality of the information can be stated probabilistically. If one said that they had probable knowledge of the existence of substance, this is still about the information of awareness. None of this can be applied to the concept of substance since substance is atomic. “Johanna Seibt has argued that the

idea of a substantial object as standardly conceived in the philosophical literature is logically incoherent."[131]

Nicholas Rescher[132] has very recently suggested that future development in philosophy necessarily entails a shift in our metaphysical paradigm. To resolve the paradoxes of substance it is necessary to reverse the concrete-abstract relationship between substance and information; To think of metaphysics from the point of view of the process of information, where substance, if anything, is one of many attributes of "things." Consider a substance before us, say a rock. That this thing is a particular atomic presence is only an abstraction. Is this any different from the abstraction of a Euclidean point or perfect triangle? These are useful abstractions but they do not imply anything substantive. Is the point more substantial, as Plato might have it? Clearly not, since the point is not appropriately located in space-time. Is the point less substancial? If it was, it would not be a substance itself, but some quality of substance. If anything, these "objects" are less real than the duration of experience.

Notice that I am closely matching Whitehead's atomism. Rescher defends C.S.Pierce's "synechism" as an appropriate approach to Whitehead's atomism, but, I think this is mistaken.[133] "A true continuum is something whose possibilities of determination no multitude of individuals can exhaust."[134] This is yet another example of substance language, suggesting that "a true continuum" is an "object." We know that an infinite determination of abstract individuals (recall Zeno's paradox) can and does determine an exact continuum, but one of duration.

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[131] Rescher, *Process Metaphysics*, p. 64-5
[132] Rescher, *Process Metaphysics*
[133] Rescher, *Process Metaphysics*, p. 55-6
[134] Rescher, *Process Metaphysics*, p. 64-5, Note that Rescher is quoting C.S. Pierce here.

## Newton and Laplace's Assumption

Conceptions derived from culture and habit can easily mislead us. Galileo Galilei's (1564-1642) reliance on the doctrine of Parmenides' ideal motion delayed his understanding of gravitational acceleration for many years. Indeed, his theory of motion of bodies in *De Motu*, around 1590, was mistaken because Gallileo left out time from his equation.[135] He corrected this only after three more years of work.[136] Not much later Issac Newton's contributions were to shine brilliantly.

> Nature and nature's law lay hid in sight:
> God said, "Let Newton be",
> and all was light. (Alexander Pope)

Yet, I am left with some uneasiness given the possibility of misconceptions such as Pearse's earlier ideas about sea star behavior. The science of Newton is based on the conception of irreducible ideal particles or ideal bodies with a particle center of mass; matter in motion. Physics grounded in Aristotelian-type substance. The physical understanding of the contemporary world is still based on Newtonian physics itself mired in the doctrine of Parmenides. The world is understood as matter in motion.[137] We think of physics primarily as motions of entities in the mesocosm, at the scale of every day life. But, life takes place for stars and star fish outside of the mesocosmic world.

The permanence of an object and the fact that an object changes over time is paradox of substance metaphysics. Zeno criticized Heraclitus' idea of flux because of the difficulty of thinking of a thing being both one and many. In the passing of time, how can we understand that something is enduring, perhaps the human soul, if we say that that

[135] http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Galileo.html
[136] Galileo only published the results 35 years later and never published De Motu.
[137] Peter Farleigh, "Whitehead's Even More Dangerous Idea," *Australasian Association for Process Thought*, Discussion Paper

something is always changing? For the soul to endure, it must be something that does not change. Substances are things that have certain attributes and do not change. To accept this is to accept the dualism of Descartes and all the problems that follow from it.

Strangely enough, Newton is one of the major perpetrators of erroneous thinking concerning substance in physics. Late in the 17th century he had two major contributions to make. One would be the introduction og the Calculus of infinitesimals and the other would be completing the work on motion of bodies that Galileo had failed to finish in *De Motu*. But in 1672, Newton needed to solve a problem of the infinitesimal, or of microcosm (the points) and macrocosm (infinite partition), in order to complete the development of his Calculus.

> In a letter of to Mr. J. Collins…having described a method of tangents [tangential approximation by finite sums of areas under a curve] … I added these words: This in one particular, or rather a Corollary, of a general method, which extends itself, without any troublesome calculation, not only to the drawing of tangents to any curves lines…but also to the resolving of other abstruse kinds of problems .. limited to the equations which are free from surd quantities. The method I have interwoven with that other of working in equations by reducing them to infinite series.[138]

Newton[139], had developed a method using infinite sums to represent the exact area over a finite interval. It is not an accident that Newton referred to this as "the method of fluxions." The method is a process that is only slightly more complicated than the one would use to add a sum on an interval, as in the solution of Zeno's paradox.[140] This step, from an infinite set of discrete or separate, individual partitions, to a continuity or unity of a single finite distance is a very difficult intellectual step indeed. Infinite sum is a ordinary but still misunderstood mathematical concept. It had been the curse of Zeno

[138] Newton from his Principia, in Boyer and Merzach, History of Mathematics, p. 444-5
[139] Gottlieb Leibniz would independently discover the Calculus a few years later, but published before Newton.
[140] See Chapter 5, section titles "Zeno's Paradox Answered"

since around 466 B.C.E. and Newton's treatment of infinite sums in 1666 AD had finally got a small hold on the concept.[141] Even Newton, though, did not fully grasp infinity. It would have to fall on the shoulders of George Cantor for precise understanding of infinity and the properties of real numbers. "No one before 1872 had been able to tell precisely what he was talking about."[142] Any calculus student will confirm that the shift from infinite discreteness to finite continuity is not easy. It is the quintessential step in the history of mathematics that describes and solves a mesocosmic problem in language that is both microcosmic and macrocosmic.

So, in 1672 Newton was rapidly developing a method and applying it to problems of greater and greater complexity. But he had already developed a theory of bodies in motion and had the three laws of motion by 1666, before he completed the Calculus. Unfortunately, Newton decided not to re-write his physics in the language of the Calculus, but instead left it in the more commonly understood finite algebra. Why would the brilliant Newton do such a thing? Emilio Sergè suggests that it is the fault of Newton's aberrant personality traits of under confidence and hatred of confrontation.[143] Sergè quotes the expert Newton scholar Lord Keynes (around 1936-40), "In vulgar modern terms Newton was profoundly neurotic of a not unfamiliar type, but - I should say from the records - a most extreme example."[144] Newton's was neurotic about any type of confrontation. When his first paper, on optics, was published in 1672, "it was assailed by some members of the [Royal] Society, including [Robert] Hooke"[145] (1635-

[141] Boyer and Merzach, *History of Mathematics*, pp. 437-63
[142] Ibid., *p. 631*
[143]Emilio Sergè, *From Falling Bodies To Radio Waves: Classical Physicists and Their Discoveries*, (New York: W.H. Freeman and Company, 1984) pp. 48-9
[144] Ibid., p. 49
[145] Ibid., p. 57

1702). Newton's response was telling: "I intend to be no farther solicitous about matters of Philosophy: and therefore I hope you will not take it ill if you find me never doing anything more in that kind."[146] When Edmund Halley (1656-1742) came to realize that Newton not only had considered the well known but unanswered problem concerning the "trajectory of a body attracted to a fixed point," but that Newton had worked out a solution and a proof, he began a quest to convince Newton that he should publish this and other works in physics.[147] In 18 months the result was *Philosophiae naturalis principia mathematica*, Newton's greatest work. Newton had already written much of the text but did not want to publish for fear of dissention and confrontation. Why not use the calculus?

