2012 CSCP GRADUATE ESSAY PRIZE WINNER
PRIX DE L'ESSAI ÉTUDIANT SCPC 2012

SENSE-MAKING AND SYMMETRY-BREAKING: MERLEAU-PONTY, COGNITIVE SCIENCE, AND DYNAMIC SYSTEMS THEORY

Noah Moss Brender (McGill University)

From his earliest work forward, Merleau-Ponty attempted to develop a new ontology of nature that would avoid the antinomies of realism and idealism by showing that nature has its own endogenous sense which is prior to reflection. The key to this new ontology was the concept of form*, which he appropriated from Gestalt psychology. However, Merleau-Ponty struggled to give a positive characterization of the phenomenon of form which would clarify its ontological status. Evan Thompson has recently taken up Merleau-Ponty's ontology as the basis for a new, "enactive" approach to cognitive science, synthesizing it with concepts from dynamic systems theory and Francisco Varela's theory of autopoiesis. However, Thompson does not quite succeed in resolving the ambiguities in Merleau-Ponty's account of form. This article builds on an indication from Thompson in order to propose a new account of form as* asymmetry*, and of the genesis of form in nature as* symmetry-breaking*. These concepts help us to escape the antinomies of Modern thought by showing how nature is the autoproduction of a sense which can only be known by an embodied perceiver.*

Merleau-Ponty's signature contribution to epistemology, which takes up and extends one of Heidegger's fundamental insights[1], is the discovery of a pre-reflective, corporeal relation to the world which is prior to theoretical knowledge, language, and self-consciousness, and takes place through the perception and move-

[1] Martin Heidegger, *Being and Time*, (tr.) J. Macquarrie and E. Robinson (New York: Harper & Row, 1962), Division One, Section III.

ment of the living body. This is a naturalized epistemology[2], in that it places knowing back into nature; in order to accomplish this, however, we must not only revise our concept of knowledge, but also our concept of nature.[3] In particular, Merleau-Ponty argues that we cannot understand how knowledge arises within nature unless we abandon the Cartesian view of nature as a machine composed of mutually external and indifferent parts.

If nature is a mechanism then it has no intrinsic meaning or unity. Thus nature could only be meaningful for a constituting consciousness that imposes a meaning on it by synthesizing its disconnected parts into an ideal whole. However, this amounts to denying that we can know nature at all. First, it means that nature can only be known from the outside, from a God's-eye-view that could comprehend it as an object. But this is not our situation; we find ourselves born into a nature that is older than thought, and indeed gives rise to it—a nature that we can never encompass or transcend. "Nature is an enigmatic object, an object that is not entirely an object; it does not exactly stand before us. It is our soil, not that which faces us, but that which carries us." (N 4/20; trans. mod.)[4] It is precisely for this reason that we wish to *naturalize* epistemolo-

---

[2] We could equally call it a naturalized phenomenology. The question of whether or not phenomenology can be naturalized has been much discussed of late. See, *e.g.*, Jean Petitot et al., eds., *Naturalizing Phenomenology: Issues in Contemporary Phenomenology and Cognitive Science* (Stanford, CA: Stanford Univeristy Press, 1999); Sean Gallagher, "On the Possibility of Naturalizing Phenomenology," in *The Oxford Handbook of Contemporary Phenomenology*, (ed.) D. Zahavi (Oxford: Oxford University Press, 2012); Dan Zahavi, "Naturalized Phenomenology: A Desideratum or a Category Mistake?," *Royal Institute of Philosophy Supplement*, vol. 72 (2013), 23–42.

[3] See David Morris, "From the Nature of Meaning to a Phenomenological Refiguring of Nature," *Royal Institute of Philosophy Supplement*, vol. 72 (2013), 317–41. See also Renaud Barbaras, "The Movement of the Living as the Originary Foundation of Perceptual Intentionality," in Petitot et al., eds., *Naturalizing Phenomenology*.

[4] Texts by Merleau-Ponty will be cited parenthetically in the text with the English pagination followed by the French, and abbreviated as follows: *The Structure of Behavior* (SB), (tr.) A. L. Fisher (Pittsburgh: Duquesne University Press, 2006); *Phenomenology of Perception* (PP), (tr.) D. Landes (New York: Routledge, 2012); "Titres et Travaux" (TT), in *Parcours deux: 1951–1961* (Paris: Verdier, 2001); *Nature: Course Notes from the Collège de France* (N), (tr.) R. Vallier (Evanston: Northwestern University Press, 2003); *The Visible and the Invisible* (VI), (tr.) A. (Evanston: Northwestern University Press, 1968).

gy—to understand how knowledge arises *within* nature. Second, if the only meaning we can find in nature is one that we ourselves put into it, then nature ceases to be an object of knowledge that transcends consciousness and becomes instead an idea within consciousness—a representation or mental construct.[5]

The problem is for consciousness to reflect on its own emergence within nature, without projecting the results of this reflection back into its conditions.[6] There must be something for us to know, some nascent intelligibility in nature that is not placed there by us—otherwise, knowing would be impossible. But this natural meaning must not yet be an idea for a consciousness—otherwise, knowing would already have taken place. For knowledge to be possible at all, then, nature must have its own endogenous meaning which is prior to thought.[7] As Merleau-Ponty says in the lecture courses on *The Concept of Nature* that he gave near the end of his life, "Nature is what has a sense [*sens*], without this sense having been posited by thought. It is the autoproduction of a sense." (N, 3/19; trans. mod.) Thus Merleau-Ponty transforms epistemological questions into ontological ones: what is this natural meaning that is prior to thought, and how do such meanings arise in nature without being posited by consciousness? How are we to think a sense that is the source of all thought, but is not itself an idea?

