

LIVING WAYS OF SENSE MAKING

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My title—"Living Ways of Sense Making"—comes from the title of a paper that Francisco Varela gave in 1981 to the Stanford International Symposium on "Disorder and Order."¹ Building on his work on autopoiesis or the self-producing organization of living beings,² Varela spoke as a neurobiologist concerned with the biology of mind. His paper is notable both for being an early critique of the representationist view of the brain and cognition, and for being an early statement of an alternative view informed by phenomenology—a view we were later to call the enactive view of cognition.³

According to the enactive view, living beings are sense-making beings; they enact or bring forth significance in their intimate engagements with their environments. Here is how Varela put this idea at the outset of this early paper: "Order is order, relative to somebody or some being who takes such a stance towards it. In the world of the living, order is indeed inseparable from the ways in which living beings make sense, so that they can be said to have a world."⁴

"The ways in which living beings make sense"—these words have a double meaning. On the one hand, they refer to how living beings go about their sense-making activities and thereby constitute and inhabit their worlds. On the other hand, they refer to how we understand living beings, how living beings make sense to us. In this way, these words point back to us as those living beings who have a pre-understanding of life and who can therefore raise the question, "what is living being?"

This question is the overarching question of Donn Welton's and John Protevi's papers responding to my book, *Mind in Life*.⁵ Welton has examined how to integrate a "bottom up" phenomenology of biological systems into a phenomenology of intentional consciousness, while Protevi has discussed whether this kind of integration of life and mind might lead us also to panpsychism. My way of entering this discussion

and responding to their rich papers will be to take up again the question, "what is living being?" Or, more simply and precisely, "what is living?"

My essay has four parts. First, I will say more about what I mean when I ask, "What is living?" Second, I will present my way of answering this question, which is that *living is sense-making in precarious conditions*. Third, I will respond to Welton's considerations about what he calls the "affective entrainment" of the living being by the environment. Finally, I will address Protevi's remarks about panpsychism.

What is Living?

To explain what I mean by the question "what is living?" let me contrast it to the question "what is life?" Whereas the first question treats life as a *process*, the second treats life as an *object*. When we ask, "what is life?" we are easily led into trying to define life by certain characteristic properties. For example, here is a recent attempt to define life from the perspectives of biology and medicine: "Life is a self-contained, self-regulating, self-organizing, self-reproducing, interconnected, open thermodynamic network of component properties which performs work, existing in a complex regime which combines stability and adaptability in the phase transition between order and chaos, as a plant, animal, fungus, or microbe."⁶ Whatever we may think of this particular definition, this kind of definition treats life abstractly as a thing or as a natural kind. Thus, already at the outset, a certain objectifying attitude has been taken toward the phenomenon of life.

Even the theory of autopoiesis, which decisively overcomes trying to define life through a list of physical and functional properties, does not necessarily depart from this objectifying attitude. The concept of autopoiesis refers to an *organizational* property: An autopoietic system is one that is organized as a self-producing network of processes that also constitute the system as a

topological unity. In the molecular domain, such a system amounts to a network of molecular reactions that continually generate and realize those reactions, including the reactions that generate and realize a semipermeable boundary, which in turn houses and thereby makes possible those reactions. When Humberto Maturana and Francisco Varela proposed that autopoiesis is necessary and sufficient to describe the organization of living beings—to be living, a system must realize the autopoietic organization, and any system realizing this organization is living—they went beyond viewing life through some indeterminate list of physical and functional properties, to viewing life through a precise specification of its organizational pattern. Nevertheless, and as Varela himself acknowledged,⁷ viewing life this way remains abstract and needs to be linked to concrete experimental and phenomenological analyses of living being.

