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Process Ecology: Making Room for Creation

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Abstract The laws of physics, because they are cast in terms of homogeneous variables, fall short of determining outcomes in heterogeneous biological systems that are capable of an immense number of combinatoric changes. The universal laws are not violated and they continue to constrain, but specification of results is accomplished instead by stable configurations of processes that develop in a nonrandom, but indeterminate manner. The indeterminacy of physical laws puts an end to Deist speculations and necessitates an alternative to the mechanical-reductionistic metaphor for nature. An antithetical Heraclitan metaphysics, called 'Process Ecology,' entails a dialectic between centripetal creation and centrifugal decay in which nature, humanity and the Divine can all potentially participate. The dialectic can be quantified and tracked using information measures applied to networks of processes to allow for the statement and testing of falsifiable hypotheses. Creation no longer appears as an emergent enigma, but rather as a core phenomenon of Process Ecology that allows for free will, Divine intervention, intercessory prayer and a necessary tolerance for petty evil. No longer is 'heat death' the inevitable and only endpoint of the cosmos. Rather, the course of the universe may include as well the production of 'perpetual harmonies' akin to Teilhard's 'Omega Point.'

Keywords Centripetality · Contingency · Divine intervention · Indeterminacy · Free will · Process metaphysics

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The Chasm

In the dialogue between science and religion many exchanges between physicists and theologians are aimed at papering over the yawning gap between their respective metaphysics, as though it does not exist. While biologists do enter the conversation, most do so as physicalists, believing that all sciences are derivative of physics. Physicists, of course, are delighted to encourage this belief—witness the opinion shared by Nobel Laureates Murray Gell-Mann, Stephen Weinberg, and David Gross, who maintain that all causality originates from below and that there is nothing 'down there' but the laws of physics (Kauffman 2008).

Such nihilism is the trademark of those who deny the authenticity of anything theological. Encouraged by the absence of any violations of the four force laws of physics (strong and weak nuclear forces, electromagnetism and gravity), Carl Sagan and Hawking (1988) sought to seize the entire domain of metaphysics with their belief that 'There is nothing left for a Creator to do.' So cowed are many believers by the power of physics and the other sciences that even a believer like Hefner (2000) came to doubt that miracles can happen, lamenting that God 'just doesn't have enough "wiggle room".' Many who still pray have abandoned intercessory prayer in the Neo-Deist belief that God cannot act in a world totally ruled by the laws of science. Truly, a metaphysical chasm persists between physics and theology.

Historical Roots of Disconnect

In the hope of bridging the yawning chasm, it helps to consider some of the origins that led to such disconnect. The dawn of the Enlightenment era assuredly was the result of numerous causes, many of which lie beyond the scope of this essay. Suffice it here to focus on how the divide grew out of a consensus between two disparate interest groups who found common cause to persevere against a socio/political background that today would be characterized as overbearing clericalism.

During the sixteenth and seventeenth centuries, in Europe and the British Isles, clerics exercised final judgment over which ideas were orthodox and which should be eliminated (oft-times along with those who espoused them). Everyone, for example, is familiar with the tribulations of Galileo and Bruno. The climate harbored particular dangers for those involved in the emerging sciences, even for those who were believers. Better to remain occupied with explicitly inanimate phenomena than to chance censure or worse by expressing opinions on any phenomenon bordering upon the living or the transcendental.

At the same time a number of thinkers who took deep umbrage to clerical censorship and secretly yearned for purely material explanations of reality that would undermine the beliefs upon which clerical power rested (e.g., F. Bacon, Hobbes, Halley, and Wren). Instead of fear, it was resentment that drove the nascent materialists to sever any and all connections between natural events and the transcendental.

Whence, during the eighteenth century, both groups contributed to the emergence of a set of metaphysical assumptions devoid of transcendental agency to become the foundations for order in the natural world. The resulting metaphysic is commonly and mistakenly referred to as 'Newtonian' to conscript the authority of the individual whose formulations of law accidentally provided gravitas to material ambitions.[1] The metaphysic rested on five axioms, which at the beginning of the Nineteenth Century enjoyed almost universal acceptance among scientists. The consensus held that nature possesses the following attributes (Depew and Weber 1995):

- Closure—Only material and mechanical causes are operant in nature.
- Atomism—Systems can be taken apart and the pieces studied individually. The behavior of the ensemble is the sum of the behaviors of the individual parts.
- Reversibility—The laws of nature are reversible. They appear the same whether time is played forward or backward.
- Determinism—Given some small tolerance, ε, the behavior of a system can be predicted to within some corresponding tolerance, δ.
- Universality—The laws of nature are valid at all temporal and spatial scales.

This Enlightenment metaphysics was particularly effective as a tool against religion, because it rendered Divine intervention unnecessary or even impossible. As Laplace apotheosized it, any spirit capable of knowing the positions and momenta of all particles in the universe would be able to use the laws of mechanics to predict all of the future and to retrodict all of history. The Modern synthesis was truly Parmenidean in holding that everything that was and possibly could be is immanent in the current state of the cosmos. The only influence that God could have exerted was to set the whole thing into motion (the prime mover) and retire—a belief that came to be known as 'Deism.'

It did not take long, however, before holes began to appear in this fabric. Carnot (1824) provided empirical evidence that all real processes are irreversible. Then Einstein (1905) brought universality into question with his relativity theory. Soon thereafter, Planck and others discovered the indeterminate world of quantum phenomena.

Despite these exceptions, the notions of closure and atomism have tenaciously survived into the present.

And so the chasm still yawns, with many in science still convinced that the Modern synthesis will eventually be extended to encompass the middle realm, and in so doing will provide a full understanding of the phenomena of life. In reference to the continuing dialectic, Wojtyla (1988) suggested that a balanced conversation would consist of science purifying religion of error and superstition, while religion would warn science against idolatry and false absolutes. The past exchange has hardly been balanced, however. Examples of science 'demythologizing' religious belief abound, whereas critiques of scientific beliefs by theists remain comparatively rare.

Redressing an Imbalance

Today, opinions are emerging that question the final bastions of the Enlightenment metaphysic. For example, the notion is spreading among ecosystem scientists that not

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[1] Presently, it will be seen that the origins of this world view owe more to Leonhard Euler and Gottfried Leibniz.

all causality arises from below, and cause is now widely assumed to be dispersed among the hierarchical scales of space and time (Allen and Starr 1982). Furthermore, there are accumulating reasons to doubt that the laws of physics are capable of determining all that transpires at macroscopic scales (Henning and Scarfe 2013). It is beginning to appear that the ontological status of the laws of physics has been much exaggerated. Problems with the idea of 'totalizing' physical laws have to do with the history of their formulation, with their logic, with their dimensionality, with their sufficiency, and with their implicit but necessary accompanying contingencies.

An Obscure History

Most scientists, for example, remain unaware of how Newton's second law of motion has come to be interpreted. Ask almost anyone familiar with freshman physics to state Newton's second law of motion and their reply probably will be something like, 'The force exerted on a body is equal to the product of its mass times its acceleration,' or algebraically, $F = ma$, where F is the force, m the mass of the body, and a its acceleration.