In order to answer these questions, Merleau-Ponty turns to the natural sciences—not only to criticize them, as his phenomenological predecessors had[8], but also to learn from them:

> Thus, on the one hand it is necessary to follow the spontaneous development of the positive sciences by asking whether man is really reduced to the status of an object here, and on the other hand we must reconsider the reflexive and philosophical attitude by investigating whether it really gives us the right to de-

[5] Ted Toadvine, *Merleau-Ponty's Philosophy of Nature* (Evanston: Northwestern University Press, 2009), 11ff. This objection applies equally to postmodern accounts that take nature to be a *social* or *linguistic* construction.
[6] Kym Maclaren, "Embodied Perceptions of Others as a Condition of Selfhood? Empirical and Phenomenological Considerations," *Journal of Consciousness Studies*, vol. 15, no. 8 (2008), 72.
[7] David Morris, "The Nature of Meaning," 317ff.
[8] See, *e.g.*, Edmund Husserl, *The Crisis of European Sciences and Transcendental Phenomenology*, (tr.) D. Carr (Evanston: Northwestern University Press, 1970) and Martin Heidegger, "Science and Reflection," in *The Question Concerning Technology and Other Essays*, (tr.) W. Lovitt (New York: Harper & Row, 1977).

> fine ourselves as unconditioned and timeless subjects. It is possible that these converging investigations will finally lead us to see a milieu which is common to philosophy and the positive sciences, and that something like a third dimension opens up, this side of the pure subject and the pure object, where our activity and our passivity, our autonomy and our dependence no longer contradict one another. (TT, 13)[9]

The key to this new "dimension," for Merleau-Ponty, is the concept of *Gestalt*[10]: a non-synthetic whole that cannot be analyzed into mutually external parts. Merleau-Ponty appropriates this concept—which he translates as "form" (*forme*) or "structure" (*structure*)—from the German school of Gestalt psychology. However, he argues that the Gestalt psychologists have failed to recognize the true ontological significance of their discovery. In the phenomenon of form, Merleau-Ponty finds "intelligibility in its nascent state" (SB, 207/223; trans. mod.): a self-organizing whole that is not a machine, and does not need an intellectual synthesis to constitute it. Because it is neither a thing nor an idea (SB, 127/138), form seems to point beyond the old antinomies toward a new ontology. Everything depends, however, on whether and how it is possible to think a whole that resists analysis. Form is not reducible to its parts, but neither is it anything *other* than those parts. "How then are we to understand this relation of the totality to its parts? What status must we give totality?" This question, Merleau-Ponty says, "is at the center of this course on the idea of Nature *and maybe the whole of philosophy*." (N, 145/194; my emphasis)

Merleau-Ponty's first—and in some ways most complete—attempt to articulate a *Gestalt* ontology can be found in his first book, *The Structure of Behavior*.[11] Merleau-Ponty never abandoned

[9] Translation taken from Bernhard Waldenfels, "Perception and Structure in Merleau-Ponty," *Research in Phenomenology*, vol. 10, no. 1 (1980), 21.

[10] "Indeed, it is no exaggeration to say that from the beginning to the end, Merleau-Ponty was attempting to think the form discovered by Gestalt psychology; and that in this sense, form takes the place of the 'thing itself' to which the Husserlian precept enjoins us to return: all of Merleau-Ponty's descriptions, of behaviour as of the perceived world, are guided and constrained by the *Gestalt*." Renaud Barbaras, "Merleau-Ponty et la psychologie de la forme," *Les Études philosophiques*, vol. 57, no. 2 (2001), 151–63, here 151; my translation.

[11] Toadvine, *Merleau-Ponty's Philosophy of Nature*, 21. I am here siding with Toadvine against commentators who argue that Merleau-Ponty only turned to

this ontology, referring back to this book repeatedly in later works. However, he was never satisfied with the account of form he had inherited from Gestalt psychology, which defines it as a whole that cannot be reduced to the sum of its parts. In a working note from 1959, near the end of his life, Merleau-Ponty criticizes this as "a negative, exterior definition"—it says what form is *not*, but does not succeed in explaining what it *is*. (VI, 204/255) Unfortunately, Merleau-Ponty died without having discovered the positive account of form that he was searching for.