Such analyses—by Ezequiel Di Paolo, myself, and others, including John Protevi and Donn Welton—have helped to move autopoietic theory beyond focusing simply on life as an organizational pattern in order to attend to living as a purposive and normative process.⁸ Specifically, these analyses have made clear that autopoiesis is necessary but not sufficient for living being. On the one hand, work in synthetic chemistry and theoretical biology has shown that it is possible to construct real chemical systems and abstract mathematical models that are minimally autopoietic in the sense that they self-produce themselves as topological unities through autocatalytic reactions, yet these systems lack the kind of flexible and adaptive interactions with the environment characteristic of even the simplest microorganisms.⁹ These minimal autopoietic systems are basically vesicles that autocatalytically produce their own membrane-like boundary, while also being able to self-repair ruptures to the boundary. Yet beyond self-producing and repairing their own boundary, these systems have no internal self-producing reaction networks—no metabolism—so they cannot adaptively relate themselves to the environment, as bacteria, for example, do when they register the rate of change in the concentration of attrac-

tants and repellents, and change direction accordingly as they swim. On the other hand, phenomenological analyses following Merleau-Ponty and Jonas have described how living beings are intrinsically purposive and relate to their environment through self-generated and self-maintained norms of activity.¹⁰ Thus, bacteria swim up a sucrose gradient because sucrose for them is food and more of it is better than less. But autopoiesis as minimal self-production is not sufficient to ground such purposiveness and normativity, for these require what Ezequiel Di Paolo calls *adaptivity*¹¹—being able to monitor and regulate the autopoietic process in relation to conditions registered as improving or deteriorating, viable or unviable. In sum, according to these conceptual and phenomenological analyses, bare autopoiesis is not sufficient for something to be recognizably living; adaptivity also is required.

By asking “what is living?” instead of “what is life?” I mean to build on these analyses by shifting attention away from life as an object or natural kind or abstract pattern, in order to focus on living as a *process*. By “process” I mean modes of change having phases and rhythms, in which we can recognize dynamic patterns of individuation and behavior—following Merleau-Ponty and Simondon¹²—as well as existential structures—following Jonas.¹³ Let me say more about how I see the relations among these thinkers, or at least how they have inspired my own work on living being.

In his first book, *The Structure of Behavior*, Merleau-Ponty distinguishes between what he calls physical structures and vital structures (where by “structure” or “form,” he means a dynamic pattern that behaves as a whole). Whereas physical structures, such as a soap bubble, obtain equilibrium in relation to *actual* physical conditions of force and pressure, living systems seek equilibrium, in Merleau-Ponty’s words, “with respect to conditions which are only *virtual* and which the system itself brings into existence; when the [system] . . . executes a work beyond its proper limits and constitutes a proper milieu for itself.”¹⁴ For example, bacteria swim up and down chemical gradients by sensing and adjust-

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ing themselves to changes in the rates of concentration of various molecules; in this way (among others), the bacteria constitute a proper milieu for themselves by actively changing their own boundary conditions and adapting themselves to those changes, while registering those changes as better or worse. Thus, Merleau-Ponty says, whereas physical structures can be expressed by a *law*, living structures have to be comprehended in relation to *norms*: “each organism, in the presence of a given milieu, has its optimal conditions of activity and its proper manner of realizing equilibrium,”¹⁵ and every living being “modifies its milieu according to the internal norms of its activity.”¹⁶

Simondon builds on these ideas, but revises and enriches them.¹⁷ A physical individual, such as a soap bubble or a crystal, emerges as a resolution of tendencies within a pre-individual and metastable field—the super-saturated field in the case of a crystal; the liquid medium with various molecular densities in the case of a bubble. So too does a living individual emerge as a resolution of tendencies within a pre-individual and metastable field—in bacterial mitosis, for example, or embryological development in metazoans. But in the case of living individuals, unlike physical individuals, there is not only an individuating process but a process individuating itself, and equilibrium is not stable equilibrium but metastable. This *self-individuating*—we could say *autopoietic*—process is perpetual; it never settles down (except in death) but maintains itself as metastable, that is, as living a life of *tendencies* instead of *states*. In dynamical systems theory, a metastable system, strictly speaking, has no states but only *transients* or tendencies; it never resides in any one basin of attraction, but hovers around an attractor for a while, then is unpredictably ejected into another unstable orbit, which it stays in for a while, until it is unpredictably ejected again, and so on endlessly. Although there are nonliving metastable systems, Simondon points out that what distinguishes the living individual is that its metastability both maintains and is maintained by a “genuine interiority.” The soap bubble has an inside, but it does not have a genuine interior because it does not

have a self-individuating topological boundary; it does not have an autopoietic membrane. In Simondon’s words:

The internal structure of the organism is brought to completion not only as a result of the activity that takes place and the modulation that occurs at the frontier between the interior domain and the exterior—as is the case with a crystal; rather, the physical individual—perpetually ex-centric, perpetually peripheral in relation to itself, active at the limit of its own terrain—cannot be said to possess any genuine interiority. But the living individual does possess a genuine interiority, because individuation does indeed take place within it. In the living individual, moreover, interiority plays a constitutive role, whereas only the frontier plays this role in the physical individual.¹⁸

Although I did not draw from Simondon in *Mind in Life*, his thinking here about interiority seems very close to what I had in mind when I wrote that autopoiesis (in a broad sense that includes adaptivity) is the “self-production of an inside that also specifies an outside to which it is normatively related,” and thus that autopoiesis is best seen as the “dynamic co-emergence of interiority and exteriority.”¹⁹ Yet I also immediately went on to write that “there seems to be an asymmetry here, for it is the internal self-production process that controls or regulates the system’s interaction with the outside environment.”²⁰ To support this point, I quoted two philosophers and theoretical biologists, Alvaro Moreno and Xabier Barandiaran, who have written about what they call, following Varela, the “basic autonomy” of life: “the (self) generation of an inside is ontologically prior to the dichotomy in-out. It is the inside that generates the asymmetry and it is in relation to this inside that an outside can be established. Although the interactive processes [and] relations are necessary for the maintenance of the system, they presuppose it (the system) since it is the internal organization of the system that controls the interactive relations.”²¹

Now, it is precisely this assertion of asymmetry between interior and exterior that Donn Welton suspects of being a kind of “bio-idealism” and that he wants to correct with his notion

of “affective entrainment,” whereby the environment leads the organism into certain rhythms, behaviors, and internal transformations. John Protevi has also wondered whether Varela’s notion of an autonomous system “overemphasizes the individual as self-conserving product as opposed to individuation as always ongoing process.”²² From a different but related angle, Susan Oyama, one of the principal architects of developmental system theory in biology,²³ has also expressed worries about the privileging of interiority in autopoietic discourse. I will say more about this issue later, but let me say now that I am sympathetic to their friendly and helpful criticisms, for a certain tendency to privilege interiority in autopoietic discourse has always worried me. I felt that worry in writing those words in *Mind in Life* about the reciprocal yet asymmetrical relation between interiority and exteriority, but I did not adequately address the worry because of another argument I was trying to advance, specifically that the genuine interiority of life is a precursor to the interiority of consciousness, and hence that the conception of nature presupposed in standard formulations of the hard problem or explanatory gap for consciousness—namely, that living nature has no genuine interiority—is misguided. So the task is to see whether we can retain the crucial advance that a phenomenological reading of the theory of autopoiesis provides, while situating that advance in an enriched and more balanced account of the dynamic co-emergence and mutual entrainment of living processes and their environments. I will come back to this issue later.

Let me now bring Jonas’s perspective on the interiority of life into this discussion, for it is Jonas who gives us the resources for a phenomenological reading of autopoiesis (as Varela himself appreciated). What Jonas adds to Simondon’s statement that living individuals possess a genuine interiority, and to Maturana and Varela’s specification of the autopoietic organization required for genuine interiority, is a specifically existential perspective on that interiority. Jonas announces that perspective on the first page of the Foreword to his book, *The Phenomenon of Life*:

The great contradictions which [humanity] discovers in [itself]—freedom and necessity, autonomy and dependence, self and world, relation and isolation, creativity and mortality—have their rudimentary traces in even the most primitive forms of life, each precariously balanced between being and not-being, and each already endowed with an internal horizon of “transcendence.”²⁴

Jonas finds these contradictions in the most basic living process of metabolism. In its simplest unicellular forms, metabolism consists in the constant regeneration of the cell as a dynamic pattern through a ceaseless flux of matter and energy. A living individual must constantly regenerate the molecules that constitute it, yet its being as an individual through time coincides not with them but with the ongoing pattern of self-generation. In this way, the individual exists in what Jonas calls a condition of “needful freedom”—its freedom to change itself is also its necessity. Jonas highlights three existential characteristics of this needful freedom. First, it establishes a “self” in the sense of an individual whose being is its own doing and whose doing is its being; and whose being and doing in relation to the environment depend on a self-generated topological boundary or interface between interiority and exteriority. Second, this self necessarily exists in precarious conditions, for its being and doing consist in renewing itself constantly in a changing and challenging environment. Third, such self-renewal is intrinsically normative because it parses events into those which are favorable or unfavorable for continued being and doing.