> The book is written in the style of Greek geometry, using geometrical proofs throughout. There is little doubt that many of the results have been obtained otherwise, using analytical methods either known to Newton's contemporaries or invented [The Calculus] by him. … He told a friend that "to avoid being bated by little smatters in mathematics {he} designedly made {his} principle abstruse [i.e. algebraic not infinitesimal]; but yet so as to be understood by able mathematicians.[148]

The great work published was a simplification from Calculus to Algebra. While the first account of the Calculus is indeed found in Book I of the *Principia*, this is only a marginal consideration of the limit concept.[149] The physics in Book II and Book III is entirely of geometric and algebraic definition, demonstration and proof. [150] An understandable point of view, since as Newton likely wanted as many people as possible to understand his physics, and this would be difficult if calculus were used. More

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[146] Ibid.
[147] Ibid.
[148] Ibid.
[149] It is apparently in Newton's notes related to *Principia* that we get the full extension of Newton's conception of The Calculus, which is, to say the least, substantially greater that what appeared in *Principia*.
[150] Boyer and Merzach, *History of Mathematics,* p. 443-4 and Sergè, *Falling Bodies*, p. 61-5

importantly, he wanted to avoid at all costs any confrontation that might have resulted from use of the still to be tested and still sketchy mathematics of the infinitesimal.[151] (There was even a companion work written by Francesco Algarotti (1712-1764), *Newtonianism for Ladies*, "which became extremely popular."[152])

The result is that most scientists, and ultimately the world, learned physics from an idealism related to an understanding of discrete 'things,' a view sympathetic to the doctrine of Parmenides, instead of a physics relating to the flux of infinitesimals, a view more sympathetic to changes or processes. If our understanding, or misunderstanding, of star fish is any indication, a purely discrete or numerical singular or atomist description of physics may be gravely mistaken about the ultimate nature of reality. Newton himself saw that his physics would be limited and uncertain in a language of flux, as Einstein and physicists after Einstein demonstrated. Most would not be up to the task of learning both a new physics and a new mathematics. The connection between the calculus and physics was tenuous at best and the calculus still was imperfect. Newton stressed that his substance was matter with the attribute of ideal existence, perhaps understood by the concept of inertia. By underscoring and using this idea of substance in his physics, Newton unwittingly sent his successors into a metaphysical dead end. The ideal simple location that Newton assumed is not possible; as Einstein demonstrated, position is relativistic. Quantum mechanics goes much farther. There is a difficulty in even demonstrating the position or velocity of a substance and some major question as to what

[151] Ibid.
[152] Sergè, Fa*lling Bodies*, p. 67 I can just imagine the oversimplification of a theory already simplified from The Calculus to the Algebra.

exactly is the ultimate stuff. Thus we had atoms, then sub-atomic particles such as neutrons, protons and electrons, then smaller parts to these such as quarks and leptons.

> So, what then is the true nature of the atom? It certainly isn't a solid little piece of matter like the tiniest bit of something that you can get hold of. So, where do we loose the concept of solid matter at what point does it disappear?
>
> When you reach out and touch something that you can see you perceive the presence of what are supposedly millions of tiny atoms. But if we dissect any substance down to the smallest particle we can see or feel it is true that we are still nowhere near experiencing a single atom. Ordinary optical microscopes still leave us dealing with millions of these tiny particles and it is somewhere near this point that the solidity of the material universe begins to disappear.[153]

Contemporary physics is far beyond understanding stuff in terms of substance. In addition, the tradition of science had and still holds the idea that primary qualities are objective[154]. Einstein's point about relativity, in addition to results from Quantum Mechanics, suggests that there might be problems with a strictly ideal or objective idea of measurement. The subject determining the substance is having an effect on that substance by merely considering it. Hargrove[155] suggests that most scientists have maintained a belief that science is purely objective. This may result in a problem with the compatibility of facts and value in nature and must certainly have an impact on environmental philosophy. In addition, I am suggesting that our attitude about our world in terms of substance is incompatible with both fact and value. This realization suggests that, as philosophers, we should (1) recognize that substance is not ideal or simply located and (2) reconsider substance as a basic component of our metaphysics. We should therefore begin to consider a metaphysics that is not dependent directly on substance as a starting point: we need to wean ourselves from the attitude that substance is a primary

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[153] Cichowski, Roland, "The Atom" in *Presence*, anonymous source found at http://users.senet.com.au /~presence/SitePages/SecretsOnWheel/CelestialWheel/StructureAtHub/atomgate/theatom.html
[154] Hargrove, *Foundations*, p. 41
[155] Ibid.

concept of metaphysics. But the worst metaphysical problem has yet to be acknowledged: randomness.

## Incompleteness, Uncomputability and Randomness in the Logic of Arithmetic

Information theorist Gregory Chaitin has very recently made the claim that randomness is a characteristic of arithmetic.[156] In this section I will outline this claim and show that if the claim is correct, it suggests that process information metaphysics can offer some solutions to contemporary problems.

In Paris, 1900, David Hilbert, addressing the International Congress of Mathematicians, outlined 23 problems that remained to be adequately addressed by mathematicians.[157] He threw down the gauntlet to the congress and urged them to fix mathematics truly and finally.

> I should say first of all, this: that it shall be possible to establish the correctness of the solution by means of a finite number of steps based upon a finite number of hypothesis which are implied in the statement of the problem and which must always be exactly formulated. This requirement of logical deduction by mean of a finite number of process is simply the requirement of rigor in reasoning. David Hilbert, 1900

Within the text of the second problem, "The Compatibility of the Arithmetical Axioms", Hilbert stated the common faith of mathematicians and scientists at the beginning of the twentieth century; A faith that has not, to a large extent, diminished in the one hundred years since his address.

> I am convinced that it must be possible to find a direct proof for the compatibility of the arithmetical axioms, by means of a careful study and suitable modification of the known methods of reasoning in the theory of irrational numbers.[158]

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[156] Gregory Chaitin, "The Decline and Fall of Reductionism in Pure Mathematics", in *The Limits of Mathematics*, (Singapore: Springer-Verlag, 1998)

[157] David Hilbert, "Mathematical Problems", lecture delivered before the International Congress of Mathematicians at Paris in 1900, translated by Mary Winton Newson for Bulletin of the American Mathematical Society 8 (1902) 437-479, p. 439 I am quoting from a text version of the paper and page numbering will vary slightly.

[158] Ibid., p. 443

According to Hilbert, a systematic search for meaningful statements in mathematics, or "well formed formulae and their proofs," is a pursuit that is both possible and realistic. "The first step in the construction of an absolute proof [of mathematical statements], as Hilbert conceived the matter, is the *complete formalization* of a deduction system."[159] Recall that in a study of any formal axiomatic system, arithmetic for example, one is first concerned with logical consistency and the completeness of the axiomatic system. Consistent means that a well formed formula and its negation both cannot be proved from the system's axioms. Thus, no contradictory statements within the formal system are possible, i.e. one cannot generate the falsity or $F_o$. Why is this important? The existence of $F_o$ would mean that any statement, any well formed formula, could be proven; For any well formed formula P, $F_o \rightarrow P$ is always true.[160]

Completeness is also an important logical device. Completeness means that any well formed formula in the logic can either be proved or disproved. A proved formula we shall call a theorem. In the logic of arithmetic, the logic that Hilbert was most interested in, this means any arithmetic theorem can be proved or disproved based on the axioms of arithmetic using the formal rules of inference of the system. Consequently, Hilbert's problem can be stated simply as a search for all possible well formed formulae and checking them to see if they are provable. The properties of completeness and consistency are verified along the way.

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[159] Ernest Nagel and James R. Newman, *Gödel's Proof*, revised edition, (New York: New York University Press:, 2001), p. 25

[160] $F_o \rightarrow P$, is really $F \rightarrow (T \vee F) \equiv T$ , i.e. true for P or not P.

As Chaitin notes in his paper *Randomness in Arithmetic and the Decline and Fall of Reductionism in Pure Mathematics,* David Hilbert Was Not a Twit.[161] Hilbert's search can be stated as a **simple** algorithm that can be processed by a computer program. This algorithmic program would first generate all possible proofs of well formed formulae. By running through the algorithm that generates all possible proofs based on the axiom set and check for the occurrence of A and not A, one is checking for consistency. Since the program automatically evolved formulae that have proofs, completeness should not be an issue. Either A or not A is a provable generated well formed formula. In the early 1900s, this approach would have been practically unworkable as the problem is rather large, especially when Hilbert had the whole of mathematics in mind.[162]

The goal of Hilbert's problem progressed instead with Russell and Whitehead's effort to show that mathematics is reducible to logic, the positivist program.[163] Russell and Whitehead started with the axioms of arithmetic and generate, through proof, all of mathematical theory. Using a particular set of axioms of arithmetic that seemed promising, commonly labeled as Peano's axioms of arithmetic, Russell and Whitehead proceeded to construct set theory and number theory. The result was *Principia Mathematica*[164], a monumental three volume tome spanning thousands of pages of small print. Never in doubt was the assumption that such a system would necessarily be consistent and that one would, in due course, prove everything known in mathematics

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[161] Chaitin, *Limits of Math*

[162] Henri Poincaré was famous for attempting calculations at this scale and for his diagrams and calculations of chaos, although the meanings of his results only became apparent in the 1970s. Note that Poincaré also provided much of the mathematic basis for *General Relativity*.

[163] The school of thought that assumes that one could reduce all of mathematics to logic is referred to, as positivism, logical positivism or logicism. See Marc Corbeil, Mathematics and Logic, (Montréal: Concordia University Library Archives, 1997) Available online at www.mcorbeil.com.

[164] Bertrand Russell and Alfred North Whitehead, *Principia Mathematica*, (Cambridge: Cambridge University Press, 1989) Develops mathematical theory from base axioms. A forth volume on geometry was planned but never completed.

and more. It was a smug, stiff and arrogant self-assurance set fully in the tradition of Laplace's assumption. It was also dead wrong!