Recently, there has been a resurgence of interest in *The Structure of Behavior* and Merleau-Ponty's *Gestalt* ontology. Of particular note are Ted Toadvine's *Merleau-Ponty's Philosophy of Nature* (2009), and Evan Thompson's *Mind and Life: Biology, Phenomenology, and the Sciences of Mind* (2007).[12] Toadvine turns to Merleau-Ponty's ontology in search of a new philosophical approach to our present environmental crisis. Thompson takes Merleau-Ponty's ontology as the basis for a new, "enactive" approach to cognitive science, synthesizing it with concepts from dynamic systems theory and Francisco Varela's theory of autopoiesis. However, both Toadvine and Thompson identify a troubling ambiguity in *The Structure of Behavior*'s account of form and its relation to consciousness—an ambiguity which stems from Merleau-Ponty's failure to clarify the ontological status of form.

In this article, I attempt to resolve this ambiguity by offering a new account of form which builds on Thompson's use of concepts from dynamic systems theory. I begin by summarizing the argument of the *Structure* and explaining the ambiguity that Toadvine and Thompson identify in it. Next, I discuss Thompson's appropriation of Merleau-Ponty's ontology. I argue that Thompson fails to clarify the ontological status of the *Gestalt*, and that as a result, his enactive account of cognition or "sense-making" exhibits the same

---

ontology toward the end of his life, when he was writing *The Visible and the Invisible*, and that this turn constituted a break with his earlier, phenomenological project. Probably the most influential advocate of the latter reading is Renaud Barbaras, *e.g.*, in *The Being of the Phenomenon: Merleau-Ponty's Ontology*, (tr.) T. Toadvine and L. Lawlor (Bloomington, IN: Indiana University Press, 2004).

[12] Other examples include Brett Buchanan, *Onto-Ethologies: The Animal Environments of Uexküll, Heidegger, Merleau-Ponty, and Deleuze* (Albany: SUNY Press, 2008) and Douglas Low, "The continuing relevance of *The Structure of Behavior*," *International Philosophical Quarterly*, vol. 44, no. 3 (2004), 411–30.

ambiguity that troubles Merleau-Ponty's ontology. In Part Three, I work out the implications of Thompson's suggestion that natural forms arise through *symmetry-breaking*, in order to offer a new account of form as *asymmetry*. Finally, I argue that this account can help us to resolve the ambiguity in Merleau-Ponty's ontology, as well as in Thompson's account of sense-making.

1. Merleau-Ponty's *Gestalt* Ontology

In *The Structure of Behavior*, Merleau-Ponty introduces the concept of *form* through a critique of behaviourism. (SB, 3–4) He argues that the biology and psychology of his time have maintained, contrary to their own principles, certain metaphysical presuppositions that cannot be justified empirically. Specifically, Merleau-Ponty argues that they have uncritically inherited the Cartesian view that nature in general, and the living body in particular, are *machines*.

The essence of the machine is its *decomposability*: to say that nature is a machine is just to say that it can be analyzed into independent parts. From a "naïve," pre-scientific point of view, behaviour—both human and animal—appears to be a coordinated, goal-directed activity that responds creatively to the meaning of its situation. If the living body is a machine, however, then its behaviour must admit of a mechanical explanation: both behaviour and its causes must be decomposable into simple parts in such a way that the same elementary cause always produces the same elementary effect.

> To explain nerve functioning can only be to reduce the complex to the simple, to discover the constant elements of which behavior is constituted. Thus one would decompose the stimulus as well as the reaction until one encountered the "elementary processes" composed of a stimulus and a response which were always associated in experience. (SB, 11/9)
> The adaptation of the response to the situation would be explained by pre-established correlations (often conceived as anatomical structures) between certain organs or receptor apparatuses and certain effector muscles. (SB, 8–9/6–7)

Thus the meaning of the organism's situation would be explained away along with the unity of its body and its behaviour: "If behavior seems intentional, it is because it is regulated by certain pre-established nerve pathways in such a way that I in fact obtain satisfaction. The 'normal' activity of an organism is only the functioning of this apparatus constructed by nature; there are no genuine norms; there are only effects." (SB, 9/7)

When experimental scientists attempted to put this theory into practice, however, the results were not at all what they expected. The "elementary reflex" which was supposed to be the basic unit of behaviour—a simple sensory stimulus that always produces the same simple response—turned out to be largely mythical. Such constant conjunctions could hardly be produced, even under the most artificial laboratory conditions. Instead, the effect of a given stimulus was found to vary according to the presence or absence of other stimuli, the history of the organism, and the activity it was engaged in. But if the effects of one stimulus cannot be isolated from those of another then perception cannot be decomposed into a collection of elementary stimuli. If there are no elementary stimuli—*i.e.*, no stimuli that invariably produce the same motor response—then behaviour cannot be decomposed into a collection of elementary reflexes. And if there are no elementary reflexes then the nervous system cannot be decomposed into a collection of isolated circuits connecting individual sensors to individual effectors. Thus the living body exhibits in its perception, behaviour, and anatomy the existence of wholes that cannot be analyzed into independent parts. It was this that led certain psychologists to reject the mechanistic assumptions of behaviourism and introduce the concept of the *Gestalt*.[13]