The problem with this rendition, it may surprise many to learn, is that Newton never formulated his second law in such algebraic fashion and argued strenuously against doing so (Dellian 1985, 1988, 2003; Jammer 2000). His statement in *Principia* was that impressed force is proportional to the change in momentum, or F is proportional to Δp, where p is the momentum of the body ($p = mv$, v being the body's velocity). It was not by chance that Newton presented his formula in terms of a geometric proportion rather than an algebraic equation: 'Proportional' is not the same as 'equal' or 'equivalent.' The law in its Newtonian rendition reads $F/p = c =$ constant, implying that force and momentum are *heterogeneous* entities. It is important to note that Newton's geometric expression is discrete and *irreversible*!

The familiar algebraic formula was rather the invention of Leonhard Euler, based on the suggestion by Gottfried Leibniz that cause can be equated to effect, and it was this equivalence to which Newton vociferously objected (Dellian 2014). It comes, perhaps, as a bit of a shock to learn that (at least in *Principia*) Newton never made the continuum assumption. His reluctance to do so is important, because the three 'exceptional' disciplines mentioned above (thermodynamics, relativity, and quantum physics) all appear to treat phenomena for which the classical assumption of continuity becomes problematic. These exceptions have prompted historian of science Dellian (1985, 1989) to speculate that one might be able to begin with Newton's geometric formulation and work forward in a way that uniformly encompasses the three exceptional domains. It should suffice, however, to leave that task to theoreticians and mathematicians and note simply in passing that the Modern synthesis, referred to by most as 'Newtonian,' is a serious misappropriation and should be ascribed instead to individuals who had an interest in describing nature in purely material terms.

Lingering Disparities

As for the early challenge by Carnot, it has never been adequately refuted. Reversibility at microscales cannot in general be reconciled with irreversibility at macroscopic dimensions without undue assumptions. The second law of thermodynamics, which is first and foremost empirical by nature, placed the atomic hypothesis in jeopardy (because empirical fact always trumps theory). For a full half century, physics felt itself besieged as theoreticians struggled with rescuing their Parmenidian worldview. It finally fell to Ludwig von Boltzmann and Josiah Willard Gibbs late in the nineteenth century to create an extremely simple and hypothetical model (an ideal gas) subject to very narrow constraints and less than realistic assumptions (the Ergodic Hypothesis) whereby reversibility at the microscale, along with imported stochasticity, leads to a description of irreversible ensemble behavior. With that demonstration, the controversy came to an abrupt halt! A single hypothetical construct was accepted as proof of a universal maxim. Given Popper's (1954) later emphasis on falsification, it remains a mystery why this 'reconciliation' is still accepted.

Enter Logical Dissonance

Irreversibility also points to a logical inconsistency in the effort to extend reversible mechanics into the highly dissipative and irreversible domain of life. In science, and especially in engineering, logic is intimately related to the units or dimensions by which actions are measured. The reversibility in the laws of force has been shown by Noether (1983) to be logically equivalent to conservation. That is, one can take any reversible law and from it derive a 'potential function' that does not change over time. Physics thus can be seen as a description of the world in terms of timeless, Neo-Platonist essences.

Time, however, is an intimate part of living dynamics. Life proceeds by changing from one distinguishable state to the next, almost always in irreversible fashion. The transitions between distinguishable states are separated by measurable time, and a sequence of such transitions is referred to as a process. In fact, life itself is process (a verb) comprised of other processes; it is not a thing (a noun). Popper (1990) ecstatically proclaimed as much, calling it a network of physical and chemical processes. de Chardin (1959) also recognized life as coming out of process.

A poignant illustration of how life is process exists in Tiezzi's (2006) description of a dead deer. The thermodynamicist Tiezzi ran a Tuscan estate near Siena that was plagued by deer grazing on his olive trees and grapevines. In frustration, he shot a deer and then was immediately transfixed as he looked down at the dead animal. 'What is different about this deer than when it was alive only tens of seconds ago?' he asked himself. Its mass, form, bound energy, genomes—even its molecular configurations—all these things normally used to describe living systems remained virtually unchanged in the minutes after death. What was missing, however, was the configuration of processes that had been co-extensive with the animated deer—the very phenomena by which the deer was recognized as being alive.

Despite this overt identification of life with process, the bulk of effort in biology continues to be expended on casting the phenomena of living systems, as Ayala (2009) has described it, within the framework of 'objects moving according unchanging laws.' Now, because science deals mostly with equations, one can interpret Ayala's statement in terms of the equation, 'Life is (=) objects moving according to universal laws.' As every beginning student knows, while the appearances of the two sides of an equation can differ greatly in their formulations, both sides must express the same essence—they must have the same dimensions (units). As the aphorism goes, 'one cannot compare apples with oranges.' Neither can one equate temporal processes with timeless conservative laws.

Process involves transitions among heterogeneous kinds, which raises yet another logical problem. Bateson (1972) noted as how physics deals almost entirely with homogeneous, universal descriptors, like mass, charge, and energy. The role of homogeneity was also important to Elsasser (1981), who researched the logical foundations of the universal laws of physics. Elsasser noted that Whitehead and Russell (1927) in their *Principia Mathematica* demonstrated that the force laws of physics are logically equivalent to operations made among *homogeneous* sets. Such logic, however, was not appropriate to operations among *heterogeneous* groups. Elsasser concluded, therefore, that laws akin to the universal force laws could never arise among the heterogeneous types that constitute living systems.

Facing the Complete Problem

Defenders of the totalizing reach of physical laws are likely to reject Elsasser's critique by noting that heterogeneity can always be dealt with in formulating what is called the boundary statement that must accompany each and every application of the universal laws. In order for the fundamental laws of physics to be universal, they must be cast in the broadest possible terms, i.e., in terms of the universal variables identified by Bateson. Even the simplest of real problems, however, possesses its particulars. Those specifics are called the 'boundary value problem,' and the statement of any real problem remains incomplete (and insoluble) until those particulars can be clearly stated (Ulanowicz 2013).

For example, one might wish to calculate the trajectory of a cannon ball. The appropriate law would be Newton's second law of motion in the presence of gravity. The specific trajectory and impact point cannot be calculated, however, until one stipulates at least the location of the cannon, the muzzle velocity, and the angle of the cannon with respect to the earth—items that comprise the boundary statement. That is, laws can never be considered alone. They must always be accompanied by a boundary statement, which constitutes an integral and requisite part of the problem formulation. In order for the laws to produce a determinate result, it must be possible to formulate the boundary statement in clear, closed form. Furthermore, as every modeler knows, it is the boundary stipulations that 'drive' the laws.

Now, in order for universal laws to remain inviolate, it is necessary that they can be paired with any contingent (arbitrary) boundary statement. Obviously, if one could point to particular boundary conditions which the law could not accommodate, then by definition the law would no longer be universal. In practice, boundary statements that are definitive (clear and unequivocal) give rise to results that are determinate. Nothing, however, prohibits an investigator from choosing boundary conditions that are stochastic (blind chance). In fact, Boltzmann introduced stochasticity into his reconciliation in precisely this way. Thus, reversible laws themselves remain indifferent to what is driving them. Clear boundary drivers yield determinate outcomes; 'messy' stipulations yield untidy outputs (the latter an analogy to the familiar aphorism from computer science, 'Garbage in—garbage out').

A Contingent World?

That one might encounter stochastic output is not in itself a troubling prospect, because there exist highly effective tools from probability theory that deal with blind chance. Mainstream probability theory is built upon the assumptions that chance events are simple, directionless, indistinguishable (homogeneous), and repeatable. Only an incrementally small fraction of contingent events satisfy all those assumptions, however. What happens, then, when contingencies appear that do not conform to these assumptions?