Thirty-one years after Hilbert's speech in Paris, Russell and Whitehead are found desperately working on the fourth volume of Principia Mathematica. Kurt Gödel's *On Formally Undecidable Propositions of Principia Mathematica and Related Systems*[165] appeared out of the school of logical positivism at the University of Vienna, refuting the possibility that a consistent axiomatic system is can also be complete. Hilbert's conviction was wrong, no program can be consistent and complete. Russell and Whitehead never completed the fourth volume and parted company soon after.

Incompleteness is only part of the problem - it gets much worse. Recall the approach suggested by Hilbert's challenge in terms of the analogy of the algorithmic program as stated by Chaitin. Alan Turing in 1934 stated this exact problem to address some bothersome problems in number theory. Turing asked the question, "Can we truly show that arithmetic is both consistent and complete?" But he asked in the question in the formulation of Hilbert's 1900 problem, an algorithmic search for **information** about the well formed formulae. The requirement of consistency and completeness is approachable by what Hilbert called the Entscheidungproblem or the decision problem.

> Solving the decision problem for a formal axiomatic system is giving an algorithm that enables you to decide whether any given meaningful assertion is a theorem or not. A solution to the problem is called a decision procedure. [166]

Hilbert's program would **require** a result in the decision problem, information. In other words, if you put the algorithm to the test and you ran through all the well formed formulae, a decision on a statement's provability necessarily results. You learn if the well

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[165] Kurt Gödel, *Uber formal unentscheidbare Sätze der Principia Mathematica und verdwandter Systeme [On Formally Undecidable Propositions of Principia Mathematica and Related Systems – 1931],* translated by B. Meltzer, (Dover Publications: 1992)
[166] Chaitin, *Decline and Fall*, pp. 3-4

formed formula is a theorem. In other words, you gain information about the well formed formula. Gödel assumed that the system was consistent, but incomplete. With this decision algorithm, we can assume a consistent system that is incomplete, but still attempt to use the decision algorithm to check for theorems. Even after Gödel there was some hope to that methods and work of Russell and Whitehead would have limited success. In principle this could work but, as we saw before, it does not seem very practical.

Not surprisingly, in 1936, Alan Turing showed that "there could be no decision procedure."[167] Turing proved a decision procedure for a theorem cannot be the case for all theorems[168]. Inexorably, some theorems are undecidable. This is a stronger result than Gödel's. Not only is such a system incomplete, but Hilbert's whole scheme must fail.[169]

The question hangs on the idea of computability. A computable algorithm is one for which there is a method to calculate or compute the algorithm to a result, to the point where information results. The assumption for computability is that the algorithms **halts** or completes itself and the algorithmic program ends. Consider a computer program that will list all possible algorithms, i.e. a program that will list all possible well formed formulae.[170] If the program halts the problem is computable, or, alternatively, the process is said to be denumerable or countable. Using a Cantor diagonal argument, one can check if the problem is always denumerable, i.e. the well formed formulas can always be

[167] Ibid., p. 6
[168] Alan M. Turing, "*On Computable Numbers with an Application to the Entscheidungsproblem*," Proc. London Math. Soc., Vol. 42, pp. 230-265, 1936
[169] Chaitin, *Decline and Fall*, p. 7
[170] The machine that does this is called a Turning Machine and s the inspiration that lead to the first real computer in 1943, called Colossus, and then the modern computer.

counted.[171] The question is "Does the program work?" What happens if the program fails to print a line or fails to compute a result? What if the program fails to stop or halt?

Turning proved that there is no algorithm, no mechanical procedure, which will decide if the nth computer program ever outputs an nth result.[172] There is no guarantee the program will halt. Anyone who has experience programming recognizes this is an infinite looping problem, like trying to get an algorithm to divide by zero. The program gets caught up within the algorithm and can't escape the loop. Such a programming situation is said to be uncomputable.

Chaitin argues that the algorithm to find and check all well formed formulae in the logic of arithmetic will fail to halt. The system of arithmetic is therefore uncomputable. In addition, by using a coded set of instructions of set theory in the programming language LISP, a low level or machine-language program similar to assembler, Chaitin claims that his result leads to randomness in number theory[173], the basic theory of addition and subtraction of numbers. Chaitin shows that his halting probability is an uncomputable real between zero and one and one cannot reduce or compress the information contained in such an expression. The information is irreducible. In addition, if you were to examine a particular digit within this information you would find that the probability of the digit being particularly a 1 or 2 or 3 … or 9,

[171] Although possibility infinite. By countable here we mean that a one-to-one correspondence with the set of natural numbers is possible. The set of rational numbers, all the natural numbers and fractions, anything that is writable as p/q, where p, q are both integers and g not zero: this set is countable by Cantor's argument. (Cantors' Diagonalization Theorem). The real number set is the union of the set of rational numbers with the set of irrational numbers like Pi, square root of 2, non-repeating, non-terminating decimal representations. The real numbers fail the Diagonalization Theorem and are not countable. Thus, there are at **least two** types of numerical infinity: countable and uncountable. Finite sets, by the way, are countable by definition.

[172] Chaitin describes this in terms of as a numerical process and translates the algorithmic issue as a numerical process. The output is the nth digit.

[173] This is worse than randomness in arithmetic.

would be 10%. But this is the same probability of any of these digits chosen randomly![174] If you flipped a coin to decide a particular digit you would do as well as trying to compute the digit using a algorithmic program.[175] This means that the digit is purely random. Thus randomness can be found in elementary number theory. But this is not all Chaitin has to suggest.

> Consciousness does not seem to be material, and information is certainly immaterial, so perhaps consciousness, and even the soul, is sculpted in information, not matter. … The conventional view is that matter is primary, and that information, if it exists, emerges from matter. But what if information is primary, and matter is the secondary phenomenon![176]

Chaitin is suggesting that information should be primary rather than substance and this information will have some kind of randomness property related to it.

Let us recap. Hilbert suggested a problem, that all theorems in arithmetic are provable using an axiomatic system that is consistent and complete. Gödel proved the system could be consistent but could not be complete. Turning proved Hibert's original algorithmic search program could be represented, but is uncomputable, and therefore also incomplete. Follow this with Chaitin's demonstration that the halting program can be expressed as a well known as Borel real number which is characteristically random. This means that Hilbert's search program results in some kind randomness in number theory. Randomness is a feature of reality and randomness is a feature found in the structure of mathematics. And, the person who demonstrates all of this thinks information is so important so he suggests this is the basis for understanding reality.

What conclusion can we now reach about Newton's implications, paradoxes of substance and Chaitin's discovery-demonstration of randomness? Zeno's paradox has a

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[174] Chaitin, *Fall and Decline*, p. 14-5
[175] Chaitin, *Fall and Decline*, p. 16
[176] Gregory Chaitin, *Unknowable (Springer Series in Discrete Mathematics and Theoretical Computer Science)*, (Singapore: Springer-Verlag, 1999), p. 106

solution, substance cannot be ideal or simply located, and metaphysics has to consider the broadest issues of infinity and randomness. Consider evolution. For evolution to even be possible, randomness must be a feature of nature's structure, not a feature of mathematical theory of numbers, not a feature of the search for a halting program but a feature of information. Chaitin admitted that he could not **increase** randomness in a numerical string. This is a problem that can be used to challenge the theory of substance metaphysics.

If a method could be found that would allow an increase in randomness in an information string relating to the natural world, in the D.N.A. molecule for example, then the process-information theory can explain a very complex problem of physical reality that substance theory cannot. In the following sections we will see that just this demonstrated is possible.

# CHAPTER 4

## PROCESS-INFORMATION METAPHYSICS

> "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 human will win, because the Drac is an expert on standing outside 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."[177]

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 for stepping outside the game of substance metaphysic is process philosophy, an attitude focused on change and interconnectedness in the universe. In this chapter I will develop a process-information philosophy similar to those of Whitehead and Bergson but differing in suggesting that information is what process operates on primarily. This will lead to the concluding criticism of process philosophy, involving the gap from discrete to continuous.

Remember that 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 can things 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 see what there is obvious there to see.

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

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 even require an observer? As a solution, Bishop Berkeley, not unlike Descartes, offered the argument that that God was the ultimate observer and the objection was resolved thus:

> 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." [178]

I don't think this is good enough. To observe a 'thing,' I direct my conscious focus on some 'thing.' In Whitehead's terminology, I *apprehend* this "thing.' This relationship of process among entities is, as Chaitin[179] and Wolfram[180]suggest, about information of 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. I look specifically at you 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

[178] "God in the Quad- a précis of Berkeley", Attributed to Ronald Knox
[179] Chaitin, *Unknowable*
[180] Wolfram, *Science*

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.[181]

No entity can exist without prehensive qualities of other entities. And, 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 focus on a single one.