Jonas also finds in metabolism the rudimentary traces of space and time as forms of experience. Metabolism brings forth the living form of space because it necessarily involves the formation of a membrane as a topological boundary that defines and selectively relates inside and outside, and thereby enables the organism to behave as a unity in relation to its environment. Metabolism brings forth the living form of time because its rhythms establish a living present, a virtual horizon of conserved conditions and projected needs—the vital analogues of retentions and protentions in the living present of time-consciousness. Metabolism propels the organism outward and forward, beyond its present condi-

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tion in space and time. On the one hand, space founds time because the topological boundary of the organism makes possible the metabolic rhythms; on the other hand, time founds space because these rhythms create the boundary and orient the organism toward its world. Jonas, following certain lines of thought in Husserl and Heidegger, ultimately founds space on time:

self-concern, actuated by want, throws open . . . a horizon of time that embraces . . . inner imminence: the imminence of that future into which organic continuity is about to extend by the satisfaction of that moment's want . . . In fact, [life] faces outward only because . . . it faces forward: so that spatial presence is lighted up as it were by temporal imminence and both merge into past fulfillment (or its negative, disappointment).²⁵

Jonas's existential analysis illustrates well the point that understanding living as a process presupposes our self-experience of living and demands a phenomenological account of that self-experience. Self, world, freedom, necessity, spatiality, temporality—we are acquainted with these existential structures through our self-experience as living beings. The organism as a self-individuating unity relating to its world—this phenomenon can show up or come into focus for us only because we experience ourselves as such beings. As Merleau-Ponty says, “I cannot understand the function of the living body except by enacting it myself, and except in so far as I am a body which rises toward the world.”²⁶ Or in Jonas's pithy phrase: “life can be known only by life.”²⁷

Sense-Making

I am now in position to propose a way to answer our guiding question, “what is living?” By “answer” I certainly do not mean a resolution of the question; I mean, rather, a way of responding to it that continues the conversation the question opens and orients that conversation in a certain direction. Here, then, is my answer: *Living is sense-making in precarious conditions.*

Before saying more about this proposition, I want to make clear that it is not meant as a definition or provision of necessary and sufficient con-

ditions. It is meant instead to help elucidate or clarify in a general way living as a phenomenon (in the phenomenological sense of that term). In other words, I hope to cast light on how living as a process appears or shows itself, or is disclosed, both to phenomenology and to scientific observation and experimentation. The proposition, “Living is sense-making in precarious conditions,” is thus first and foremost a phenomenological proposition belonging to a phenomenology of living being. This phenomenology is one that plunges into the empirical sciences of life and mind, allowing itself to be guided by their findings, while also making visible to those sciences how our self-experience as living beings inescapably and necessarily constitutes our understanding of life as an object of scientific investigation. In this way, phenomenology can also play an important role as a critique of false consciousness in the sciences of life and mind.

I turn now to the notion of sense-making. Since minimal or stripped-down examples can be instructive, I want to consider again the bacteria, the oldest and smallest kind of living being, as well as the evolutionary and modern symbiotic basis for every other form of life we know—the plants, animals, fungi, and protoctists. Specifically, I want to consider the phenomenon known as bacterial chemotaxis. Many bacteria are rod-shaped and swim by means of rotating flagella embedded in their membranes. These bacteria can detect around fifty distinct chemicals, including sugars and amino acids that attract the cells so they swim toward them, as well as acids and heavy metals that repel the cells so they swim away. The bacteria swim by coordinating the rotation of their flagella so they form a propeller; when the flagellar rotation is uncoordinated, the cells tumble about randomly. As the cells move, they are able to register temporal differences in the levels of attractants and repellents—for example, in the rate of change in the concentration of sucrose or aspartate (which the cells can feed on). The cells maintain their direction as long as they detect an increase in the nutrient level over time. If the nutrient level decreases, then the cells go into their random tumbling mode, until they hit on an orientation where they again detect an

increase, at which point off they go in that direction. By repeating these behaviors—swimming in the same direction as long as conditions are improving or not getting any worse, and tumbling when conditions start deteriorating—bacteria can travel long distances toward favorable locales.