Elsasser (1969), for example, argued that in a heterogeneous world compound events are always occurring that are entirely unique; that is, each is distinguishable and, in the absence of any selection, non-repeatable. Furthermore, nothing dictates that they remain directionless. Elsasser demonstrates how, whenever more than about 80 distinguishable chance events combine, the resulting amalgamation will be physically unique. He comes by this number through a simple argument involving combinatorics: Physicists generally agree that there are roughly 10^{81} elementary particles in the entire known universe, which in turn is reckoned to be about 10^{25} nanoseconds old. Therefore, at the very most, about 10^{106} simple events could have occurred since the Big Bang. Any number larger than this magnitude Elsasser calls ‘enormous’ and warns that such numbers transcend the bounds of known physics. It takes approximately only 75 distinguishable tokens before the possible combinations among them exceed 10^{106}. It follows that in the realm of ecology, where even the simplest of ecosystems consists of hundreds or thousands of distinguishable entities, one is continuously encountering unique events. With a combination of 80 distinguishable entities, an interval of more than a million times the age of the universe would have to transpire before that particular combination could be expected to occur again by chance. Such contingencies can be termed ‘radical’ chance events, and they evade treatment by the laws of probability theory.

In the other direction from blind chance occur a host of arbitrary events that exhibit varying degrees of bias. For example, when dice are not true, one observes bias for or against certain values; or when a predator ingests a prey item, the probabilities of ingestion are usually skewed from the random frequencies of encounter. One speaks in either case of ‘conditional’ probabilities. Still less random, Popper (1990) identifies ‘propensities,’ whereby one outcome predominates, but other results may occasionally occur. For example, during the early twentieth century over nine of ten young immigrants to America married someone from their own ethnic group, although a few would venture to take native-born spouses.

One thus sees that Monod’s crisp dichotomy between ‘chance and necessity’ is a gross oversimplification. Instead, there exists an entire spectrum of contingencies ranging from radical chance at one extreme to blind chance, conditional probabilities, propensities, and finally to deterministic phenomena. Not even intentionalities can be excluded from boundary constraints. (Someone has to fire the cannon!) Any sort of contingency may appear in boundary conditions on universal laws, and in most cases the reversible laws will produce outputs that reflect their respective inputs.

Are Universal Laws Sufficient?

The last item in the litany of problems with the totalitarian view of universal physical laws is the question of sufficiency. The overwhelming combinatorics among heterogeneous systems renders the universal laws incapable of determining outcomes. Basically, this follows from the fact that the number of fundamental laws is small—for example, the four force laws of physics plus the two laws of thermodynamics. Although the number of possible combinations among them may seem large (say, $6! = 720$), this count absolutely pales in comparison to the combinations among a mildly heterogeneous system (say, $35! \approx 10^{40}$). As a consequence, there can be billions or trillions of combinations of a given heterogeneous system that are capable of satisfying exactly each configuration among the fundamental laws. The laws are not violated and they continue to constrain possibilities, but they cannot discriminate among a plurality of system configurations, each of which exactly satisfies any chosen mix of those laws.

As previously mentioned, whenever one is unable to articulate a boundary statement clearly, the associated problem remains insoluble. Such is very often the case with highly heterogeneous systems, because their combinatorics rapidly grows unmanageable. This inflation of possibilities is perhaps best exemplified by Longo et al.'s (2012) 'exaptations.' Evolutionary theory suggests that organs or structures emerge to adapt a given species to a particular environment. It occasionally happens, however, that a structure which arose in response to one set of conditions will serve an entirely different function in another environment. The classical example is the evolution of the swim bladder in fish. The cavity, as it originally developed, served as a proto-lung for fishes in oxygen-depleted environments to survive by gulping air. Some such fishes emerged from the water and the vacuole developed into a full lung. Others escaped back into oxygenated waters, where the empty space changed its function to serve as a buoyancy regulator. There is simply no way one could have cast a boundary statement so as to include the virtual infinity of all possible such exaptations that might have occurred.

Order Withal

Order Among Processes

None of the limitations on the laws of force disqualify them as outstanding human accomplishments, nor denies them a proper role in creating the order apparent in living systems. It's just that their role is one of support and constraint, not determination. Although the laws are not violated, neither are they the totalizing agency that most perceive them to be. But not all is chaos in world of the living, and so what, if not the universal laws, does *determine* order in biotic systems?

As Tiezzi argued, life is process, not substance; and it appears that processes, once extant, are able to interact with one another. Some collections of interacting processes form stable configurations, which in their turn give rise to enduring forms. (It is too rarely mentioned that configurations of processes can create structures.) One is thus prompted to search for manifestations of stable order among what might be called 'an ecology of processes.' A prominent clue in this search was provided by Bateson (1972), who wrote, 'In principle, then, a causal circuit will generate a non-random response to a random event.'

An Agency for Order

Following Bateson, the focus falls upon chains of processes in which the first and last links are identical, i.e., cycles of processes. In examining such loops, a particular subcategory is found to be prominent among living systems and to impart direction to consequent dynamics: Autocatalysis ('auto' meaning 'self' and 'catalysis,' the act of quickening) is any cycle of processes for which each constituent process catalyzes the next one in the sequence (Ulanowicz 2013). In Fig. 1, for example, if process A facilitates another process, B, and B catalyzes C, which in its turn augments A, then the activity of A indirectly promotes itself. The same goes, of course, for B and C. In general, A, B, and C can be objects, processes, or events, but focus remains upon sequences of processes, and while those linkages can be deterministic (mechanical), the primary interest here is on the contingent.

An ecological example of autocatalysis is portrayed by the aquatic community that develops around a family of aquatic weeds known as Bladderworts (genus *Utricularia*, Ulanowicz 1995). All Bladderworts are carnivorous plants. Scattered along the feather-like stems and leaves of these plants are situated small visible bladders (Fig. 2a). At the end of each bladder are a few hair-like triggers, which, when touched by any tiny suspended animals (such as 0.1-mm water fleas), will open the end to suck in the animal, which then becomes food for the plant (Fig. 2b). In nature, the surface of Bladderworts always hosts the growth of an algal film. This surface growth serves in turn as ready food for a variety of microscopic animals. Thus, Bladderworts provide a surface upon which the algae can grow; the algae feed the micro animals, which close the cycle by becoming food for the Bladderwort (Fig. 3).

Such autocatalysis among living systems, when it interacts with random singular (chance) events, can give rise to dynamics not usually associated with mechanical systems (Ulanowicz 2009a). Most importantly, autocatalysis exerts *selection* pressure upon all its participating elements. If there happens to be some contingent change, for example, in the surface algae that either allows more algae to grow on the same surface

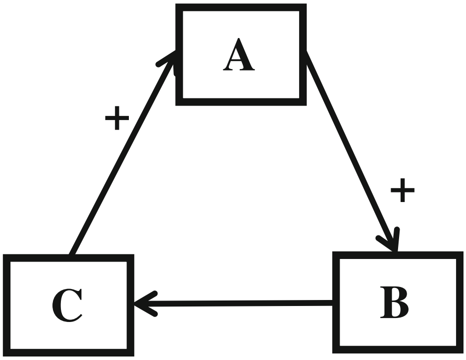

Fig. 1 Schematic of a hypothetical three-component autocatalytic cycle (created with *.doc)