Our existence and our reality do not allow us a complete or absolute objectivism, as Heraclitus hinted. In 1905, Albert Einstein rejected the idea of absolute location and replaced it with location relative to an observer.[182] 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, measure the nature of the universe precisely.[183] The best that quantum physics can provide, even instantaneously, is a subjective observation over a duration of experience. "Even after more than fifty years they [these results of the uncertainty principle] have not been fully appreciated by many philosophers."

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[181] Callicott, "Flux of Nature," p. 96
[182] Hawking, Stephen, *A Brief History of Time: From The Big Bang to Black Holes*, (New York: Bantam Books, 1988), pp. 23-5
[183] Ibid., p. 55

Essence or substance must be a characteristic that is relative to the scale of consideration, it is relativistic even beyond the Einsteinium sense. Rather than an absolute substance, we might abstract a relative substance in relation to duration in space-time. Is the object considered in the microcosm, the mesocosm or the macrocosm, each bearing properties related to space-time?

As Callicott suggests the dynamism of stability and integrity of an ecosystem largely depend on assumptions of scale.[184] But let us extend this further. When we take a snapshot of apprehension of some 'thing,' perhaps, as argued by Chaitin[185], 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. 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 advocates nine p-branes or dimensions. Super-gravity theory, another type of physics, advocates 7-11 dimensions, and the Sierpinski Gasket, a fractal object, has a dimension that can be

[184] Callicott, *Spatial Scales* and Callicott, "Flux of Nature."
[185] Chaitin, *Unknowable, pp. 106-7*

calculated to approximately 1.58![186] Truly, God only knows the brand of dice with which Stephen Hawking plays when he says space-time is either 10 or 26 dimensional.[187]

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 this 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.[188]

This is the idea of information process as the primary characteristic in perception. [189]

> 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 individualism of the substrate activity. … An entity of which we become aware in sense perception is the terminus of our act of perception. [190]

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" is information. Prehesion, 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**

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[186] Robert L.Devany, *An Introduction to Chaotic Dynamical Systems*, Second Edition, (Redwood, CA: Adison-Wesly, 1989)
[187] Hawking, *History of Time*, see chapter 10 particularly.
[188] Henri Bergson, *Matter and Memory*, (New York: Zone Books, 1991), p. 186
[189] Rescher, *Process Metaphysics*, p. 45
[190] Whitehead, *Science*, p .70

**process**. Cognition over duration of time is an iterative process of discrete information events.[191] 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 smallest or atomic, in the ancient sense, as Leucipuss and Demoncritus' first conceived a theory of atomism in the sense that 'thing' can be "an indestructible and internally changeless particle, "so small as to escape sensation."[192]

Looking out at the world, I locate some 'thing.' "There it is, I have it in my grasp." As I am saying this, a little phrase, usually conspicuously missing from translations of fragment #91 of Heraclitus, comes again to my mind:

… 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[193]

Can I truly have the same item in my grasp that I had only a minute, 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."[194]

> It supposes that the individual entity is "in a single moment of time and merely inwardly point 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…"[195]

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[191] Bergson and duration of time.
[192] J. Baird Callicott, "Traditional American Indian and Western European Attitudes Toward Nature: An Overview, " in *Foundations of Environmental Philosophy: A Text with Readings,* edited by Frederick A. Kaufman, (New York: McGraw-Hill, 2003)
[193] fragment #91, partial
[194] Paul Weiss, Reality, (Princeton, 1938), p. 208
[195] Weiss as quoted in Reck, "Substance," p. 766

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"[196], thus, an Einsteinium space-time. But just saying space-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 love 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 fallacious. 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, when we leave the gravitational field, or leave the regular scale (mesoscale) of the world, we also need to leave behind both Newton's laws and ancient ideas of substance. Metaphysics is a consideration general enough to force such an abandonment for a 'more descriptive' approach.

Additional information other than location is also possible. Our analysis of things, our apprehension, is a directed perception, a prehension of this information. Often this information lacks parts of location, such as a timeless triangle, or the view of the edge of a square where one sees only a line. Characteristics such as colour again are bits of information. Aristotelian-type substance is information about matter and form. Substance, as either Aristotle or Descartes might exposit, 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.

[196]Whitehead, *Science*, p. 49

Whitehead, the heavy weight of the process philosophers, clearly opposed "substance-attribute metaphysics" and a "subject-predicate logic."[197] "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."[198]

I must point out that process philosophy does not suggest process as a replacement of substance in metaphysics. To do so would be too casual an error. Such a metaphysic would open to any all the paradoxes of substance by substitution of a single word. [199] It would be circular to remove the "substance thing" and "replacing 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."[200] This Cartesian image of "things" must be completely rejected. But how do we avoid "throwing our the machine along with the ghost?"[201] This is accomplished by going from substance-thinking to event-thinking.

## Fallacy of Misplaced Concreteness

A primary criticism of process philosophy, event-thinking, concerns the paradox of unity, as suggested by Gill[202], 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, continuant, and independent individuals … must undo the possibility of process, since our awareness of process as

[197] D. Bidney, "The Problem of Substance in Spinoza and Whitehead," *The Philosophical Review*, Volume 45, Issue 6 (Nov., 1936), 574-592, p. 583, par 4
[198] Bidney, *Problem*, p. 583, par 4
[199] Mario Bunge as quoted in Rescher, *Process Metaphysics*, p. 33, par 2
[200] Peter Farleigh, "Whitehead's Even More Dangerous Idea," *Australasian Association for Process Thought*, Discussion Paper, p. 1
[201] Ibid.
[202] See Chapter 2, Gill and "Paradox of Unity,"

well as its reality would be thereby impugned."[203] 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.[204] 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."[205] 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 saw this, 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."[206] 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 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

[203] Andrew J. Reck, "Substance, Process and Nature," *The Journal of Philosophy*, Volume 55, Issue 18 (Aug. 28, 1958) 762-772, p. 767
[204] Alfred North Whitehead, *Process and Reality*, corrected edition, (New York: The Free Press, 1978), p. 29
[205] Ibid., p. 29
[206] David Hume, *A Treatise of Human Nature*, edited by L.A Selby-Bigge (Oxford, 1955) Book I, Part IV, Sec. 3, p. 219

> 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.[207]

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. [208]

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 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.[209] 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.

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[207] Whitehead, *Science and The Modern World,* (New York: Free Press, 1925) , p. 50-1
[208] Whitehead, *Process,* p. 25
[209] Ibid., p. 77

Consider Holmes Roston'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 D.N.A.

> 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 …"[210]

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. Is this pain I feel in me or outside of me? Where's the connection? The connection is that 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 that we need to consider in process. Cogito datum ergo data sum. Consider the following comment from Bradie:

> Russell and Whitehead's relationship, I have often thought misunderstood. Russell, early in his career, avowed that a logic that demanded that all propositions be of subject-predicate form were the result on an inadequate logic.[211]

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[210] Homes Rolston III, *Environmental Ethics: Duties to and Values in The Natural World*, (Philadelphia: Temple University Press, 1988), p. 137
[211] Bradie, "Russell," p. 441

Ushenko adds the claim that it Whitehead who convinced Russell "to abandon Newtonian absolute time and space, and also particles of matter, substituting systems of events" in 1914.[212]

Russell looked to space-time perception and recognized that substance seemed "unperceivable."[213] Bradie also suggested that "the events in this latter space [of substances] are also assumed to by Russell to be spatio-temporally connected"[214] 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."[215] 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."[216] "What Russell seems to be saying here is that as perceivers we are constantly being bombarded by casual influences [prehesions] or causal chains of events. 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."[217] As Bradie points out, this is one of Russell's most ambiguous positions that he attempts to defend in later life. Indeed, Russell may have completely adopted Whiteheads process viewpoint later in life (1954-1960!).[218]

> 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. … 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,

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[212] A.P. Ushenko, "Einstein's Influence on Philosophy," in *Albert Einstein: Philosopher-Scientist,* Ed. Schilpp (PA: Open Court, 1949)
[213] [213] Michael P. Bradie, "The Development of Russell's' Structural Postulates," *Philosophy of Science*, 44 (1977), 441-63, p. 444
[214] Ibid.
[215] Ibid.
[216] Ibid., 446
[217] Ibid., pp. 445-6
[218] Ibid., p. 441

> 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.[219]

It is clear that the Master Blaster of metaphysics, Bertrand Russell, had conceded the metaphysical battle to his "lesser contributor" Alfred North Whitehead, himself a former positivist. All philosophers should respect the conversion of the two most notable analytic Aristotle-style substance metaphysicians, Whitehead and Russell, great men of positivism and the authors of Principia Mathematica, to metaphysics with grounded on a primacy on process and relationships[220].