If the decomposability of the machine implies a mechanical understanding of causality, then the existence of *form* implies a non-mechanical causality, which Merleau-Ponty calls "dialectical." (SB, 160/174) The machine is defined by the exteriority—spatial, ontological, and causal—of its parts: each can come to be, change, or pass away without affecting the others. In a *Gestalt*, on the contrary, a change to one part alters every other part: "We will say that there is form whenever the properties of a system are modified by every change brought about in a single one of its parts and, on the contrary, are conserved when they all change while maintaining the same relationship among themselves." (SB, 47/50) Thus

[13] Many psychologists, however, refused to abandon the reflex theory, instead attempting to prop it up with an ever-growing number of auxiliary hypotheses, which Merleau-Ponty chronicles in Chapter 1 of the *Structure*.

the *Gestalt* exhibits a *circular causality* between part and whole: "The genesis of the whole by composition of the parts is fictitious. It arbitrarily breaks the chain of reciprocal determinations." (SB, 50/53) In other words, the *Gestalt* is self-regulating or self-organizing.[14] It is precisely this property that allows it to explain the adaptation and coordination of behaviour.

The concept of a self-organizing whole allows us to explain the *intelligence* of behaviour without appealing either to fixed mechanisms or to mental representations. (SB, 127/138) The phenomenon of animal behaviour thus appears as an intermediary between matter and mind: it exhibits an intelligence that is not yet self-consciousness, and a meaning that is not yet an idea. The relation between consciousness and nature is split in two by the appearance of behaviour as a mediating term, and revealed as two distinct relations: one between inanimate nature and vital behaviour, and the other between behaviour and consciousness. The introduction of this intermediate term transforms those it mediates: if the living body is not a machine, then neither is the inanimate nature from which it emerges; and if consciousness emerges from behaviour, then the mind cannot be a disembodied region of pure self-presence. The study of behaviour thus leads Merleau-Ponty to a *Gestalt* ontology which distinguishes three levels of organization in nature: the physical, the vital, and the human. The key to this ontology is the concept of *form*: "Equally applicable to the fields which have just been defined, it would integrate them as three types of structures by surpassing the antinomies of materialism and mentalism, of materialism and vitalism." (SB, 131/141)

We find already within the physical order (*i.e.*, inorganic nature) the existence of form. It is this which has led physicists to introduce the concept of the *field*:

> an ensemble of forces in a state of equilibrium or of constant change such that no law is formulable for each part taken separately and such that each vector is determined in size and direction by all the others.… 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.

[14] David Morris, "What is living and what is non-living in Merleau-Ponty's philosophy of movement and expression," *Chiasmi International: Trilingual Studies Concerning Merleau-Ponty's Thought*, vol. 7 (2006), 225–39, especially 226.

> 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. (SB, 137/147–48)

Thus it is not only in psychology and biology that we are forced to abandon the mechanical ontology; in physics too, we must move beyond the atomistic view that nature can be decomposed into "elements or particles invested with absolute properties." (SB. 138/148)

The autoproduction of sense in nature would thus be a process of *morphogenesis*, in which more complex forms arise naturally out of simpler ones. The physical, organic, and human worlds would be distinct levels of *organization*, each emerging from but not reducible to the level below it, which it integrates and reorganizes so as to produce new, qualitatively original phenomena.[15] The concept of *integration* or *reorganization* contains already the germ of Merleau-Ponty's later concept of *expression*: the "higher" orders express a sense that is nascent in the "lower" ones; but this expression can never completely assimilate that which it expresses.[16] There remains always an element of opacity, an excess of the lower over the higher. The integration of lower forms into higher ones is always threatened by an inevitable *dis*-integration: mind is always disintegrating back into "mere" life through fatigue, illness, or injury; and life is constantly disintegrating back into "mere" matter in death. (SB, 210/227)[17] Thus Merleau-Ponty's ontology attempts to steer a middle course between a materialism that would assimilate the vital and human orders to the physical order, and an

---

[15] Toadvine, *Merleau-Ponty's Philosophy of Nature*, 32.
[16] *Ibid.*, 49. Merleau-Ponty develops the concept of expression in *Phenomenology of Perception*, Part One, Chapter VI: "The Body as Expression, and Speech." See Bernard Waldenfels, "The Paradox of Expression," in *Chiasms: Merleau-Ponty's Notion of Flesh*, (ed.) F. Evans and L. Lawlor (Albany, NY: SUNY Press, 2000); Leonard Lawlor, "The end of phenomenology: Expressionism in Deleuze and Merleau-Ponty," *Continental Philosophy Review*, vol. 31, no. 1 (1998), 15–34; Donald A. Landes, *Merleau-Ponty and the Paradoxes of Expression* (New York: Bloomsbury, 2013).
[17] Toadvine, *Merleau-Ponty's Philosophy of Nature*, 47.

idealism that would reduce matter and life to mental representations.