Bacterial chemotaxis provides a minimal yet rich and fundamental case of living as sense-making in precarious conditions. Sucrose and aspartate, for example, have valence as attractants and significance as food, but only in the milieu or niche that emerges through bacterial living. Put another way, the status of these molecules as nutrients is not intrinsic to their molecular structure; nor is it even simply a relational feature of how these molecules can bond to other molecules in the cell membrane. Rather, it belongs to the context of the cell as an individual, that is, as a self-individuating process that behaves as a unity in dynamic concert with its immediate environment. When Merleau-Ponty writes, in his lecture course on *Nature* (discussing von Uexküll), “the reactions of the animal in the milieu . . . behaviors . . . deposit a surplus of significance on the surfaces of objects,”²⁸ his description applies also to microbial life: the reactions of the bacteria in their milieu—their tumbling and directed swimming—deposit a surplus of significance on the surfaces of molecules. Clearly, this significance depends on the structural features of physiochemical processes; it depends on the molecules being able to form a gradient, traverse a cell membrane, and so on. For this reason—and here I distance myself from Welton’s reading of my views—the physicochemical world is not formless and undifferentiated, receiving form only from living beings; rather, the physicochemical world is a morphodynamical world of qualitative discontinuities that offer regions of salience for living beings. But the significance and valence of these saliencies as attractants and repellents emerges only given the bacterial cell as a metabolic and behavioral unity—in other words, as a living being.

Let me say something about the notion of precarious conditions, which comes from Ezequiel

Di Paolo’s work on autopoiesis.²⁹ Imagine you are very small, so that you are continually buffeted by water molecules and bumped off course, while the watery contents inside you are in constant motion. Such is the external and internal milieu of bacteria, the microworld of thermal diffusion and Brownian motion. How do you hold together as a living being? You depend completely, of course, on the chemical properties of strong and weak bonds, but you also hold together because you are autopoietic and therefore have a kind of circular organization—every one of your constituent processes is both enabled by and is an enabling condition for one or more of your other constituent processes, so that together they form a recursive and interlocking network. Precarious conditions are ones in which such processes cannot sustain themselves in the absence of this network in otherwise equivalent physical situations. In other words, remove such processes from their enabling networks and they will tend to run down or atrophy. Any living process is precarious in this sense: Break open a cell and its metabolic constituents diffuse back into a molecular soup; take an ant out of a colony and it eventually dies; remove a person from a relationship and she or he may cease to flourish.

The notion of precariousness thus provides another way to characterize the peculiar mixture of disorder and order, instability and stability—which is to say, metastability—that is constitutive of living as a process of sense-making. As Di Paolo says, “life would not be better off without precariousness; it simply would not be life at all.”³⁰

Clearly much more needs to be said about sense-making in precarious conditions beyond my bacterial example. My proposal, spelled out in *Mind in Life*, is that living as sense-making in precarious conditions is the living source of intentionality. Sense-making is threefold: (1) sensibility as openness to the environment (intentionality as openness); (2) significance as positive or negative valence of environmental conditions relative to the norms of the living being (intentionality as passive synthesis—passivity, receptivity, and affect); and (3) the direction or orientation the living being adopts in

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response to significance and valence (intentionality as protentional and teleological). This threefold framework structures my discussions in *Mind in Life* of the sensorimotor and affective sense-making of animal life, which is made possible by the unique structure of the nervous system, as well as my discussions of human forms of sense-making, such as time-consciousness, emotion, and the participatory sense-making of empathy and social cognition. I cannot say more about those discussions here, so I turn now to my responses to Welton and Protevi.

Affective Entrainment

Welton puts his finger on a crucial pressure point—the issue of asymmetry versus symmetry in the reciprocal coupling of living beings and their worlds. On the one hand, the adaptive-autopoietic process is said to “bring forth” or “enact” what counts as the living being’s world, and not the reverse; on the other hand, the living being and its environment are said to be “structurally coupled,” and interiority and exteriority are said to be “dynamically co-emergent.”