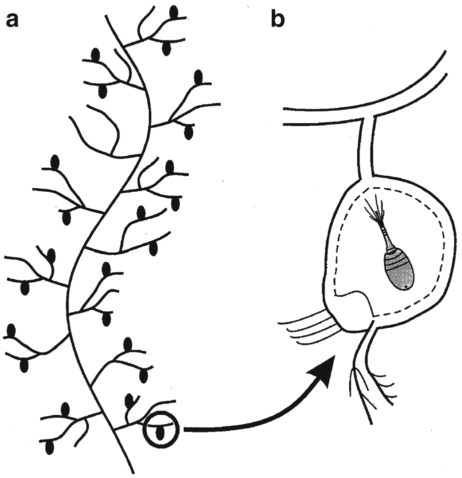

Fig. 2 **a** Sketch of a typical 'leaf' of *Utricularia floridana*, with **b** detail of the interior of a utricle containing a captured invertebrate (drawing)

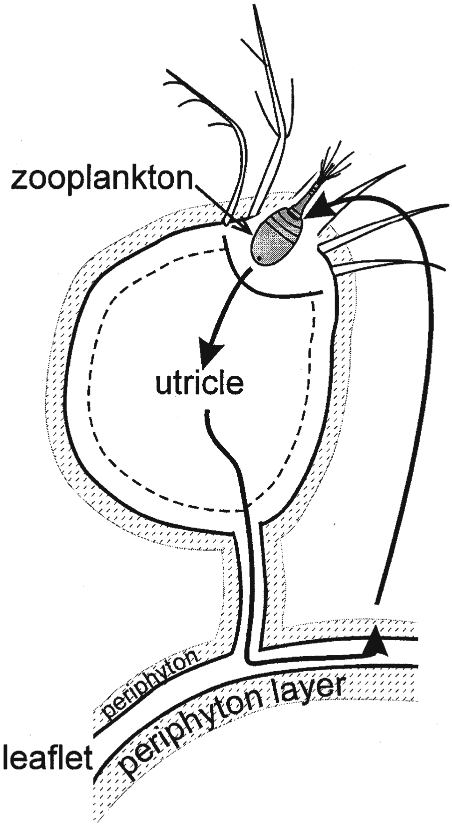

Fig. 3 Schematic of the autocatalytic loop in the *Utricularia* system. Macrophyte provides necessary surface upon which periphyton (*speckled area*) can grow. Zooplankton consumes periphyton and is itself trapped in bladder and absorbed in turn by the *Utricularia* (drawing)

of Bladderwort (e.g., by becoming more transparent) or makes the algae more digestible to the tiny floating animals, then the effect of the increased algal activity that contingent event induces will be rewarded two steps later by more Bladderwort surface. The activity of all the members of the triad will be increased. Conversely, if the change either decreases the possible algal density or makes the algae less palatable to the micro animals, then the rates of all three processes will be attenuated. Simply put, contingencies that facilitate any component process will be rewarded, whereas those that interfere with facilitation anywhere will be decremented. This selection by autocatalytic configurations is the means by which change is accomplished, i.e., the 'agency' of development (Ulanowicz 2001). Such configurations are both self-advancing and self-preserving. As well, such selection increases the probabilities of activity along certain pathways, providing an example of Lonergan's (1997) 'emergent' probabilities.

One consequence of autocatalytic selection is absolutely essential to life, but is almost universally ignored—namely, the mutual beneficence of autocatalysis induces a centripetal flow of resources into the loop (Fig. 4): The dynamics of selection imply that any increase of resource taken in by a component process will be rewarded. Because this result applies to each member of the cycle, all the avenues of resources into the autocatalytic loop tend to be amplified. That is, autocatalysis works to increase the amount of resources that are pulled into its orbit. Such centripetality, or radial attraction, is evident, for example, in coral reef communities, which sequester major concentrations of nutrients well over and above those in the oceanic desert that surrounds them.

This ratcheting-up of activity and its accompanying centripetality together constitute what commonly is referred to as 'growth.' Growth, especially in the geometric proportions described by Thomas Malthus, played a major role in Darwin's narrative. Unfortunately, the later disciples of Darwin have found it convenient to allow the role of growth in evolution to atrophy to the point where it now appears simply as a given that does not warrant further attention. But Darwin's full dynamic was a balanced dialectic that Stanley Salthe (personal communication 2011) paraphrased as 'Growth proposes, natural selection disposes.' Contemporary discussions of evolution strongly emphasize the eliminative role of nature, commonly referred to as 'natural selection,' but the enormous advantages imparted to some species via their participation in autocatalysis appear almost nowhere in the Modernist narrative.

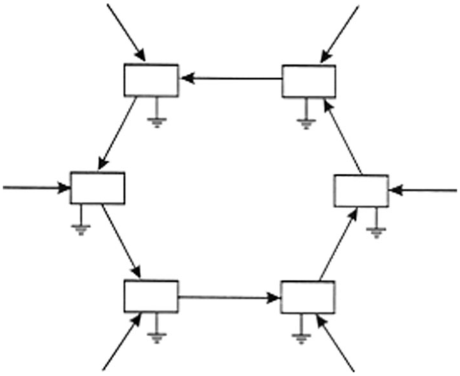

Fig. 4 Centripetal action as engendered by autocatalysis (created with *.doc)

Comments in the literature about the role of centripetality in living nature are rare. Like most natural phenomena, centripetality per se is normatively neutral—it can have either a light or dark side. The noted philosopher and detractor of Christianity, Russell (1960), viewed it in an unattractive light as 'chemical imperialism,' but he nonetheless was probably close to the mark when he claimed it was the drive behind *all* of evolution. His claim is counter to the conventional view of competition as the central player in evolution. It does not take much effort, however, to uncover what actually drives competition: Place two autocatalytic systems within a field of finite resources and their centripetalities eventually will intersect. It follows that competition will not take place unless centripetal drives are already active at the next level down. Hence, the mutualism that generates centripetality is a primary agency, whereas competition itself is a derivative phenomenon that plays a decidedly secondary role.

Centripetality imparts a proto-self to any living system in which it acts. Domning (2014) actually points to centripetality as 'original selfishness'—a prototype of Original Sin. Chardin, however, sees the configuration in a more positive light (Savary 2007). If love can be regarded as a particular form of beneficence, then it is love's centripetality to which Chardin is referring to when he states that love is the fundamental law of attraction. de Chardin's (1969) further claim that love underlies the physical structure of the universe also accords with Bonaventure's declaration that the love shared among the Holy Trinity is the basis of all action (Delio 2005). As with the parables of Jesus, a degree of understanding of theological statements can be achieved via the images they project onto the natural world.

It needs be mentioned that, in order for autocatalysis to ratchet up its activity, the related system must possess some form of memory or hysteresis. In this age of obsession with DNA/RNA, most will probably envision some molecular structure as the repository of the necessary memory. But one should recall that the autocatalytic dynamic itself is structured and stable and can function as a rudimentary form of memory. The highly structured polymers of nucleic acids now deemed essential for life are likely the products of earlier configurations of processes (Deacon 2006). Once encoding had emerged from those more diffuse process forms of memory, their inherent efficiency and greater durability allowed them to extirpate their progenitors (a form of temporal supervenience).