However, Merleau-Ponty's articulation of this third way in *The Structure of Behavior* is not entirely successful. Merleau-Ponty distinguishes his position from transcendental idealism by insisting that form does not require a consciousness to constitute it. But in order to distinguish his position from materialism, Merleau-Ponty argues that physical form is a *perceptual* being, "conceivable only as an object of perception." (SB, 144) Even if we understand perception as a *bodily* rather than an intellectual activity, this formulation seems to reinscribe the logic of transcendental idealism at the level of vital behavior, placing us right back in the old antinomies: how can life emerge from matter and express the latter's nascent sense if physical forms exist only as objects of perception? "Merleau-Ponty lacks a language with which to describe the perceptual character of nature without having recourse to a subject by which nature would be perceived."[18] As a result, the relation between physical form and perception in Merleau-Ponty's ontology remains ambiguous.

2. Thompson's Appropriation of Merleau-Ponty's Ontology

In *Mind in Life*, Evan Thompson attempts to resolve this ambiguity by synthesizing Merleau-Ponty's *Gestalt* ontology with more recent scientific developments. Thompson builds on Merleau-Ponty's account in two ways. The first concerns the *continuity* between the physical and the vital orders, while the second concerns the *discontinuity* between them. First, Thompson draws on developments in dynamic systems theory—the study of how complex systems change over time—to lend mathematical precision to Merleau-Ponty's descriptions of form and morphogenesis. Second, Thompson draws on the work of Francisco Varela to flesh out Merleau-Ponty's account of how living bodies differ from non-living systems, and how the vital order emerges from the physical.

In order to explain the self-organization and circular causality that Merleau-Ponty discovers in physical and organic phenomena,

[18] *Ibid.*, 24.

Thompson turns to the relatively new science of nonlinear dynamic systems.

> Although dynamics is an interdisciplinary study today, it was originally a branch of physics. The subject began in the mid-1600s, when Newton invented differential equations, discovered his laws of motion and universal gravitation, and combined them to explain Kepler's laws of planetary motion. Specifically, Newton solved the two-body problem—the problem of calculating the motion of the earth around the sun, given the inverse-square law of gravitational attraction between them. Subsequent generations of mathematicians and physicists tried to extend Newton's analytical methods to the three-body problem (e.g., sun, earth, and moon) but curiously this problem turned out to be much more difficult to solve. After decades of effort, it was eventually realized that the three-body problem was essentially *impossible* to solve, in the sense of obtaining explicit formulas for the motions of the three bodies.[19]

This discovery led the French mathematician Henri Poincaré to develop a new, *qualitative* approach to the study of differential equations, and it is this approach that now goes by the name of "dynamic systems theory."[20] We now know that the difficulties posed by the three-body problem are far from unique: in fact, *most* systems of differential equations cannot be solved analytically. This is due to the surprising phenomenon of *nonlinearity*.

We generally expect causes to have proportional effects. That is, we expect a small change in one part of a system to produce only a small change in the system's global state, and a large change to have a similarly large effect on the system as a whole. Such proportional relations are expressed mathematically by *linear* functions, in which the output is proportional to the input. A linear dynamic system is one whose dynamics can be described entirely by such linear functions. In such systems, a change in any of the system's parameters always produces a proportional change in the system's global state. As a result, causes and effects in a linear system are *additive*: the effect of two causes put together is simply the sum of

---

[19] Steven H. Strogatz, *Nonlinear Dynamics and Chaos* (Cambridge, MA: Westview Press, 1994), 2.

[20] Evan Thompson, *Mind in Life: Biology, Phenomenology, and the Sciences of Mind* (Cambridge, MA: Harvard University Press, 2007), 40.

the effects each would have on its own.[21] This means that complex causes and effects can be decomposed into simpler ones, which is what allows linear systems to be solved analytically.[22]

It turns out, however, that many, if not most, natural phenomena are *nonlinear*. That is, they exhibit effects which are *not proportional* to their causes, and thus can only be described using nonlinear differential equations. Thompson offers the classic example of Bénard convection:

> The emergence of Bénard cells can be seen in the behavior of cooking oil in a frying pan. Applying heat to the pan increases the temperature difference between the cooler layer of oil at the top and the hotter layer of oil at the bottom. When the temperature difference between top and bottom is small, there is no large-scale or global motion of the oil, but eventually when the difference becomes large enough instability occurs and the liquid starts to roll in an orderly fashion known as convection rolls. In other words, the system undergoes a state transition, described mathematically as a bifurcation, as the new self-organizing behavior and spatial structures of convection rolls emerge. As the temperature gradient is increased still further, the convection rolls undergo another transition or bifurcation and give rise to an array of hexagonal up-and-down flow patterns called Bénard cells.[23]