At this point, I would like to inject an autobiographical remark to indicate how long this tension has preoccupied me. When Varela and I were working together on our book *The Embodied Mind*, it was the late nineteen-eighties and I was a graduate student. It was during those years that Varela introduced into his work the terminology of organisms “enacting” and “bringing forth” their worlds, rather than representing them (though, of course, this idea was already implicit in his work on autopoiesis with Maturana). This way of talking worried me—precisely for its not fully worked-out suggestion of some kind of idealism or constructivism. So whenever Varela would write that the organism enacts its world, I would try to rewrite the sentence to say that a world is brought forth or enacted by the structural coupling of the organism and its environment. My aim was to shift the emphasis away from the organism as the enactor of its world to the relational process of enactment. Varela was happy with these changes, as they fitted better his other sympathies (and mine) with the Indian Buddhist concept of dependent co-origination

(*pratītyasamutpāda*).³¹ Nevertheless, my rewording clearly did not deal adequately with the tension, for the question of the asymmetrical versus symmetrical status of the organism—or of the adaptive autopoietic process—in the relational process of enactment remained unanswered.

Welton proposes a way to resolve this tension with his notion of affective entrainment. He writes, referring specifically to the requirement of adaptivity for sense-making:

Adaptation is much more than a dynamic adjustment allowing the organism to get along better with its habitat according to internal self-generated norms. It is also a transformation of the organism’s internal processes and norms according to the demands of an environment that introduces “sense-producing” or “sense-demanding” requirements of its own. . . . The environment that the organism opens or *enacts* is also the world that *entrains* it and reflexively transforms both the processes and the structure of the cell “reacting” to it.

Thus, in the case of bacteria, the presence of sucrose exerts an “extrinsic” control over chemotaxis; in dynamical systems language, sucrose acts as an external control parameter, entraining the cells to swim up-gradient. And it is precisely this entrainment, Welton says, that accounts for the status of sucrose as attractant.

I welcome and agree completely with these points. Living as sense-making in precarious conditions is *systemically generated*, with living beings enacting environments that pull them along into certain rhythms, behaviours, and internal transformations. (This point becomes especially important when we remember that the environment is always an environment of other living beings—bacteria do not live in isolation but in microbial communities.) In Welton’s words: “*The organism enacts an environment as the environment entrains the organism. Both are necessary and neither, by itself, is sufficient for the process of sense-making.*”

But now comes the tricky point. What we have just said implies that the relation between organism and environment is *reciprocal*, for each acts as a control parameter for the other. But this kind

of reciprocity does not imply that their relation is not also *asymmetrical*, in the relevant sense of asymmetry. Although the physical and energetic coupling between a living being and the physicochemical environment is symmetrical, with each partner exerting more influence on the other at different times, the living being *modulates* the parameters of this coupling in a way the environment typically does not.³² Living beings, precisely because they are autopoietic and adaptive, can “surf” environmental events and modulate them to their own ends, like a bird gliding on the wind. *Interactional asymmetry* is precisely this capacity to modulate the coupling with the environment.³³ If we lose sight of this interactional asymmetry, then we lose the ability to account for the directedness proper to living beings in their sense-making, and hence we lose the resources we need to connect sense-making to intentionality.

There is one more issue in Welton’s paper on which I want to comment briefly. Welton suggests that the notion of affective entrainment reintroduces the importance of spatiality for transcendental aesthetics in a biological phenomenology, in contrast to Jonas’s privileging of temporality. I cannot discuss this complex matter here, but since *Mind in Life* could be read as endorsing Jonas on this point, I would like to record here that I am far more drawn to the idea that spatiality and temporality are co-originary and co-founding, for the reasons I mentioned earlier and for the related reasons Welton gives. I call attention to the point here because I think this co-founding relation becomes especially important when we go in the other, “top-down” direction from the phenomenology of intentional consciousness to life and the body, for an important project there is to show how the structures of consciousness implicate not just a phenomenal lived body but a flesh and blood living body.

Panpsychism

In this last section, I respond to Protevi’s paper. I find the links he makes between my project in *Mind in Life* and Deleuze’s writings fascinating, but I do not know Deleuze well enough to re-

spond, so I am going to focus on the question of panpsychism.

Protevi thinks my conception of the “deep continuity” of life and mind, although escaping from the Cartesian problem of the relation between the mental and the physical, lands us with the problem of the emergence of life and mind from nonlife. He wonders whether I am too restrictive in my conception of mind, which traces mind back to living as sense-making. And given that I work with the notions of processes and networks as webs of processes, what is to stop me from embracing the kind of process panpsychism we find in Whitehead or Deleuze?