## Discreteness versus Continuity

One of the most important issues that process philosophers recognize is 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 difficulty. In terms of process philosophy, per se, the linear non-linear issue can be reduced to the discrete to continuity gap. 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."[221] 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 special extensions are reflexively definable because they are quantities, continuous and divisible."[222] Definable because they are divisible; A little circular in terms of metaphysics, I think. Magnitude,

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[219]Ibid., p. 442
[220] I must add the caveat that Russell's conversion was neither one hundred percent explicit nor complete, but it was certainly substantial enough to cause comment.
[221] Reck, *Substance*, p. 768
[222] Albert William Levi, "Substance, Process, Being," *The Journal of Philosophy*, volume 55, Issue 18 (Aug. 28, 1958) pp. 749-61, p. 752

> movement, and time are all continuous because of the succession of "now" which defines the cutting edge of time is assimilated to Euclidean imagery of points which defines the infinite divisibility of space. If one "now" cannot be next to another, it is for the same reason that one point cannot be next to another.[223]

This comment is nonsense. First, to base metaphysics on Euclidean imager is to deny the physical world after Heraclitus. Second, if one point cannot be next to another, what exactly is between two points? At what scale can one say that two points are truly separated, even in the Euclidean sense. Levi lacks the imagination of the infinite and infinitesimal. Process reality offers a description of entities in process and relations in a flowing world. Heraclitus' world of flux: the old tricks are the best ones! Western tradition, as remarked above, requires that we start with a single substantive objects or substances. If entities 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. [224]

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?

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[223]Ibid., p. 752

[224] Henri Bergson, *Matter and Memory*, Translated by N.M. Paul and W.S. Palmer (New York: Zone Books, 1991), p. 186

# CHAPTER 5

# DISCRETE VERSUS CONTINUOUS

## Zeno's Paradox

The previous chapter outlined process philosophy but terminated with the criticism of the linear/non-linear or discrete-continuity gap. I will offer two approaches to a solution. The semi-traditional solution comes from setting Zeno's paradox to rest. The contemporary solution is to make a further extension of process-information theory such that we can solve the dilemma and offer a proper solution to the evolution-entropy paradox. Further, I will demonstrate a metaphysic that is consistent with science and a foundation for environmental philosophy that will put "the environment back into philosophy"[225]

Recall that with Zeno's paradoxes, an apparently infinite set of discrete entities was assumed. The proposition is that an infinite sum of an infinite number of partitions of measurable distances in infinite. But, the sum in question, $\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\frac{1}{32}\cdots$ is an example of a convergent sum; i.e. a finite sum equal to one; the unit distance between you and the student. The sum represents a distance that matches our expectation at normal world scale or (mesoscale)[226]. It is almost certain that Newton intuitively knew this. Galileo's student Bonaventura Cavalieri also was very likely to have known this in

[225] Hargrove, *Foundations*, p. 3
[226] CF. p. 15 and p. 50 where distinction between scales is given.

1635 when he published the *Geometria indivisibulus continuorum*.[227] It was George Cantor who first stated infinite indivisibles with precision in 1872. But this precision is at the price of learning advanced mathematics. For many people infinity and infinite sums are still tricky concepts to understand.[228]

How can non-mathematicians come to grips with infinitesimal sums? An analogy might be a car running smoothly at speed. The engine motion created by the finite number of cylinders going up and down in a piston engine is discrete but the motion transmitted to the wheels is continuous. The more pistons, or partitions, the smoother the engine will run. Even scientists in the modern period understood this, for they designed many engines of great complexity requiring theories of the discrete and the continuous . In fact, the early attempts at engines used continuity thinking. These early engines, called Wankel Rotary engines, proved complex and unreliable. Contemporary improvements in technology, especially metallurgy, resulted in engines of similar design that are some of the best engines today. The jet engines is essentially of rotary design.

Consider Reck's second criticism.[229] If we accept that Zeno's paradox has this type of solution, then we 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 philosophy it that is starts from the relationships and interrelationships as actual and at worst treats "the one" as the illusion.

[227] Boyer, *History of Mathematics*, p. 367 Cavalieri calculated the infinite sum rule that Newton would later write as the integral rule for polynomial functions to integer powers.
[228] Ibid., p. 631
[229] Also Bidney's main criticism.

Reck, Bidney and Rescher[230] seem unaware of contemporary resolutions to Zeno's paradox and have problems with the infinitesimal. Even Rescher, a staunch process philosopher, states that "Zeno's classical paradoxes demonstrated the incapacity of stable concepts to characterize the fluidities of an ever-changing reality."[231] 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."[232] Bidney's criticism of is even more specific than Reck's in term of Zeno's paradox:

> 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 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. [233]

It is this call to the infinite that Zeno identified as the problem, but for the point of view of process metaphysics, this is favorable. Once again, the fallacy of misplaced concreteness; the abstraction of a duration into touchable singular or atomic "oneness," is false. Bergson had it right[234], 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 place? 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

[230] See Rescher, "Process Metaphysics," p. 15
[231] Rescher, "Process Metaphysics," p. 15
[232] Ibid., p. 40
[233] D. Bidney, "The Problem of Substance in Spinoza and Whitehead," *The Philosophical Review,* Volume 45, Issue 6 (Nov., 1936(, 574-592, p. 578
[234] Bergson had it right; it is our philosophic tradition that blinds us.

> extended body, there can only be, at a given moment a single system of movements and sensations.[235]

Can an extension of process really get us from the discrete to the continuous? Is there another approach? The central limit theorem is another method to bridging this gap. In addition, applying this concept to a Levy flight will make a connection to chaos theory. Given that we now have a possible resolution to Zeno's paradox, the question will become, "Can we resolve the evolution-entropy paradox?""

## Levy Flights

Steve Wolfram, in *A New Kind of Science*[236], illustrates how such an extension is possible through the process of random discreetness of very large sets of discrete entities. Consider a discrete set of information and use the analogy that information represents behavior. Consider what the outcome of arranging the information would be. Discrete elements usually result in complex arrangements of discrete behavior. But, in nature we seem to encounter continuous information. 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.[237]

The following solution explains the sometimes fuzzy intuition of Whitehead, Bergson, and, yes, Heraclitus. It might also keep us from the mystic or overly phenomenological complications found throughout the tradition of process philosophy.[238]

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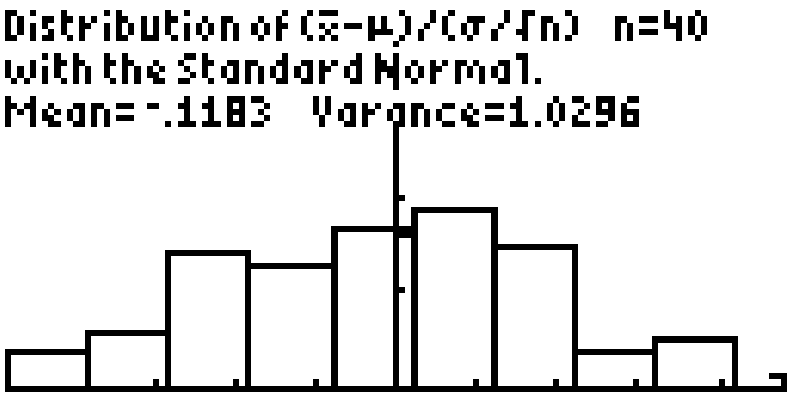
[235] Bergson, *Matter and Memory*, pp. 137-8
[236] Steven Wolfram, *A New Kind Of Science*, (Champlain, IL: Wolfram Media Inc, 2002)
[237] Ibid., p. 547
[238] Some process philosophers have similarly followed a theological extension, called process theology. Whether this is a problem or not I will leave for another paper.

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."[239] Rescher also recognizes that large populations, 'large n,' contribute to a truer understanding of the whole.[240] This does not mean that discontinuity is fundamental, since the central limit theorem allows one to jump from discrete to continuous.

A tidy and definite example of this kind of behavior is 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.

[239] Ibid., p. 327
[240] Rescher, "Process Metaphysics," p. 22

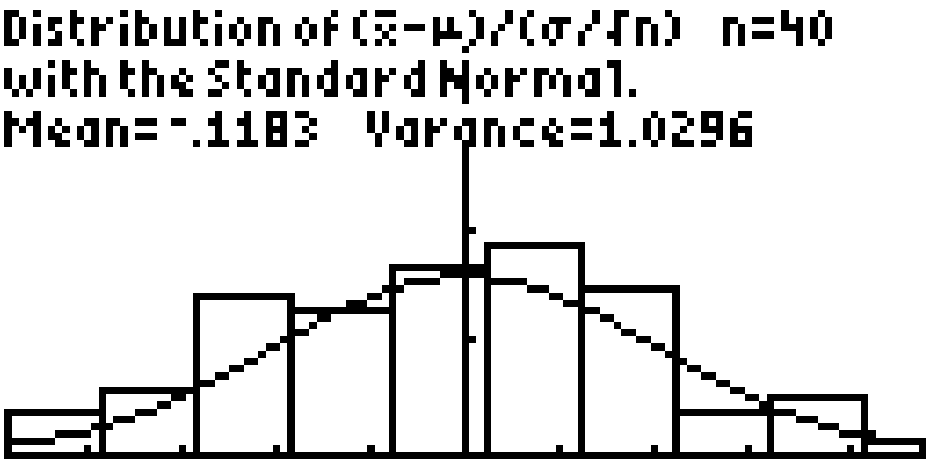



[241]

"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?"[242] If the number of particles and the number of iterations of the operator is very large numerically [but in terms of biological systems this might still be quite small], 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 the diffusions starts to 'look' like a continuous distribution. But how does 'look smooth' become 'is smooth?'