At first, variations in the control parameter (the temperature gradient) produce no observable changes in the system's global state. When this parameter approaches a certain *critical point*, however, the system becomes *unstable*. In this unstable state, a very small change in the control parameter can produce a very large change (a "bifurcation") in the system's global behaviour—namely, the emergence of convection rolls (Fig. 1). Because cause and effect are not proportional in nonlinear systems, they are not additive: we cannot predict what will happen when two or more causes are combined by examining the effects of each cause in isolation. Thus complex causes and effects in a nonlinear system

---

[21] *Ibid.*, 419.
[22] Strogatz, *Nonlinear Dynamics*, 8–9.
[23] Thompson, *Mind in Life*, 60–61.

cannot be broken down into independent parts, which is why they cannot be solved analytically.[24]

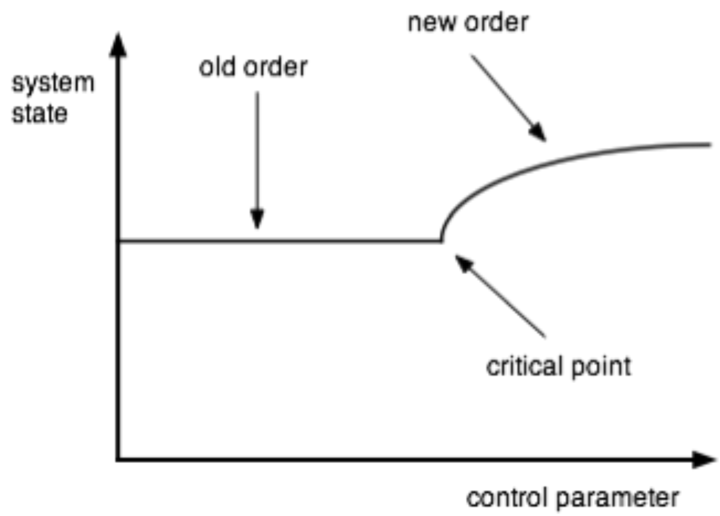


Fig. 1

Thompson argues that the science of nonlinear dynamic systems explains how form or structure emerges in nature. Quoting Jean Petitot, Thompson writes that "structures are essentially dependent on *critical phenomena*, *i.e.*, on phenomena of symmetry breaking which induce qualitative discontinuities (heterogeneities) in the substrates… Discrete structures emerge via qualitative discontinuities."[25] Thus the concepts of dynamic systems theory allow us to describe in precise, mathematical terms the self-organizing *Gestalts* that Merleau-Ponty identifies in behaviour:

---

[24] "Why are nonlinear systems so much harder to analyze than linear ones? The essential difference is that linear systems can be broken down into parts. Then each part can be solved separately and finally recombined to get the answer. This idea allows a fantastic simplification of complex problems, and underlies such methods as normal modes, Laplace transforms, superposition arguments, and Fourier analysis. In this sense, a linear system is precisely equal to the sum of its parts. But many things in nature don't act this way. Whenever parts of a system interfere, or cooperate, or compete, there are nonlinear interactions going on." (Strogatz, *Nonlinear Dynamics*, 8–9)

[25] Jean Petitot, "Morphodynamics and attractor syntax: constituency in visual perception and cognitive grammar," in *Mind as Motion: Explorations in the Dynamics of Cognition*, (ed.) R. F. Port and T. van Gelder (Cambridge, MA: MIT Press, 1995), 231; cited in Thompson, *Mind in Life*, 71.

> To say that the organism's global response varies quantitatively when the stimuli vary quantitatively is to say that stimuli act upon the organism as *control parameters*, which upon reaching a certain *critical threshold* induce a *global qualitative discontinuity* in the organism (a *bifurcation* in phase space).[26]

Merleau-Ponty's claim that behaviour is a form or structure (SB, 127) "can thus be mathematically elaborated and empirically substantiated by morphodynamical science."[27] Furthermore, the discovery of pervasive nonlinear phenomena such as Bénard convection in inorganic nature confirms Merleau-Ponty's claim that the physical order already exhibits forms which cannot be analyzed into mutually external parts. Thus dynamic systems theory integrates the physical and vital orders by demonstrating that the same processes of morphogenesis are at work in each.

However, Thompson, like Merleau-Ponty, is concerned to show not only that the concept of form can *integrate* the orders of matter, life, and mind, but also that it can account for the *originality* of each order with respect to the others.[28] To this end, Thompson attempts to flesh out Merleau-Ponty's account of how living bodies differ from non-living systems by drawing on the work of Francisco Varela. According to Varela, it is the organism's self-producing or "autopoietic" character that distinguishes it from non-living dynamic systems. The paradigm case of autopoiesis is the single cell: a system of bounded chemical processes that both produce and depend on the semi-permeable membrane that sets them apart from their surroundings.[29]

It is precisely because the living body is an autopoietic whole that it endows its situation with a meaning. "Something acquires meaning for an organism to the extent that it relates (either positively or negatively) to the norm of the maintenance of the organism's integrity."[30] In order to illustrate this point, Thompson returns repeatedly to the phenomenon of bacterial chemotaxis, in which a motile bacterium placed in a sucrose gradient swims "up-