It is helpful to take account of how autocatalytic configurations evolve through time. Each new feature of a given repertoire is the result of selection exercised by the autocatalytic structure on some new incident contingency, be it radical, blind, or somehow already ordered. That earlier configuration in its turn came into being through a previous inclusion of some other contingency, and so forth back into the past. The system at any time is built upon a history of serial contingent events that could be referred to as "frozen contingencies". The development of the system can thus be seen as indeterminate, but nonrandom. Any particular inclusion of a contingency is not totally random, because it was selected by the configuration as it existed at the time of encounter. A large number of other contingencies were not selected, because they did nothing to advance the program of autocatalysis. At the same time, it is impossible to predict the exact nature of the contingency next to be selected, in the same way that one cannot predict the nature of an exaptation. The pathway built upon such a dynamic remains perforce indeterminate. Thus, it is that the universal laws of physics serve to constrain what is possible, but they are insufficient in a heterogeneous world to determine exactly what will happen.

An Indeterminate Conversation

The notion of a process that is nonrandom but indeterminate may be difficult at first to comprehend. A helpful metaphor for such a process was scripted by physicist Wheeler (1980), who suggested that the evolution of science is like a parlor game (Ulanowicz 2012): A number of guests are invited to a dinner party. Dinner is late, and so the hostess encourages the guests to entertain themselves with a game. They elect to play the game ‘20 Questions’ in which the object is to guess words. One individual is sent out of the room, while those who remain are to choose a particular word. It is explained to the delegated person that upon returning, he/she will pose a question to each of the group in turn and these questions may only be answered with a simple ‘yes’ or ‘no’ until a questioner guesses the word. After the chosen player leaves the room, one of the guests suggests that the group not choose a word. Rather, when the subject returns and poses the first question, the initial respondent is completely free to answer ‘yes’ or ‘no’ on unfettered whim. Similarly, the second person is at liberty to make either reply. The only condition upon the second person is that his/her response may not contradict the first reply. The restriction upon the third respondent is that that individual’s reply must not be dissonant with either of the first two answers, and so forth. The game ends when the subject asks, ‘Is the word XXXXX?’ and the only response coherent with all the previous replies is ‘Yes!’ At any point in the game, the response is not fully random, and yet it is impossible beforehand to ascertain which word will end the game.

Important here are the rules of the game. Even when the rules are never violated, they only constrain what can happen, but they obviously do not determine the outcome. What does specify the outcome? A little reflection will reveal that the game is cast as a conversation, or more accurately a dialectic. On one side stands the questioner, who continuously attempts to narrow down the range of possibilities. Against him are the respondents, who are free to choose answers that could serve to extend the game. One perceives the same agonism in nature. It was shown earlier how in autocatalysis order and form are built by the progressive inclusion of contingencies into the existing configuration of its processes. On the other hand, such order as has arisen is constantly being impacted and eroded by entropic contingencies.

Evolution as first proposed by Darwin was truly dualist, not on the sense of Descartes, but rather like that described by Heraclitus, who saw nature as the outcome of actions that build up as opposed to events that tear down—or akin to the ancient Tao, where the active agency of Yan stands in contrast to a more passive and conservative Yin. Perhaps even more accurately, the dynamics were described by de Chardin (1972) as a ‘law of attraction’ that emerged out of countervailing directions of convergence/divergence.

It becomes apparent, as suggested by hierarchy theory, that causality is different at different levels. In the physical netherworld, homogeneous entities obey the universal laws of physics. In the heterogeneous realm of life, those laws of physics are not violated, they simply lack direction and take a backseat to more proximate constraints that build around local and historical occurrences that define the specific pathway (direction) of events. Peirce (1935) called these local constraints 'habits' of nature, while Stanley Salthe calls them 'laws of matter.' Here the term of choice is 'proximate laws,' even though these laws are at times rather ubiquitous, like the constraints occasioned by the nexus of reactions involving DNA/RNA that provides direction for the development of all surviving living forms on earth. Thus, it is not the force laws themselves that *drive* the selection dynamics of the *Utricularia* community, but rather the mutualistic set of services that the participants perform for one another. One concludes, therefore, that every enduring form that one encounters is the outcome of mutual beneficence selectively accumulating contingencies.

Quantifying Processes

Although this ecological approach to evolution seems logically consistent, science is generally required to deal with quantitative, testable hypotheses. Assuming that life is process and that the dynamics of life are driven by cycles of processes, how could one quantify such process dynamics in a way that will allow the formulation and testing of hypotheses? It happens that systems ecologists have been occupied for over 70 years with linking together processes of trophic transformations into quantified networks (Lindeman 1942). Figure 1, for example, is a schematic of 'who eats whom and at what rate?' in the middle Chesapeake Bay ecosystem (Baird and Ulanowicz 1989). Because a process is a sequence of transitions from one distinguishable state to the next, one may regard each pathway in the network as describing a process. Each cycle in the network outlines some form of feedback dynamics. Heterogeneity explicitly appears as the multiplicity of distinguishable nodes. All of the elements needed to portray the ecosystem as a configuration of processes are present and quantifiable in the network.

It happens more recently that physicists have also discovered networks, so that a huge literature has grown around the topic. Unfortunately, the great bulk of this research is devoted to the search for mechanical explanations as to why certain types of networks occur under various conditions. That is, emphasis focuses almost entirely upon the constraints inherent in the networks. But the emphasis here has been upon the strong role of contingency and indeterminacy in natural dynamics. Such indeterminacy also resides in networks, albeit it is usually ignored. Networks are amalgams of constraint and contingencies (Pahl-Wostl 1995). For example, if one is at a particular node in a network, transition usually cannot occur directly to all other nodes. Algae are not immediately ingested by striped bass in Fig. 5. Any number of factors can *constrain* such action from happening. On the other hand, from a given prey node, it is usually indeterminate to which predator transition will next occur (who will eat it?) It is unknown a priori whether a particular variety of zooplankton will be eaten by a variety of filter-feeding fish or by a host of bottom-dwelling invertebrates. Networks encompass both constraint *and* indeterminacy.

Although one cannot physically disentangle the web of most networks (but see Baird and Ulanowicz 1989), it is serendipitous that one can mathematically assess how much network activity is being guided by constraints as distinct from how much freedom remains for events to transpire in indeterminate fashion. It is

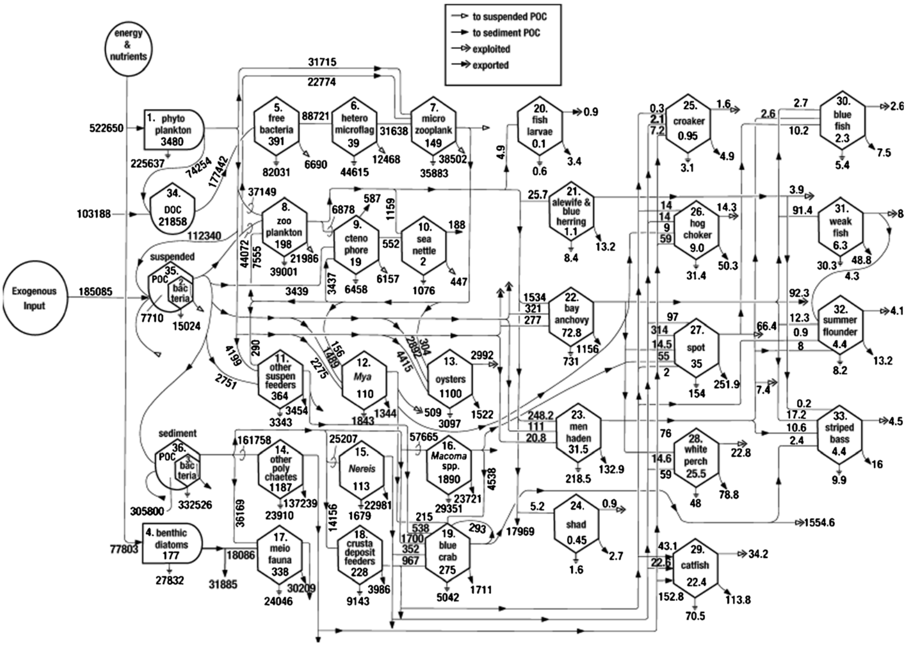

Fig. 5 Carbon flows among the 36 major trophic components of the mid-Chesapeake Bay ecosystem. *Arrows* indicate flows from prey to consumers as measured in mgC/m^2/year. *Numbers* inside nodes are the estimated densities of that taxon in mgC/m^2 (created with *CorelDraw*)

easy to depict the extremes of full constraint and total indeterminacy that networks can exhibit. For example, in the cycle graph of Fig. 6a, all transitions are determinate and equiponderant. Only one flow enters or exits each node. There is no indeterminacy. Figure 6b, however, depicts the other extreme. Transition between any two nodes is equally likely. There are no visible constraints, only indeterminacy. How then does one quantify how far between these extremes a particular network falls?