Mathematically, the assumption is that any physical quantity has a Gaussian, or continuous, distribution of probabilities. The justification for this assumption is the central limit theorem: for large n a discrete distribution converges to a normal or continuous distribution. Consider the diagram bellow:

[241] These images produced by the author using a TI-86 calculator and TI graph link software.
[242] Wolfram, *New Science*, p. 327




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 with 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. This argument is similar to the transformation going from discrete to continuous in the calculus of Newton-Leibniz, what is called the Riemman 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. Another example was the convergence of an infinitesimal sum in Zeno's paradox.

## Evolution versus Entropy

Consider, as an example of process thinking, a major issue in evolutionary theory exemplified by the following passage.

> 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.[243]

How do things in the world in general become self-organizing toward complexity, i.e. "Why is there life at all?" If we are to understand that life and nature have increased in complexity over the eons, 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? Substance metaphysics is simply going to fail to explain a reversal of entropy.

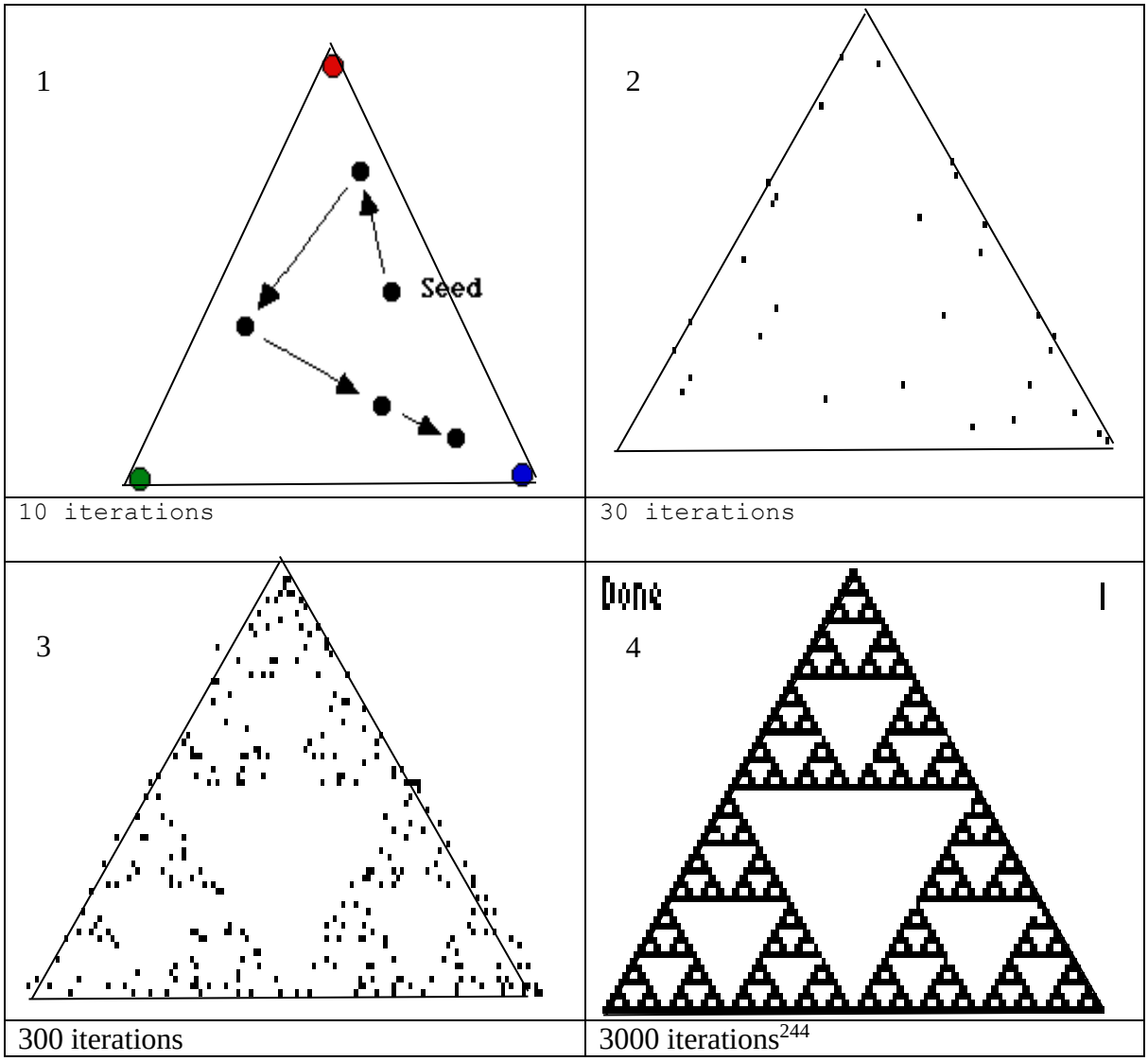
The processes of life via a study of the information contained in life forms. Iterated information, or the information contained in extant life forms, seem to have characteristics of self-similarity and sensitivity of initial conditions. We know that ecological systems have these qualities, and we know that this sort of information certainly can take discrete probabilistic iterations and quickly generate these patterns. This behavior is surprisingly easy to demonstrate.

## 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 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 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

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

that matches this second roll. This is the second iteration. Continue the game for a very long time, for a great number of iterations.




[244] These images 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 will relatively very large pixelations. If one had an infinite dept 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 pixelation. In other words, by definition, any accuracy wanted can be achieved in the image. Discreteness is only a illusion of limited pixelation 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.

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 on the D.N.A. of life, and if some randomness is mixed with a numerically large iterative process, chance survival and millions of species and billions of living things, then pattern as a product of this process is understandable. Evolution is possible and relativity simple to demonstrate if process-information is the basic concept of metaphysics. This demonstration plainly demonstrates the value of information-process metaphysics over substance metaphysics, at least for explaining evolution.

Yet, most biological or ecological questions are like evolution. Environmental philosophy will be related to problems of complicated environmental systems that will fail to yield to descriptions based on linear or discrete explanations only. Looking at 'things' alone and not primarily at relationships will surely mean that we will fail to understand and, thus, we will fail in environmental philosophy.

# CHAPER 6
# WHY PROCESS? ENVIRONMENTAL PHILOSOPHY

> No important change in ethics was ever accomplished without an internal change in our intellectual emphasis, loyalties, affections, and convictions. The proof that conservation has not yet touched these foundations of conduct lies in the fact that philosophy and religion have not yet heard of it. [245]

## Paradigms of Ecology and Environmental Philosophy

Ecology is not an old science; the term 'oecology' first appeared in 1886 in a paper by the German disciple of Darwin, Ernst Haeckel.[246] The origin of ecology coincided with the height of the Newtonian paradigm, itself governed by a substance metaphysics. It is not surprising that ecology started with a general focus on objects in the management of the environment. But it quickly developed into a study of relationships of processes, even though a part of ecology has kept to a substance orientated ideal. This has resulted in a duality in ecological thinking: ecological science based on dynamic processes and justification of ethics of the environment dependent on issues of 'balance,' 'stability,' and 'integrity' – all concepts from a traditional substance metaphysics. Process-information philosophy may allow a bridge of this gap and provide justification for values in and of the environment, bringing the environment back into philosophy.

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[245] Aldo Leopold, "The Land Ethic," in *A Sand County Almanac: With Essays on Conservation From Round River*, (New York: Balantine, 1966), p.246

[246] David Worster, *Nature's Economy: A History of Ecological Ideas*, Second Edition, (New York: Cambridge University, 1997), p. 192a

Notice the duality in the structure of ecology. On the one hand there is a metaphysics that wants to handle objects or 'things' in the environment, sere, climax or ecosystem. On the other hand, there is an understanding nature as a study of relationships or dynamic processes. Adding to the confusion, environmentalists and environmental philosophers are distanced from the hard scientific attitudes of ecology and have been sheltered from metaphysical issues. Justifications based on philosophy based on substance metaphysics are incompatible with process-relational ecology and environmental issues. In this chapter I will extend process-information philosophy to bridge the gap between the environment and metaphysics, bringing the environment back into philosophy. In addition, support for dynamism of Leopold's vision will be gathered. But let us first start with the start of the science of ecology.