---

[26] Thompson, *Mind in Life*, 69; my emphasis.
[27] *Ibid.*, 71–72.
[28] *Ibid.*, 78.
[29] *Ibid.*, 98–99.
[30] *Ibid.*, 70.

gradient" in the direction of increasing sugar concentration.[31] "Sucrose has significance or value as food, but only in the milieu that the organism itself brings into existence.… Living is a process of sense-making, of bringing forth significance and value."[32] Thus the meaning things have for the living body is not simply given in advance in nature, waiting to be represented within consciousness; but neither is it an arbitrary construction projected onto the world by a disembodied mind. Rather, vital significance is *enacted* by the living body in and through its behaviour, which takes the form of a "dynamic sensorimotor loop": the way the organism moves depends on what it senses, and what it senses depends on how it moves.[33]

Like Merleau-Ponty, Thompson hopes to escape the antinomies of Modern thought by showing how meaning arises in nature through the movement and perception of the living body. However, recall that it was precisely here, in the relation between vital significance and physical form, that the problematic ambiguity in Merleau-Ponty's ontology arose—an ambiguity captured in Merleau-Ponty's claim that physical form is conceivable only as an object of perception. Thompson stakes out a nuanced but ultimately critical position with respect to this claim: "There is something important in this argument, but we need to be careful. In particular, we need to guard against making it into an argument for metaphysical idealism."[34] We can distinguish three moves in Thompson's interpretation and critique of Merleau-Ponty's argument. First, Thompson argues that since dynamic systems theory allows us to describe form mathematically—something Merleau-Ponty did not think was possible—we can no longer maintain that form has meaning only in the perceived world.[35] Second, Thompson argues that these mathematical developments allow us to explain psychological phenomena (including perception) in terms of "dynamic patterns of spatiotemporal activity in the brain."[36] Thus Thompson defends Gestalt psychology's thesis of "psychoneu-

[31] *Ibid*., 74–75, 154, 157–58.
[32] *Ibid*., 158.
[33] *Ibid*., 157.
[34] *Ibid*., 82.
[35] *Ibid*., 84–85.
[36] J. A. Scott Kelso, *Dynamic Patterns: The Self-Organization of Brain and Behavior* (Cambridge, MA: MIT Press, 1995), 288, cited in Thompson, *Mind in Life*, 83.

ral isomorphism" against Merleau-Ponty's objections. Finally, Thompson argues that his position is not incompatible with Merleau-Ponty's claim that form is irreducibly perceptual, provided that the latter is understood as a *transcendental* rather than an *empirical* claim.[37]

Thompson's claim that form can be described mathematically is based on Petitot's suggestion that form be conceived in terms of the "qualitative discontinuities" that are generated by symmetry-breaking bifurcations in nonlinear dynamic systems. This suggestion is very promising, and I will pursue it at some length below. However, the fact that physical forms can be described mathematically does not in and of itself clarify the ontological status of form. In particular, it does not demonstrate that form can be conceived without reference to the perceived world. This would follow only if we could assume a strict distinction between the world of mathematics and that of perception. For Merleau-Ponty, however, mathematics is thoroughly rooted in the perceptual world. (PP, 403ff/439ff)[38] The language of mathematics, like any other human language, expresses a pre-linguistic, motor significance which it can never fully assimilate or exhaust. Thus the mathematical description of form is no more independent of perception than its description in English or French.

In his effort to avoid falling into a "metaphysical idealism" which would collapse the physical and vital orders into the human order, Thompson risks going too far in the other direction and collapsing mental and vital significance into physical form. This was the error for which Merleau-Ponty criticized the Gestalt psychologists, who believed they had solved the problem of consciousness "by discovering structural nerve processes which have the same form as the mental on the one hand and are homogeneous with physical structures on the other." (SB, 134–35/145) "If there is no longer any structural differences between the mental, the physiological and the physical, there is no longer any difference at all. Then consciousness *will be* what happens in the brain.... [T]his 'isomorphism' in a philosophy of form is an identity." (SB, 136/146–47) Thus Thompson's argument for an isomorphism between the nervous system and consciousness seems to contradict

[37] Thompson, *Mind in Life*, 82, 86–87.

