

Ultrastability ... Autopoiesis? Reflective Response to Tom Froese and John Stewart¹

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It is unfortunate that Tom Froese and John Stewart in their article have treated the thinking of Ross Ashby as a conceptual source for my work and the development of the notion of autopoiesis, because by doing so they have obscured their possibility of seeing what questions I am answering in my work. It is also unfortunate that they have assumed that I follow the path of cybernetics, which certainly is not the case. Cybernetics has been used in the attempt to formalize the circularity of biological processes, but one formalizes what one thinks about the processes that one wants to formalize and not the process that one believes to be formalizing. If one is not aware of this, one confuses the formalism proposed with the process that one intended to formalize, and this is what has happened with the notion of autopoiesis at least in the reflections about it. In this context it is unfortunate that in their scholarly effort the authors of this article, in their attempt to show that I do not satisfy what seems to be their deep feeling that living to occur requires the operation of some organizing principle, have been blind and deaf to what I say in my writings. At the same time I think that it is good that at the end of their article they recognize that Ashby's notions about ultrastability are not adequate to understand what makes a living system a living discrete autonomous entity.

When one speaks of the autonomy of living systems, one is saying that their operation as discrete living entities follows regularities determined by the manner they are made, and not by any external organizing factor. As such, autonomy is a feature of the operation of living systems as they continuously make themselves, and we find them autonomous when we begin to reflect about them. So what I say is that what makes living beings autonomous living discrete entities is their constitution and operation as molecular autopoietic systems. In these circumstances the autonomy of living systems needs not to be explained as such, although it is no doubt interesting to reflect on how the organisms transform as autonomous entities in the course of the ontogenic and phylogenetic drift of the different organism-niche unities that they integrate.³

The authors of this article speak as if they thought that the notion of autopoiesis were something that existed out there in the world and about which one can have different opinions, although they do not say what they are talking about when they use

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1. This is a response to Froese and Stewart's paper "Life After Ashby: Ultrastability and the Autopoietic Foundations of Biological Autonomy" published in *Cybernetics & Human Knowing*, 17 (4), 7-49.
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 3. For the notion of natural drift see: "The origin of species by means of natural drift" by Humberto Maturana and Jorge Mpodozis in: *Revista Chilena de Historia Natural*, 73 (2), 261-310. Year 2000.

the word autopoiesis. And it seems that it is in this mood that they talk about what they call the “Kantian conception of autopoiesis” accepting the notion of the operation of some “intrinsically active purposive regenerative principle in nature,” a notion that in my opinion is also inadequate. I proposed the word autopoiesis in the year 1970 to connote and describe the molecular processes that we human beings can abstract as taking place in the realization of the living of the living beings that we find around us living as autonomous entities in the worlds that we live. Therefore, I insist that if the reader were to read my work as a biological explanation of a biological happening, and not as the philosophical proposition of a formalization of the phenomenon of life, he or she would find that I am saying that living beings occur as discrete autonomous dynamic molecular autopoietic entities that exist in the continuous realization of their self-production as molecular autopoietic systems without the participation of any organizing principle. And they will hear that what I say is that one can easily see, if one attends to the interrelation of the circular operation of the metabolic path in a living cell, that the notion of molecular autopoiesis is an abstraction of the actual closed network of molecular productions that constitutes a cell as a discrete living being. Accordingly, the operation of the molecular autopoiesis is not a necessary condition for the living of a cell as if the cell were something different from the molecular autopoiesis that constitutes it as a living being; the molecular autopoiesis of a cell is its living. If the reader is in the mood of listening to what I say, and not to whether I satisfy or not his or her notion of what I should be saying, as I speak of the living, he or she will hear that what I am saying is that we human beings as living beings are molecular autopoietic systems, and that it is in the relational space in which we operate as totalities as molecular autopoietic autonomous entities, where we exist as human beings, and that humanness is a manner of relational living in which we operate in languaging as self-conscious persons. I repeat: What I say is that the continuous realization of the molecular autopoiesis in the members of the class of discrete singular molecular systems to which we belong, and which we call living systems, is their living. The notion of autopoiesis is not, and it has never been, the proposition of an abstract principle or a definition of living; when I speak of molecular autopoietic systems I am indicating and describing what constitutes and realizes any living being that we find in the biosphere as an autonomous discrete living entity. Moreover, all that we can say or distinguish in us in our operation as observing, reflecting, languaging, self-conscious human beings, as we operate as reflective persons, occurs in our operation as persons in the relational space that arises in our operation as totalities as molecular autopoietic systems, and not in the molecular dynamics of the realization of our autopoiesis.