To address this issue I want to go back to Jonas and compare him to Merleau-Ponty and Simondon, because it is on precisely this issue about matter and life—or what Merleau-Ponty (in *The Structure of Behavior*) calls the physical order and the vital order—that I follow Merleau-Ponty and Simondon, and not Jonas.

Jonas contrasts the *wave* and the *organism*.³⁴ The wave he takes to be a material aggregate, which, as “an intergrated event-structure,” has no ontologically emergent status. He writes that to the wave “no special reality is accorded that is not contained in, and deducible from, the conjoint reality of the participating, more elementary events.” In other words, Jonas accepts analytical and ontological reductionism for physical phenomena. What he then argues is that this kind of reductionism fails in the case of the organism, which *is* ontologically emergent. Life, as he puts it, is thus an “ontological surprise.”

Now, if we follow this line of thought, then I think we do face a serious life-matter problem, analogous to the mind-body problem. How does life emerge from nonlife? The panpsychist argues that we cannot make good on this invocation of emergence, that it is ultimately mysterious. Hence the options would seem to be either some kind of dualism or some kind of panpsychism.

But this line of thought is not at all the one we find in Merleau-Ponty and Simondon. Already in *The Structure of Behavior*, Merleau-Ponty rejects analytical reductionism for physical forms like waves, soap bubbles, and convection rolls. As he says, “The genesis of the whole by composition

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of the parts is fictitious. It arbitrarily breaks the chain of reciprocal determinations.”³⁵ Consider also this passage, which I quote in *Mind in Life*:

each local change in a [physical] form will be translated by a redistribution of forces which assures us of the constancy of their relation; it is this internal circulation which is the system as a physical reality. And it is no more composed of parts which can be distinguished in it than a melody (always transposable) is made of the particular notes which are its momentary expression. Possessing internal unity inscribed in a segment of space and resisting deformation from external influences by its circular causality, the physical form is an individual. It can happen that, submitted to external forces which increase and decrease in a continuous manner, the system, beyond a certain threshold, redistributes its own forces in a qualitatively different order which is nevertheless only another expression of its immanent law. Thus, with form, a principle of discontinuity is introduced and the conditions for a development by leaps or crises, for an event or for a history, are given.³⁶

As I say in *Mind in Life*, this description of physical form as introducing a principle of discontinuity and the conditions for development by “crises” has been borne out by René Thom’s “catastrophe theory,” which mathematically describes abrupt transitions and qualitative discontinuities in physical systems, and by Jean Petitot’s extension of Thom’s work to a morphodynamical “physics of phenomenality,” which aims to bridge the gap between the microphysical substrate and macrophysical forms.

Simondon’s account of macrophysical forms as processes of individuation from a pre-individual metastable field presents a similar description of matter. This description too rejects the analyti-

cal reductionist picture of the physical that Jonas uses to contrast matter and life.

Thus, in both cases—Simondon and Merleau-Ponty—what we find is a reconceptualization of matter, life, and mind, one that does not bring mind down into the domain of microphysical processes nor equate mind with information transfer and self-organization, but rather tries to show how the notion of form as dynamic pattern or individuation process can both integrate or bridge the orders of matter, life, and mind, while also accounting for the originality of each order. This is the path I try to follow in *Mind in Life* and not panpsychism.

Nevertheless, I have to admit that my characterization in *Mind in Life* of life as “autopoiesis plus cognition” could be read as simply equating mind and life, and hence opening a door for the panpsychist line of thought. What I would now rather say is that living is sense-making and that cognition is a kind of sense-making. A wave or a soap bubble is an individuating process but not a sense-making one, because it does not modulate its coupling with the environment in relation to virtual conditions and norms. A unicellular organism is a self-individuating and sense-making being but not a cognitive one, if by “cognitive” we mean being intentionally directed toward objects as unities-in-manifolds having internal and external horizons. What is important to me is not to fix the meanings of the words or concepts “matter,” “life,” “mind,” “cognition,” and so on—this effort would be misguided, since the richness of these words comes from their irreducible polysemy. Rather, my aim is to see whether we can chart multiple passages back and forth between those orders that we conceptualize, in different ways and at different times, as matter, life, and mind.