It is beyond the scope of this paper to derive the appropriate measure (Ulanowicz and Norden 1990). Suffice it to say that information theory applied to networks permits definition of a ‘degree of order,’ a, that characterizes the percentage of constraint inhering in a given network. For any quantified, directed network the percentage of constrained flow can be calculated such that $0 \leq a \leq 1$.[2] For example, the value of a for the network in Fig. 6c is approximately 0.3333. The measure a allows one to track how much order inheres in a configuration of processes as it either builds or degenerates.

It was originally thought that investigators would see a progressively rise with the development of ecosystem processes over time (Ulanowicz 1980). This expectation was never realized. (The hypothesis was falsified!) Instead, ecosystem networks of trophic processes, calculated over a diversity of habitats and environments, showed remarkable consistency and clustered around $a \approx 40$ % (Fig. 7). Such consistency seemed to indicate that a particular balance was being struck between internal order

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[2] If T_{ij} represents the effect of node i upon node j, then
$a = -\{\Sigma_{i,j}T_{ij}\log([T_{ij}\Sigma_{k,l}T_{kl}]/[\Sigma_k T_{kj}][\Sigma_l T_{il}])\}/\{\Sigma_{p,q}T_{pq}\log(T_{pq}/\Sigma_{k,l}T_{kl})\}$.

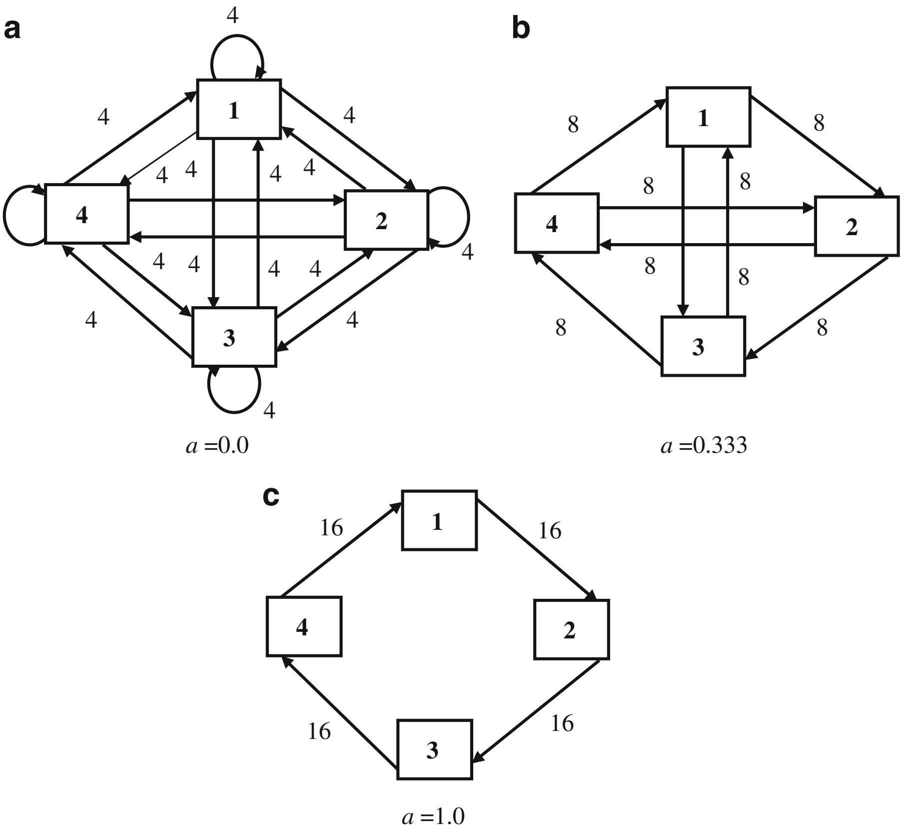

Fig. 6 **a** A four-component network with no constraints ($a = 0$) and maximal indeterminacy. **b** An intermediate network with both constraint and indeterminacy (a = 0.333) **c** A four-component digraph that is fully constrained (a = 1). (created with *.doc)

(and efficiency) and freedom (often in the guise of inefficiency or redundancy of pathways) across a wide range of circumstances.

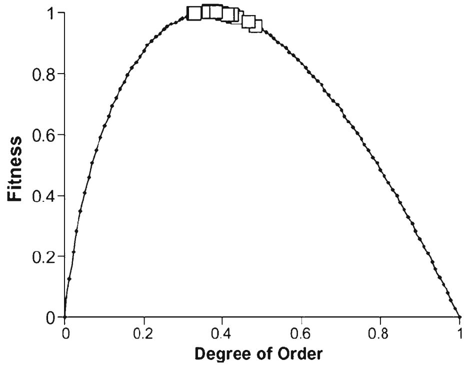

Fig. 7 The clumping of articulated ecological trophic networks around the 'degree of order' $a = 0.40$. (Fitness is measured as $-a\log(a)$ and represents the potential of the system to evolve further as the product of the system's order [a] times its relative disorder, [$-\log(a)$])

Why Disorder?

The seeming existence of a balance between constraint and flexibility immediately prompts the question, ‘Why doesn’t the efficiency of natural networks increase beyond a certain point?’ Why not maximize efficiency, as most expect nature to do? The ecological answer to this question seems to be that, when a system is disrupted by a *novel* disturbance, its ability to reconfigure itself to meet that challenge depends on how many adaptive repertoires it can fashion from among its mix of processes that hitherto had appeared as useless or inefficient. A system that is allowed to wax efficient without retaining such ‘strength in reserve’ will become ‘brittle’ and highly vulnerable and will collapse in the face of some new disruption (Holling 1986). As de Chardin (1960, 100) wrote, ‘In the spiritual life, *as in all organic processes*, everyone has their optimum and it is just as harmful to go beyond it as not to attain it.’ To endure, dissipative systems must retain some degree of ‘overhead’ that serves as insurance against novel perturbations.

At this point, it is useful to make an important digression to consider what might be called ‘scientific eschatology’—the popular consensus that the ultimate fate of the cosmos is ‘heat death,’ by which is meant an end state that consists of nothing but widely dispersed, low-energy photons. This conclusion flows from theory that is rooted in models of systems that are rarefied, homogeneous and (at most) weakly interacting. It is an equilibrium akin to that depicted by the point $a = 0$ in Fig. 7. But the value of a is actually an index of how strongly interactive system elements are. If elements remain relatively non-interactive, there is no other possible equilibrium than heat death.