If the reader of my work is a biologist he or she will know that when I speak as a biologist of living beings I necessarily speak of dynamic systems in continuous change, and will know that I know that when a cell is frozen all the molecular processes in it stop. And he or she will know that I know that when the freezing takes place there is no more living because living stops ... and he or she will know that I know that when living appears again when the aperiodic crystal that stands in the

place where there was a cell is defrosted, what happens is that the molecular autopoiesis begins anew, as the suspended molecular dynamics is reassumed starting in the structural configuration of operational-relations present at the moment of the freezing, if the molecular architecture of the cell was not disrupted when that occurred. Moreover, if the reader “listens” to what I say without presuppositions he or she will have the possibility of seeing that I show that all that we human beings do, including our explaining of our living, occurs in the domain of our living in languaging in the relational domain in which we exist as individual human beings or persons with other persons. And he or she will also realize that the relational domain in which we operate as totalities arises as something valid in itself as a domain in which what happens is intrinsically different from what may be happening in the realization of the molecular autopoiesis that constitutes our operation as living beings. The processes that take place or may take place in the domain in which the living being operates as a totality cannot be deduced from the processes that take place in the domain of the realization of the molecular autopoiesis of the realization of the living of the living being because those two kinds of processes occur in not intersecting operational-relational domains.

In what follows I shall present some aspects of the fundamentals of my thinking.

1. First of all, my writings must be read as a historical whole because they begin in a moment in which I had to create new concepts to say what I wanted to say, or I used concepts that I abandoned later because they were not adequate to evoke in the listener or reader what I wanted to say. One of them was the understanding of the operation of the observer as he distinguishes between what he says about how a system appears in his or her distinction from what he says about what may be occurring in the operation of the system in its internal dynamics.
2. My concern has been, since childhood when I claimed that I wanted to become a biologist, to understand living beings as beings that die, not life. Accordingly, years later in my research my intent was to understand living beings, not what life was. Thus one of the basic questions that guided my reflections as a biologist was, “what kind of beings appeared spontaneously some 3900 million years ago on the earth so that we can say that living beings appeared then?” This is a question in the domain of biology, not a philosophical or mathematical question, and the answer that must be in the domain of biology is: living systems.
3. The next question is: “What kind of systems or entities are living systems?” To answer that question we must look at living systems now; and the answer is pointing to what we all can see, namely, a living system is a discrete self-contained molecular dynamic system that produces itself as a closed network of productions of molecules that in their interactions produce the same network of molecular productions that produced them as a stationary dynamics sustained in a continuous flow of matter and energy through it. So, calling living systems molecular autopoietic systems that operate as totalities in a relational space that sustains the continuous flow of matter and energy through them, and in which