NOTES

1. Francisco J. Varela, “Living Ways of Sense-Making: A Middle Path for Neuroscience,” in Paisely Livingston, ed., *Disorder and Order: Proceedings of the Stanford International Symposium* (Sept. 14-16, 1981) (Anmi Library, 1984), 208.
2. Humberto R. Maturana and Francisco J. Varela, *Autopoiesis and Cognition: The Realization of the Living*. Boston Studies in the Philosophy of Science, volume 42 (Dordrecht: D. Reidel, 1980).

3. Francisco J. Varela, Evan Thompson, and Eleanor Rosch, *The Embodied Mind: Cognitive Science and Human Experience* (Cambridge, MA: The MIT Press, 1991). For a more recent statement of the enactive approach, see my *Mind in Life: Biology, Phenomenology, and the Sciences of Mind* (Cambridge, MA: Harvard University Press, 2007).
4. Varela, "Living Ways of Sense-Making," 208.
5. Donn Welton, "Can a Top-Down Phenomenology of Intentional Consciousness Be Integrated with a Bottom-Up Phenomenology of Biological Systems?" and John Protevi, "Deleuze, Jonas, and Thompson: Toward a New Transcendental Aesthetic and a New Question of Panpsychism."
6. Peter T. Macklem and Andrew Seely, "Towards a Definition of Life," *Perspectives in Biology and Medicine* 53 (year): 331.
7. See Andreas Weber and Francisco J. Varela, "Life After Kant: Natural Purposes and the Autopoietic Foundations of Biological Individuality," *Phenomenology and the Cognitive Sciences* 1 (year): 97–125.
8. See *Mind in Life*, Chapters 5 and 6.
9. Ibid.
10. See Maurice Merleau-Ponty, *The Structure of Behavior*, trans. Alden Fisher (Pittsburgh: Dusquene University Press, 1963), and *Nature: Course Notes from the Collège de France*, compiled with notes by D. Ségard, trans. Robert Vallier (Evanston: Northwestern University Press, 2003); Hans Jonas, *The Phenomenon of Life* (Chicago: University of Chicago Press, 1966).
11. Ezequiel di Paolo, "Autopoiesis, Adaptivity, Teleology, Agency," *Phenomenology and the Cognitive Sciences* 4 (2005): 429–52.
12. See Merleau-Ponty, *The Structure of Behavior* and *Nature*; Gilbert Simondon, "The Genesis of the Individual," in Jonathan Crary and Sanford Kwinter, eds., *Incorporations* (New York: Zone Books, 1992), 297–319.
13. See Jonas, *The Phenomenon of Life*.
14. Merleau-Ponty, *Structure of Behavior*, 145–46. My italics.
15. Ibid., 148.
16. Ibid., 154.
17. Simondon, "The Genesis of the Individual."
18. Ibid., 305–06.
19. *Mind in Life*, 79.
20. Ibid.
21. A. Moreno and X. Barandiaran, "A Naturalized Account of the Inside-Outside Dichotomy," *Philosophica* 73 (2004): 17.
22. John Protevi, "Larval Subjects, Autonomous Systems, and E. Coli Chemotaxis," unpublished.
23. Susan Oyama, S. *The Ontogeny of Information. Developmental Systems and Evolution*, 2nd edition. (Durham, NC and London: Duke University Press, 2000; first edition published by Cambridge University Press, 1985).
24. Jonas, *The Phenomenon of Life*, x.
25. Ibid., 85.
26. Maurice Merleau-Ponty, *Phenomenology of Perception*, trans. Colin Smith (London: Routledge Press, 1962), 75.
27. Jonas, *The Phenomenon of Life*, 91.
28. Merleau-Ponty, *Nature*, 172–73.
29. See especially Ezequiel Di Paolo, "Extended Life," *Topoi* 28 (2009): 9–21.
30. Ibid., 16n5.
31. See our discussion of this notion in *The Embodied Mind*.
32. See Xabier Barandiaran, Ezequiel Di Paolo, and Marieke Rhode, "Defining Agency: Individuality, Normativity, Asymmetry, and Spatiotemporality in Action," *Adaptive Behavior* 17 (2009): 367–86.
33. Ibid.
34. See his "Is God a Mathematician? On the Meaning of Metabolism," in *The Phenomenon of Life*.
35. Merleau-Ponty, *The Structure of Behavior*, 50.
36. Ibid., 137.

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