In *Nature's Economy: A History of Ecological Ideas* (1983) [247] David Worster considers the three major paradigms that he believes ecology has followed from the 18th through early 19th century transitions: Arcadian, empirical and Darwinian.[248] The Arcadian or naturalist paradigm of ecology, represented by Worster using the words of Henry David Thoreau (19th century), is one where "the world was no mere system of mechanical order but a flux of energy capable of welding all things into an animated kosmos".[249] Thus, the first paradigm started as a rejection of the mechanical model of Descartes and Newton. The empirical traditional stepped back towards mechanical models and developed an ecology of individuals and this progressed into an ecology of community and/or organism, concepts more in tune with substance metaphysics. As far as Darwinism is concerned, can there be any doubt that Darwinian evolution is a process

[247] Worster, *Nature's Economy*
[248] Ibid., p. xii
[249] Ibid., p. 81

based theory? Be that as it may be, the processes considered by Darwinism were developed to deal with individuals rather than on relationships. Early evolutionary theory attended to the question of what created the sole entity and how it fit within the scheme of other separate entities rather than with inter-relational issues. Eventually this resulted in blurring the demarcation of atomic individuals, but only in the last few decades.

Clearly ecology made an early turn towards process relational thinking, but the change was gradual. In the early 1900s Frederic Clement brought out an idea of succession,[250] "a processional change," in 1927 we have Charles Elton's energy flows,[251] in 1970 Likens et al's nutrient budgets[252] and finally White and Picket's disturbance regimes (1985), where patch dynamics model natural processes.[253] These are far apart in the history of the science of ecology but they share an increasing reliance on the notion of process. The concept of ecosystem, organism and other dominant theories in ecology are also related to process relational thinking. Ecological theories may change, paradigms have shifted, but each successive paradigm seems to have been further along towards a process-relational position. Ecologists today most often think of the environment in terms of a "shifting mosaic"[254], a "non-equilibrium paradigm [that] emphasizes process"[255], or simply as a dynamic process. "We define the parts and explanatory principles of

[250] Frederic E. Clements, "Nature and Structure of the Climax", *The Journal of Ecology*, 24:252-84 in *Foundations of Ecology: Classic Papers with Commentaries*, edited by L.A. Real and J.H. Brown, (Chicago: University of Chicago Press, 1991) pp. 59-97
[251] Charles Elton, *Animal Ecology*, (Great Britain, Methuen and Co., 1927)
[252] Gene E. Likens, F. Herbert Borman, Noye M. Johnson, D.W. Fisher, and Robert S. Pierce, "Effects of Forest Cutting and Herbicide Treatment on Nutrient Budgets in the Hubbard Brook Watershed-Ecosystem," 1970, Ecological Monographs 40: 23-47, in *Foundations of Ecology: Classic Papers with Commentaries*, edited by L.A. Real and J.H. Brown, (Chicago: University of Chicago Press, 1991) pp. 880-904
[253] P.S. White and S.T.A. Pickett, *The Ecology of Natural Disturbance and Patch Dynamics*, (San Diego: Academic Press, 1985), pp. 5-6
[254] Ibid., pp. 65-89
[255] Ibid.

ecosystem as pathways of processes and fluxes between organisms and their environment".[256]

Unfortunately, it seems that the early and present management of the environment is focused on objects, following the Western tradition. This has not changed with the new attitudes of ecologists. For example, when one talks of Clementian succession or Eltonian food pyramids, one converses about objects. Particularly problematic for ecology, is the "distance" that ecology has from "harder" sciences like mathematics and physics. Physics envy gleamed in the theories, and eyes, of ecologists, and corresponded to the over-mathematization of ecology and the adaptation a dualistic view: process with substances.

Aldo Leopold (1887-1948) is the acknowledged patron saint of environmental philosophy, so let us consider his assessment of what serves as good for the environment. In a *Sand County Almanac* he writes that

> A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.[257]

Further, Leopold tenders this evaluation as a supplemental ethic to be amended to human ethics: meaning that environmental philosophy does not replace human ethics but is simply a supplement to human ethics. "The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land."[258] Thus, we might consider the human ethic and the "land ethic" related as one circle within the other.

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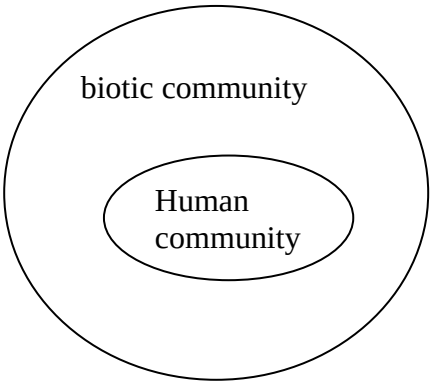
[256] T.F. Allen and T.W. Hoekstra, "The Ecosystem Criterion" in *Toward a Unified Ecology*, (New York: Columbia University Press,1993), p. 90 [emphasis mine]
[257] Leopold, "Land Ethic," p. 262
[258] Ibid., p. 239




If we are to extend human ethics to the land, it requires recognition of both the inter-relationship between human and the biota, along with an idea of scale. Natural, thus, can be defined in terms of occurrences in normal scale of space-time. Forest and species tend, for example, to endure in time scales of years. Hunting a species to extinction in the same period is unnatural, then, since is happens at to fast a pace compare to the normal space-time scale. In fact, this is what often makes human activity unnatural. Evolutionary changes, however, are usually slow and local. Man's invention of tools has enabled him to make changes of unprecedented violence, rapidity, and scope.[259]
Not that it is completed or enacted by humans, but because humans have a tendency to progress at a rapid rate in either space or time. Extinction of a species can be natural if it occurs within a relatively normal scale of space-time. Rapid and multiple extinctions occurring in one season are obviously not natural because this would not normally occur in one season.

But, if ecology is process-relational and not about things at all, then what ever can be meant by an environmental philosophy that holds that human action "is right when it

[259] Ibid., p. 254

tends to preserve the integrity, stability, and beauty of the biotic community?"[260] We have been lead to understand that integrity, stability and beauty are words that seem to apply to 'things' in the biotic community. The fall back position for justification of an environmental philosophy is what is being supplemented, and this is an ethics built out of the Western tradition, i.e. substance metaphysics.

We have an understanding of the environment that is in conflict with this tradition, an understanding of dynamic processes, hence the claim of dualism. It is the worse kind of dualism, since it justifies an environmental philosophy using a metaphysics that is contradictory to our understanding. It is no wonder that Michael E. Soulé states that environmentalism (conservation biology) is a "crisis discipline." [261] Early ecologists like Aldo Leopold were also the early environmental philosophers. It can be seen that a separation or conflict existed between their management science practices and their philosophical beliefs. Leopold, for instance, makes it clear in "Thinking like a Mountain" that a personal transition had to take place to get him to 'see' the environment from a different time scale, in this case that of a mountain.[262]

The "crisis" and the scope of the "impact," I think, is the result of a major mismatch[263] between environmental philosophy and the underlying dualistic metaphysics required to have ethics and understanding; the wrong type of metaphysics form the foundations of environmental philosophy. In ecology, for example, there is not one forest heading towards a Clementian climax, but a series of forests in time set in regimes of

[260] Ibid., p. 262
[261] Michael E. Soulé, "What is Conservation Biology: A new synthetic discipline addresses the dynamics and problems of perturbed species, communities, and ecosystems," *Bioscience*, vol. 35, No. 11, December 1985, pp. 727-34
[262] Aldo Leopold, "Thinking like a Mountain," *A Sand County Almanac: With Essays on Conservation From Round River*, (New York: Balantine, 1966), pp. 137-41
[263] Soulé, "Conservation Biology," pp. 727-34

disturbance. As suggested by White and Pickett[264], each forest itself is not really a single organismic entity, but a highly dynamic set of individual trees.[265] Can we develop an alternative basis for a metaphysics that is compatible with ecology and contemporary science?

The ontological question is, "How can we conserve a biota that is dynamic, ever changing, when the very words "conserve" and "preserve" … connote arresting change?"[266] What is the "thing" that an environmentalist wants to protect and preserve? The transition of thought going from 'thing' to substance automatically places an ontological givens of human scale of both time and space: to assume a mesoscale viewpoint is simply to commit the fallacy of division. To say a 'thing' is a substance is to assume an understanding in one single space-time scale only. A relationship to itself, but over different scales leads to different ontological priorities and identities.

A table is a 'thing' that seems solid in the mesoscale, but in the microscale it is a multitude of 'things' with parts that are fuzzy. What holds for the table in one scale does not hold for 'table' in another scale. The division of the whole into parts leads to a failure of understanding and ontology if we take substance metaphysics as a starting point. Perhaps the relationship of 'things' can be expanded through scale of space-time. The effect of a poor foundation can make the difference.