- they have characteristics (some times called properties) different from the characteristics of their components, is a biological, not a physical, not a philosophical and not a mathematical answer. And is an answer that is not part of a tradition of thinking related to Ross Ashby. At the same time that biological answer shows that the operational autonomy of a living being is a consequence of its operation as a discrete dynamic molecular autopoietic system, and that its understanding does not require any philosophical or mathematical support.
4. My concern has been and is with the happening of the living of living systems as they occur, and with the fact that I, you the reader, the authors of the article that is the motive of my reflections, Kant, other philosophers, scientists, workers ... all are living beings: We are all members of the same class of beings, and all that I say about autopoietic systems applies to all. The authors of this article say in the second page: "... life does have unique characteristics that distinguish it from non-living phenomena ...," and indeed, living systems as dissipating systems are different from candles and tornados, and the difference is that they are autopoietic systems, candles are candles and tornados are tornados. Yes, what makes any kind of dissipating system different from another kind of dissipating system is the organization that defines their different class identities as dissipating systems of different kinds. Autopoiesis is not a definition, not a postulate or an *a priori* proposition; it is an abstraction of what happens in the actual realization of the living of a living system.
 5. Sometimes people ask me, "what is your definition of life?" To accept this question is always a mistake because life and living are not to be defined. Living beings are happenings in our existence that we can either observe and study or accept as a matter of fact, and we are members of that kind of happenings. We human beings can make theories about the nature of life when we think that life is some property of living beings, but life is not a property of living beings, the word life only evokes or names an invented abstract entity that we claim that must be there to sustain the living of a concrete singular living being. Living does not need any theory to occur; it is the occurring of a molecular autopoietic system. If we want to understand living we have to abstract the operational and relational coherences that constitute the realization of the living of a living being, and that is molecular autopoiesis. The notion of molecular autopoiesis arose as that abstraction, and this is why it is not a supposition, nor a definition. And this is why I say that if there were a system that is isomorphic to a molecular autopoietic system but with a different kind of components, that system would be *like a living system* in the domain of its components. Yet, at the same time I think that for that to happen the components involved would have to operate in the way that molecules operate, and if that were the case then that autopoietic system would operate as a living system
 6. The meaning of a word is not in its sound or form, but in the way we use it as we language it. At the same time processes or entities do not have meaning in themselves; a particular substance is not a nutrient but we say it is a nutrient when

it participates in some metabolic process in a cell, and some particular behavior is not adaptive in itself, but we say as observers that it is adaptive when we see it to participate in a particular kind of processes that we call adaptive. When one does not understand this one expects that processes should have meaning or should make relational sense by themselves, and in doing so one confuses domains. Sense and meaning belong to the domain of the commentaries and reflections that an observer makes about what he or she sees.

Epistemological-operational starting points that are aspects of our living, not definitions:

1. We find ourselves living beings when we ask ourselves about ourselves as living beings.
2. We find ourselves immersed in a domain of existence that is not chaotic, in which all occurs according to regularities that can be observed and described, when we begin to explain what happens around us and how we do what we do.
3. While we live and do what we do, we find that the world that we live is not chaotic, and we live in the implicit trust that the coherences of our living and of the world in which we live are spontaneously conserved. As a result of this we explain what we do with the operational-relational coherences of what we do in the realization of our living.
4. The fundamental spontaneous background of operational-relational coherences that we human beings observe in our living, and which we all unconsciously and consciously treat as the fundament of possibility for all that we do, is structural determinism.
5. It is only when we want to explain what happens in our living, and we find situations that we cannot explain because we do not have at hand in our ordinary living operational-relational coherences that would permit us to do so, that we begin to invent “poetic” notions that would permit us to do so.
6. All systems are composite entities that exist in two not intersecting operational-relational domains, the domain of the operation of their components, and the domain of their operation as totalities. Due to this the totality does not operate as an argument in what happens with its components, and the components do not operate as arguments in what happens with the totality.
7. All that occurs in our living as persons occurs in the domain of our operation as totalities.
8. Purpose, meaning, value, utility, advantage, importance, regulation, cause, control ... are reflexive commentaries that an observer makes about what happens in the human sensory-operational-relational space, and are not features or characteristics of any process.
9. All processes occur spontaneously, all that we human beings do in terms of intent and desires is to interact in a way that the spontaneous course of their happening goes spontaneously in a direction that arises in the contingency of their encounter

with us. The so-called Kantian notion of natural purpose appears as acceptable when one does not see, and cannot see due to cultural circumstances, the spontaneity of natural processes. When this happens, as has been since the earliest attempts of human beings to explain the regularities, coherences and occasional incoherences of the worlds they live, resorting to some ordering principle that acts in a manner comparable to how they act with purposeful intent in ordering their daily affairs, unavoidably one enters in a confusion of domains. And this confusion of domains occurs in the moment in which we put purpose to spontaneous processes that we do not understand. And we do this inventing some universal organizing principle of one kind or another according to our cultural present.