It happens, however, that $a = 0$ is not the only possible equilibrium point in Fig. 7. As soon as one begins to treat systems wherein elements can interact significantly, another possible endpoint equilibrium appears at $a = 1$. In terms of networks, that point always represents a cycle, or collection of cycles, in which all links are equiponderant and in which each element is the consequence of only one other element and transitions to only one other node (e.g., Fig. 6a). No exogenous inputs are required to maintain the cycling. Ulanowicz (2009b) has noted elsewhere how this cyclical configuration is reminiscent of the electron orbits in stable matter, which quantum theory depicts as standing waves, or perpetual harmonies. As a simplistic example, a hydrogen atom, consisting of a single proton and a ground-level state electron, could conceivably endure in isolation without limit.

Such harmonies first appeared in a cosmological event called the ‘Recombination,’ some 378,000 years after the Big Bang. Before that time, light could not penetrate very far through the dense mix of radical particles. With further expansion and cooling, however, neutral matter (mostly in the form of hydrogen) precipitated out of the mix. Other forms of neutral matter followed and the cosmos, which until that time could have been considered a unitary dissipative structure, effectively separated into neutral matter (near $a = 1$) and dispersed heat ($a = 0$), the latter of which is still visible today as 2.7K background radiation. This event could be visualized on Fig. 7 as a system with an intermediate value of a separating into two parts—one (dissipated heat) migrating to $a = 0$ and the other (enduring harmonies) moving to $a = 1$.

The Recombination stands as a counterpoint to the ‘cosmology of despair’ that is so fashionable in academic circles today (Haught 2000). Such despair is occasioned by the universe having but a single endpoint—heat death. But is heat death the only inevitability? One could regard today's humanity as a highly dissipative structure (not an inaccurate portrayal!). As the universe continues to cool, what is to preclude another Recombination-like precipitation that would give rise to some self-contained, eternal, and equiponderant configuration? True, it is difficult to conceive of exactly how such a utopia could come about, suffice it to say that it would not be unprecedented and that the outcome would bear strong resemblance to the Omega Point, towards which de Chardin (1959) suggested creation is proceeding.

Dualism Redux?

In the spirit of recombination, it is time to pull together the assorted threads that have been discussed into a systematic unity. The reader has likely already noticed the theme of duality suffusing what has been written, but Cartesian duality is not where this narrative is leading. Rather two interpenetrating realms of causality have emerged, each following its own separate metaphysics:

Demarcation between the two domains lies more along the dimensions of complexity (heterogeneity) and density than with time and space. Ironically, science began with models that represented rarified, homogeneous and weakly interacting systems which only could have emerged *very late* in cosmic evolution. Under such circumstances, the four force laws allow for determinate predictions, whenever the accompanying boundary statement can be predicated in full.

Manifold heterogeneity and significant interactions, however, erode the validity of the classical assumptions that allowed the laws to be formulated (Popper 1990). Although the laws are not necessarily violated in the dense, heterogeneous realm of living phenomena, they do lose their power to discriminate among enormous numbers of possibilities that characterize the second realm. Causality there appears to arise more out of configurations of processes, the descriptions and workings of which differ significantly from those of conventional physics. The governing rules in the heterogeneous realm come into being through an historical compounding of contingent events, and they apply only within circumscribed regions of time and space. Within those areas, however, they are able to determine outcomes that elude specification by the universal laws.

Causalities in the two realms work in opposing directions as in a Heraclitian dialectic. The laws as they apply among rarefied, homogeneous, and independently acting entities do not impart coherence, and so centrifugality dominates, as with entropic decay (the second law). The dynamics in heterogeneous systems, by contrast, are dominated by centripetality and order-building, and give rise to structures of ever more effective autocatalysis. The forms that ensue are the product of a 'tug-of-war,' as between Chardin's 'countervailing directions of convergence/divergence.' This exchange cannot result in the extirpation of either agonist, however. If centripetal efficiency were to eliminate all disordered actions, the ensemble would be able neither to progress nor to maintain itself. Reciprocally, ever greater streamlining of processes tends to generate more overall dissipation.[3]

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[3] Dissipation, when calculated on a per-capita basis, sometimes decreases.

A New Metaphysics

The existence of complementary dynamics suggests that different fundamental assumptions may pertain to each realm. In the realm of classical physics, it was discussed how five assumptions were thought necessary to describe dynamics: (1) closure, (2) atomism, (3) reversibility, (4) determinism, and (5) universality.

In the discussion that followed, as the transactional scenario for ecosystem development unfolded, it was necessary to invoke three fundamental axioms along the way (Ulanowicz 2009a):

i. Contingency—Systems are continually being impacted by arbitrary events that are not amenable to complete description by laws subject to closed-form boundary specifications.

This axiom posits contingency as an ontological reality. It is not that the contingent events violate any law; it is that the accompanying requisite, associated boundary statements, cannot be formulated in closed form.

ii. Feedback—Processes, via interaction with other processes, are capable of influencing themselves.

This is a radical assumption. It violates closure and the Aristotelian prohibition against circular reasoning. It legitimates mereology (Juarrero 2016) and sets the stage for autocatalysis and its attributes, which are fundamental aspects of living systems.

iii. History—Systems differ from one another according to their histories, some of which is recorded in their material configurations.

This assumption formalizes what Darwin long ago tacitly assumed about the natural world—that there is simply no way to create history using only reversible laws.

A Natural Agonism

Of particular interest, each of these last three statements stands as the antithesis to one of the fundamental assumptions of Enlightenment physics: Contingency is the opposite of determinism; feedback violates closure and history negates reversibility. Atomism and universality have no counterparts in the revised metaphysics. In a world where relationships are primary, atomism either does not exist or serves no useful function.

The three fundamental axioms (*i–iii*) lead to the corollary notions that:

iv. Configurations of processes function as agencies.

and

v. The dynamics of creation are dialectical.

Together the scheme *i–v* constitutes what has called 'process ecology' (Ulanowicz 2009a).

Returning to the chasm which began this essay: For 300 years, the reigning consensus in the West has been that nature is monist and functions according to a single metaphysics. Furthermore, it has been assumed (and still is by most) that continued research will demonstrate that the same laws and metaphysics will eventually fully describe matters in the chasm that living systems inhabit. To doubt that belief is to exhibit what Haught (2000) calls 'metaphysical impatience.' If the immediate world of the senses does not seem to correspond to the rarefied, homogeneous, detached models upon which the Enlightenment worldview rests, then one is encouraged to adjust his/her attitude to believe that it does.

Ecology, nestled in the pit of the chasm, seems to be telling a very different story. Dense, heterogeneous systems do not entirely escape the constraining influence of universal laws, but they come to possess the freedom (indeterminacy) to satisfy those constraints in a virtual infinity of possible ways. To explain how they do operate, it is necessary to turn the conventional metaphysic on its head and to embrace a nature that results out of agonistic tendencies. Life is process and ecology is explicitly so. Shifts in perspectives (a *metanoia*) must occur from being to becoming (Prigogine 1981), from stasis to creativity, from object to relationship, from Parmenides to Heraclitus.

Making such a radical readjustment does not mean that one must forsake the scientific method. The metaphor of the network makes it possible to construct quantitative and testable hypotheses based on processes rather than things. With process ecology, the pathway from physics to life (and beyond) can be bridged. Science and the humanities can now reconnect. Theology need not be extirpated from the academic world.