The Star Fish as a wolf pack hunter

I want you to image a sea-scape of star fish meandering on the bottom living their slow and solitary lives along the edge of a living reef. Track one along the sea floor for

[264] White and Pickett, *Patch Dynamics*
[265] Individual trees, but not treated as entities or things as they are separated from the system and have recognizable subparts.
[266] J. Baird Callicott, "Flux of Nature," p. 100

hours, or days and is seems that the star fish just manages to achieve a life of almost passive subsistence at best. We would hardly think of a group of star fish as a menace. A scientist could study the species for years and be convinced that they lack any resemblance to a wolf pack. Of course this perception is false.

> Biologist John Pearse has been studying echinoderms along the rugged coast of northern California for forty years. He long believed echinoderms were capable of basic behavior, but he didn't thin they were capable of complex social interactions. They don't posses seemingly necessary hardware, like a brain. But after seeing underwater photographer Don Wobber's time-lapse films of sea stars [also called "star fish"], Pearse changed his mind. Wobber's footage showed sea stars wrestling with one another to dominate their food supplies on the ocean floor. These animals were certainly leading active lives.[267]

The film of interacting star fish is an incredible vision of what Wobber describes as "wolf pack behavior." The star fish ability to communicate, locate prey and hunt them down is obvious once you shift yourself to their time frame.[268] Considering these creatures are so long living that they not seem to die naturally, it should not have surprised us that they live in a different time scale. I use this example to demonstrate the weakness and fallibility of conclusions about our reality made at a certain limited level of perception; the perception of every day sized and timed objects in the mesocosm.[269] This is similar to what Callicott has identified as the importance of temporal spatial scale in determination of what constitutes an ecosystem. In addition, the process approach coupled with Leopold's "Land Ethics" seems to have the right idea, perhaps, as Callicott has suggested, resulting in necessary dynamism of Leopold's "Land Ethic."[270]

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[267] John Pearse and Don Wobber, "Ultimate Animal - Digesting Mussels in the Shell: Documenting Echinoderm Behavior," in *The Shape of Life*, , (Monterry, CA: Sea Studio Foundation for National Geographic Television and Film Sea Studio, 2002) Series aired on PBS April 2, 2202.
[268] Obvious if you film time lapse at around 24 hrs for 24 minutes, or 1 hr to 1 minute.
[269] Pete A.Y. Gunter, personal conversation and resembles spatial scales of Callicott
[270] Callicott, *Flux in nature*, pp. 99-103

"Taking our clue from Holling (1992), we might measure appropriate temporal mesoscales for norms of ecological restoration."[271] Pearse, a lifetime expert, was dead wrong about the basic behavior of starsfish because he applied a simplified mesocosmic viewpoint to their study, i.e. he chose an inappropriate time scale. We see simple benign behavior, but the wolf pack is in full hunt.

## Value, Process and Scale

Pete Gunter points out that "the philosophy which best fits the conceptual needs and the long-term telos of environmentalism is process-relational."[272] We have seen how process is important to ecological understanding, as well as the importance of scale. Turn now to the concept of value.

Value can either be intrinsic, value found within what is of value, or instrumental value, value given or granted to that which is valued. Either approach is viable for process thought. Beauty as a pleasant experience to us and other creatures that share the beauty is intrinsic since that which is valued, is valued simply for what it is,[273] as compared to the instrumental value of a forest for wood production. Some organisms can feel, are sentient, and have value in the sense that we can recognize that, other things being equal, we ought not cause them pain and harm.[274] Value in this case in intrinsic to these organisms. Yet, the recognition of the interconnectedness or prehensive quality of process thought requires us to think that what is valued by us humans, instrumental value, is value found in what is prehended or what is value intrinsically, is also valued by us

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[271] J. Baird Callicott, *Choosing appropriate temporal and spatial scales for ecological restoration*, J. Biosci, Vol. 27, No. 4, Suppl. 2, July 2002, pp. 409-420, p. 414

[272] Pete A. Y. Gunter, "Process-Relational Philosophy and Environmentalism A Case of Pre-established Harmony", Open Discussion Paper from the 2001 Conference of *Concrescence: The Australian Journal of Process Thought*

[273] Ibid., pp. 3-4

[274] Mary Anne Warren, "The Rights of the Nonhuman World," in *The Animal Rights/Environmental Ethics Debate: The Environmental Perspective*, Edited by Eugene C. Hargrove, (New York: SUNY, 1992)

necessarily. "Value for *ourselves* means that our own life is important to us. Value *in us* means richness of experience within ourselves in our internal relations with the world."[275]

"It is easy to show that in the long run sustaining the integrity of these communities [the "land community" – the swamp, forest, prairie, and farm] is good for man."[276] From the vantage point of process relational philosophy, it is also easy to show that each of the organisms sustained in natural communities has life, an experience, and a value of its own. I disagree with Birch's claim that process thought necessarily denies that non-sentient species have intrinsic value.

Perhaps the idea of intrinsic versus instrumental value is outmoded in process thought, since irrespective of the source of value, the prehensive quality of relationships extends value to all objects of the world. In this way, the value of a biotic community is intrinsic to us (and also to the biotic community), rather than simply instrumental to us, since we are so closely connected process-information-wise to the biotic community. By abusing or damaging the biotic community, we are damaging what is part of ourselves, not just what would be effectively worthwhile to us or an instrument to our happiness or survival.[277] I do not mean to ascribe (as does the "deep ecologist") equal value to all species and to humans. A gradation of value is necessary and hard to avoid. Birch[278] and Warren[279] have both suggested that richness of experience and level of sentience should be considered in comparing value and rights between humans and various levels of

[275] Birch, "Environmental Ethics," p. 3
[276] Gunter, "Process-Relational Philosophy," Section 5, par. 4
[277] Karen J. Warren's Eco-feminism seems to be similar in that we become one with the environment as the climber is move effective when she is one with the rock. I did not have space to expand on this here. See Warren, "The Power and Promise of Ecological Feminism", in *Environmental Ethics: Divergence and Convergence*, second edition, edited by Richard G. Botzler and Susan J. Armstrong, (New York: McGraw-Hill, 1998), pp. 471-80
[278] Birch, "Environmental Ethics," p. 5
[279] Warren, "Rights of the Nonhuman World," pp. 91-3

nonhuman, but sentient beings. Prehension implies community, a community of values of which humans and nonhumans take part. "Homo Sapiens is a part of nature, "a plain member and citizen" of the "land community," as Leopold (1949, 204) puts it.[280]

We know that the process-information dynamics of ecology are complex enough to suggest an emergence of order; Even though "chaotic", the order is predictable and a worthwhile task of analysis for the scientist. The possible types of perturbations and order are determined by conditions of the underlying structure of the information processes. Since the ecology paradigm shift is one towards dynamics, why not make a corresponding shift in ethics. "The Land Ethic" can be dynamized.

The mathematics of Chaos Theory is very clear on what constitutes characteristics of a dynamical system. Information-process carries with it all of these characteristics: iterations, complexity, and sensitivity to initial conditions, a limited kind of predictability including attractors and chaotic perturbations and self-similarity.[281] The concept of self-similarity is one of scale. Look back at our Sierpinski Triangle. Notice the detail in any third of the triangle. You can find a miniature of the entire triangle within any sub part of the object. This is self-similarity over scale. Just as the triangle really has no definition of spatial criteria, neither does an ecosystem. [282] It is no surprise that scale is an essential characteristic that one needs to add to a new conception of ethics or to the restoration of present ethical theory.[283]

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[280] Callicott, "From the Balance of Nature," p. 101
[281] See Marc Corbeil, *Environmental Ethics and Chaos Theory, fall 2001, presented fall 2002 available www.mcorbeil.com/papers, an open discussion paper.*
[282] Callicott, "From the Balance of Nature," p. 101
[283] Ibid., Also see J. Baird Callicott, "Choosing Appropriate Temporal and Spatial Scales for Ecological Restoration," *J. Biosci.,* Vol. 27, No. 4, Suppl. 2, July 2002, pp. 409-20

# Conclusion

Why should we change our basic assumptions is now clearer. We use our understanding of the world via an ecology of process-information to examine the world, to determine an ethics of the environment.

The classical, medieval, modern and contemporary metaphysics of substance has been shown to be essentially unsuited to the paradigms of 21st century science.

Process thought has been shown advantageous in solving a number of paradoxes of philosophical and is a prudent consideration for a foundation of environmental philosophy. Embracing process thought could be a defining step in the future of philosophy and particularly applied environmental ethics. Ecology and Science suggest that characteristic dynamics is needed, and process thought provides an aalternative for an environmental philosophy that is both dynamic and elastic.

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