10. No doubt we live different experiences that we feel as occurring in different sensory, operational and emotional domains, but experiences are distinctions that we make of our feelings in the realization of our living, that we feel as if they were occurring independently of what we do.
11. Living systems do not adapt to a changing environment, their living follows spontaneously the path in which their autopoiesis is realized otherwise they die: Living systems slide in their encounter with the medium in which they exist in the continuous conservation of their autopoiesis, or what is the same, in the conservation of their operational and relational coherence with their niche as that part of the medium in which they encounter all the conditions under which their living is realized and conserved. We biologists call this relation adaptation.⁴
12. If one is attentive one can see that living beings exist in the conservation of their living as a continuous realization of their autopoiesis in a coherent transformation of their structure and the structure of their niche, in what I call the organism-niche dynamic unity.
13. It is the organism-niche dynamic unity which is conserved along the individual living of an organism, and along the history of a lineage.
14. The notions of ultrastability and of dissipative systems do not add to the understanding of the constitution or of the operation of living systems. They are interesting notions but even though living systems may operate as ultrastable and dissipative systems, it is not ultrastability or dissipative processes which makes them living, it is their continuous self production as discrete self producing dynamically closed molecular entities: that is, molecular autopoiesis.

Humanness occurs as a manner living that occurs in the relational space that arose when some family of bipedal primates became our ancestors as they begun to do all

4. When we biologists speak of adaptation we refer to the relation of the operational coherence of the living system and the medium that makes it possible as its niche. As such, adaptation is an invariant relation that necessarily occurs while the living system lives. The form of the relation of adaptation changes continuously in the realization of the living of the living being while its relation of adaptation is conserved. When the relation of adaptation is lost, the living being dies, and the niche dissolves as there no more organism-niche unity. When a biologist speaks of a living system in its operation as a totality in the relational space in which it realizes its autopoiesis, he or she speaks of an organism.

that they did together in a flow of coordinations of coordinations of consensual feelings, doings and emotions as a manner of living that became our living in languaging and conversing. In that manner of living, human beings became persons as individual human beings that could reflect on what they did as well as on themselves doing what they did. Humanness, human soul and human mind arise as languaged evocations of the feelings that we feel and which we cannot describe when we reflect on our feelings as we do what we do. Languaging is evocative of the doings and of the feelings that we feel as we do what we do, and does not symbolize or represent entities or processes independent of what we do. The domain of the realization of the living (the molecular autopoiesis), and the domain of the realization of the manner of living of a living being as it operates as a totality (or organism) in the operational-relational space or medium in which it realizes its living as its niche, do not intersect, but together the organism and its niche make the organism-niche unity as that which is conserved in the ontogenic natural drift of any living system as it operates as an organism. Our niche as human beings entails the realization of the living of other human beings, other living beings and non-living entities as our explanations, our theories, our fantasies, in fact, all that we do think. Not as entities or processes as such, but as modulations of the course of the realization of our living through the realization of our living as this changes in the encountering of the independent dynamics of the structural interactions that we undergo as molecular entities immersed in a domain of molecular entities operating with independent internal dynamics. Our usual difficulty for understanding this wide network of interactions in which non-intersecting domains arise as we explain our living with our living, is mostly the result of our not realizing or accepting that, although we live each new domain as valid in our living, all that we live are experiences that we live through the realization of our molecular autopoiesis.

Comments on the confusions that arise by confusing what I say with what Varela says and what Ashby says, by assuming that these three authors are speaking of the same things or are saying the same things:

- i. Constructive requirements: A molecular process occurs only if the structural and energetic conditions that are required for it to happen, do occur. If molecular autopoiesis occurs, it means that all that has to happen for it to occur is happening.
- ii. Interactive requirements: If the reader has read what I have written about structural coupling, then he or she knows that what happens in interactions between living beings, or between living and non-living beings, is not ignored. Those considerations are not necessary for the understanding of the notion of molecular autopoiesis, or for seeing that it occurs in the cellular molecular processes without having to make special considerations about the functional interweaving of the numerous molecular cycles.
- iii. Normative activities: What the authors call normative activities such as *adaptivity* or *goal directed actions* or *cognition* as mentioned are not aspects of the dynamics of the molecular autopoiesis, they are commentaries or

explanatory propositions that an observer can make about what he or she may think that should occur in the flow of living of an organism in its relational domain.⁵

- iv. Historical requirements: Memory is an explanatory proposition that an observer make when he or she sees that an organism is behaving adequately in relation to some particular circumstance, and he or she thinks that that adequate behavior is the result of something previously lived by that organism. The structure of an organism and the structure of its niche change together congruently in the course of the flow of its ontogeny. The notion of memory as it is used as an explanatory proposition obscures such history.