A Revised Science

Ascribing to a dual metaphysic will markedly alter the scientific enterprise. For one, as Kauffman (2011) suggests, acknowledging the necessary role of indeterminacy spells an end to 'The Era of Physics.' Of course, physics will continue to advance and enlighten humanity, but the preoccupation with physical substrate must wane. Knowing the nature of the most elemental particles very likely will not be, as commonly supposed, the key to understanding higher phenomena. Furthermore, the possibility that the physical universe and its laws have evolved since the Big Bang is becoming a serious consideration (Chaisson 2001; Ulanowicz 2009a; Unger and Smolin 2014). Empirical evidence now exists that the fundamental constants of the universe have changed over time (Webb et al. 2001). In a manner similar to how neutral matter precipitated out of a dissipative milieu during the Recombination, the laws of nature could as well have sequentially emerged as the universe expanded.

Obviously, biology and evolution need to be re-evaluated in the light of process thinking. For example, Darwin's original narrative was essentially about a balanced transaction between Malthusian growth and (exogenous) natural selection. Since Darwin, however, the generative side of the evolutionary transaction has atrophied, so that almost all attention is now focused upon the eliminative actions of external conditions (natural selection). That significant selection can occur within the system is a key element of process ecology that has been proscribed from the Neo-Darwinian story. In the now prevailing scenario, agency is attributed to the material genome. But according to Aristotle, material causality plays a mostly passive role in events, just as it is portrayed in process ecology. It becomes necessary to shift more attention to the metabolic network of proteomic and enzymatic reactions that read, edit, and act upon the molecular genome.

Theological Ramifications?

Accepting process ecology as a legitimate way to describe natural systems would provide significant philosophical and theological opportunities. Starting with the question of free will—it becomes a given in a narrative that posits indeterminacy as an axiomatic attribute of nature. The burden of proof would shift to the determinists, who would then need to demonstrate how neuronal firings make their way through some five hierarchical layers of mind, each with its compliment of indeterminacy, to *determine* higher-level thought and choice.

An indeterminate world can entertain creativity of all kinds—natural, human, and possibly even Divine. Philip Hefner needs no longer worry about God lacking any 'wiggle room' to act in the natural world. Wiggle room abounds in a heterogeneous universe! An immediate corollary is that process thinking allows for intercessory prayer. It is no longer necessary to look at one's shoes, in almost Neo-Deist fashion, when friends engage in or talk about intercessory prayer. True, a mature prayer life should be judicious and patient, but there is no *natural* reason to abandon scriptural exhortations to intercessory prayer.

Unfortunately, theodicy, the problem of evil and suffering, cannot be as easily dismissed. It does not disappear, even through the lens of process theory. But process ecology does provide a different avenue along which to approach the problem. In the process scenario, the agonism in the natural dialectic is tempered by the requirement that neither agonist may extirpate its counterpart without encouraging major system collapse. It is widely accepted that good can accidently result from bad or erroneous events. For example, Albert Einstein, while he worked at the Swiss Patent Office, spent the bulk of his time in his office working on the Special Theory of Relativity instead of attending to patents, as he was paid to do. His petty wrongdoing resulted in a benefit to humanity of major proportions. To attempt to eliminate every evil would result in forfeiting all hope of human progress and is the reason why attitudes like Jansenism and Puritanism are to be avoided. The parable of letting weeds grow along with the wheat is explicit process wisdom, which now takes the form of the call by Bergoglio (2015), the Bishop of Rome, for compassion.

Of course, no one should confuse minor indulgence with a decision to abandon all normative judgment. While process ecology does resolve the ontological question 'Why evil?,' it does not speak to the issue of magnitude, i.e., 'Why enormous evil and suffering?'—like the Shoah or the recent Indonesian tsunami. It was mentioned earlier how certain dynamics like centripetality need to be judged according to their context. For example, Bonaventure recognized an ultimate good through his belief that the love among the persons of the Holy Trinity constitutes the basis of all action (Delio 2005). Much the same idea was expressed by Chardin, as a convergence drawing creation to God. The Trinitarian affections are also reflected in the perpetual harmonies extant within all stable matter, serving as a Divine 'signature' upon the material world. This signature may be what prompted Therese de Couderc when she looked at a chair and saw the word 'goodness' (la bonté) appear on it (de Couderc 1866). She then looked at another nearby object and the same word appeared on it as well. All of enduring creation bears the signature of its Creator. At the same time, the centripetality occasioned by mutual beneficence at the physiological level gives rise to the notion of human selfhood, which at times manifests itself as extreme 'selfishness' that can occasion major sin, like the wars and genocides of the twentieth century.

Doubtless, some believers are disquieted by any emphasis on process. Chardin's predilection for process likely played a significant role in his having been silenced. There are many, especially among the current Roman hierarchy, who see Christianity almost exclusively through the lens of Thomistic Neo-Platonism. To them, the idea that creation is ongoing is unsettling, suggesting somehow that God changes over time. Whence, process is largely eschewed by Thomistic purists, who hold fast to the proposition that 'God is immutable!'

Such obstructionists might wish to ponder the results of Jesus having lived during a time of clash between the Hellenic and Hebraic cultures. The tensions between those cultures contributed to the vibrant amalgam that Christianity has become. Unfortunately, over the intervening centuries, the histories of these two cultures have not been retrieved in proportion to their contributions. Thanks to Maimonides and Thomas Aquinas, Neo-Platonic and Aristotelian insights were rediscovered and applied to Judaeo-Christian thought. Less attention, however, has been given to reviving the Hebraic notion of the human-Divine conversation, and it is obvious how conversation is fundamental to process thinking. (Hebrew scripture played a marginal role in Catholic ritual before Vatican II.) A noted Thomist theologian related to the author that theologians regard the Hebrew narratives wherein a prophet converses with a God and changes God's intentions to be simply interpretive metaphors. He should not try telling that to today's practicing Jews![4]

Just as ecological thought bridges the middle ground between physics and the humanities, process ecology can help reconcile this theological controversy. In recent decades, ecology has adopted what has been called 'hierarchy theory,' the idea that dynamics at disparate scales of time and space can be qualitatively different (Allen and Starr 1982). This notion possesses theological currency as well. In hierarchy theory, events at the largest scales change very slowly, if at all. In eschatological terms, God remains truly immutable, just as process theology posits that certain attributes of God are everlasting. It seems to make little sense, however, to confine God to that distant realm. God is commonly thought to be active at *all* scales of nature and beyond. By 'active' is meant engagement with a changing world, and it would be inconsistent to hold that God cannot respond to human activity, which has already been established as freely willed. A God incapable of lower-level change would be less than human in nature.

On the other hand, consonant with hierarchy theory, Christians need not abandon Thomist insights. They represent what will be in the end, and those ends are

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[4] Witness Rabbi Bradley Shavit Artson (2013), who in his book, *God of Becoming and Relationship*, regards Neo-Platonism as an unattractive patina overlying authentic Judaica.

supremely good.[5] The faithful, however, must encounter reality at the meso-levels, where creation is continuing in their midst. (‘The Kingdom of God is among you!’) Therefore, it seems reasonable and judicious to make more room in Christian theology for process thinking, much of which already fills Holy Scripture. Only by recognizing process can one fully appreciate and celebrate immanent reality.

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[5] One is reminded of an aphorism from the recent movie, ‘The Best Exotic Marigold Hotel’—‘All things will be well in the end. If things are not all well, then it is not yet the end!’

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