According to what I have just said above, those so-called historical requirements arise from an insufficient reading of what I have written. To amend this I include a more complete bibliography at the end.

A reflection about mathematical formalisms:

1. Mathematical formalisms are logical transformations around the conservation of certain initial relations. As such they add nothing to initial relations that are being conserved although they may offer the vision of new possible circumstances under which they operate.
2. The operational value of a mathematical formalism lies in the initial conditions adopted because they are arbitrarily chosen by the observer from his or her vision of the situation that he or she wants to illuminate or manipulate with it. A mathematical formalism formalizes what the observer thinks about what he or she thinks that he or she is observing, not that which he or she thinks is happening with independency of his or her observing it.
3. If one has a mathematical formal procedure that one thinks would permit one to formally handle the relations of reciprocal modulation between the components (the local) of a system and the operation of the system as a totality (the global), the value of such mathematical formalism will depend on what the observer thinks that is happening when he or she says “there are material phenomena which exhibit global-to-local determination and it is possible to address their reciprocal relationship in rigorous manner through the mathematics of complexity theory” (Froese & Stewart, 2010, p. 44).⁶

5. The authors speak (p. 9, point iii) of adaptivity, goal directed actions and cognition as if they were referring to operational processes or properties of living systems, but those notion as presented do not connote biological processes but connote opinions of the speaker about the nature of what occurs with the living being in the flow of its living. Living beings live only while they operate adapted (in operational coherence) with their niche, otherwise they die. So they are never adapting, and they slide in their living in the conservation of adaptation. The processes of the living systems are not goal oriented, although an observer may say that they occur as if they were goal oriented. And cognition is what an observer says that occurs when he or she sees an organism behaving in a manner that he or she considers adequate to the circumstances in which he or she observes it.

4. Historical correlations between non-intersecting operational (phenomenal) domains cannot be formalized without the participation of the observer that brings forth the broad meta-domain in which he or she makes such correlations.

We human beings in our reflections create meta-domains in which we easily make historical correlations between non-intersecting processes, but if we are not aware of this we sometimes commit the mistake of treating correlations between non-intersecting domains as logical relations of contiguity. The greatest difficulty in understanding the worlds that we human beings generate in our living and our explanations of what we do in our living, arises from the confusion of experiential and explanatory domains. Such confusions are easy because in our living as persons, everything that we distinguish we distinguish as an experience, that is, as something that we live. It is only when we want to explain the different experiences that we live that we may distinguish in the domain of our experiences different kinds of realities that we may, consciously or unconsciously, want to relate, to put together or to unify them.

Whenever we reflect or make an operational recursion we create a new domain that is intrinsically new in the sense that it did not exist before and does not intersect with the reference domain in relation to which it arose through a reflection or a recursion. So we can say that in the spontaneous dynamics of the cosmos that appears as we explain the operational coherences of our human living with the operational coherences of our human living, we always find as we explain what we do that new operational-relational domains arise that do not intersect; and we also find that we human beings can always create a meta-domain that contains them allowing us to make correlations between them, that we may confuse with deductions. Molecular autopoiesis does not include or entail humanness, but as humanness arises when living in languaging begins, we may be tempted to think that molecular autopoiesis should somehow include humanness, which is something that does not and cannot happen because humanness occurs in a non-intersecting domain.

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6. The authors speak as if one could indeed claim that in systems there is or occurs operationally what they imply by speaking of global to local determination. To claim that creates a confusion of domains. The properties of an organism as it operates as a totality do not act as such on the local operation of its components. The coherence of the operation of the components of an organism with the operation of the organism as a totality is the result of the evolutionary structural drift of the organism/niche unity in which organism and niche change together congruently spontaneously in the conservation of the living of the organism. If this were not to happen the organism would die. Indeed, it is an operational fact that the results of a process do not participate of the processes that generate them.

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