[38] See Marjorie Hass and Lawrence Hass, "Merleau-Ponty and the Origin of Geometry," in *Chiasms: Merleau-Ponty's Notion of Flesh*.

his own claim that "behavior is a collective phenomenon comprising brain, body, and environment, not something that resides inside the nervous system."[39] If "[c]onsciousness is not an interior state of the mind or brain that stands in a linear causal relation to sensory input and motor output," but rather "a form or structure of comportment,"[40] then this form must be more complex (or in the language that I will develop below, more *asymmetrical*) than any of its parts or causes—including the patterns of nervous activity.[41]

Thompson takes Merleau-Ponty's objections seriously. However, he argues that their real target is not psychoneural isomorphism *per se*, but rather "objectivism," which "tries to purge nature of subjectivity and then reconstitute subjectivity out of nature thus purged."[42] Thus "Merleau-Ponty's argument seems best interpreted as an argument against the objectivist who would try to nullify the transcendental status of consciousness by appeal to psychoneural isomorphism."[43] Unlike the objectivist, Thompson wants to grant the *transcendental* validity of Merleau-Ponty's claim that form is irreducibly perceptual; at the same time, however, he wishes to maintain the *empirical* validity of psychoneural isomorphism. "Mind emerges from matter and life at an empirical level, but at a transcendental level every form or structure is necessarily also a form or structure disclosed by consciousness. With this reversal one passes from the natural attitude of the scientist to the transcendental phenomenological attitude."[44] Thus Thompson attempts to resolve the ambiguity in Merleau-Ponty's ontology by distinguish-

---

[39] *Ibid*., 71.

[40] *Ibid*., 80.

[41] Thompson's argument for psychoneural isomorphism draws on empirical results obtained by psychologist Scott Kelso. However, the work of Kelso's colleagues Thelen and Smith suggests that the moving body is a nonlinear system in its own right, and thus that there could be no one-to-one relation between nervous signals and motor actions. On the contrary, Thelen and Smith's studies of infant kicking show that a relatively simple, uncoordinated pattern in the nervous system can produce a much more complex and coordinated pattern of bodily movement. See Esther Thelen and Linda B. Smith, *A Dynamic Systems Approach to the Development of Cognition and Action* (Cambridge, MA: MIT Press, 1994), 78–83.

[42] Thompson, *Mind in Life*, 86.

[43] *Ibid.*, 86. Thompson describes objectivism as the attempt "to purge nature of subjectivity and then reconstitute subjectivity out of nature thus purged." (*Ibid.*)

[44] *Ibid.*, 86–87.

ing between a scientific or empirical standpoint and a philosophical or transcendental one, whose claims appear incompatible but are in fact equally valid within their own separate spheres. But the juxtaposition of these incompatible perspectives, each irrefutable in its own right, is precisely the antinomy that Merleau-Ponty sought to escape with the concept of form.[45] Far from explaining the ontological status of form, this distinction is itself the problem that form was supposed to resolve.[46]

As a result, the relation between vital significance and physical form remains unclarified. In attempting to show that physical form does not *only* appear to perception, Thompson fails to explain how it *ever* appears to perception. "An organism's environment," Thompson writes, "is not equivalent to the world seen simply through the lenses of physics and chemistry.... Varela describes this difference between the organism's environment and the physicochemical world as one of a 'surplus of significance.'"[47] But is this surplus simply deposited on top of the physicochemical world like an organic secretion? Returning to the example of the bacterium in the sucrose gradient, Thompson writes that "[t]he food significance of sucrose is certainly not unrelated to the physics and chemistry of the situation; it depends on sucrose being able to form a gradient, traverse a cell membrane, and so on."[48] But while these physicochemical facts *condition* the significance sucrose has for the bacterium, *they have no significance in themselves*: "Physical and chemical phenomena, in and of themselves, have no particular significance or meaning; they are not 'for' anyone."[49] If this is the case, however, then organic sense-making cannot be the expression of a sense that is already nascent in physical form; it can only be an arbitrary projection or imposition of meaning on a meaningless physicochemical world.

---

[45] I take it that this is Thompson's goal as well, and that this is why he turns to Merleau-Ponty's ontology in the first place.

[46] Barbaras articulates this problem very clearly in his critique of Husserl: "Husserl manages to think the belonging [of consciousness to the world] only at the cost of a division between empirical consciousness and transcendental consciousness, so that consciousness no longer intends the world from the same viewpoint as that from which it participates in the world." See Renaud Barbaras, "The World of Life," *Philosophy Today*, vol. 55, Supplement (2011), 8–16, especially, 8–9.

[47] Thompson, *Mind in Life*, 153–54; citation omitted.

[48] *Ibid.*, 154.

[49] *Ibid.*, 153–54.

In a footnote, Thompson qualifies his claim that physicochemical phenomena are meaningless by appealing once again to the distinction between the transcendental and empirical standpoints:

> Of course, from a transcendental phenomenological perspective this statement needs qualification. Physicochemical phenomena, considered from the first-order vantage point of physics and chemistry, *do not implicate a point of view* in the way that biological phenomena do. When seen from a second-order, transcendental perspective, however, physical and chemical phenomena also have to be understood in terms of the conditions of possibility of their disclosure to science, and thus do implicate a point of view, namely, that of the scientific tradition itself.[50]

Once again, we find ourselves vacillating between these two incompatible standpoints: the physical order is simultaneously meaningless in itself, and meaningful for us. What the distinction between the transcendental and the empirical perspective cannot explain is how a nature which has no meaning of its own could become meaningful for human scientists, without this meaning simply being imposed on it from the outside.

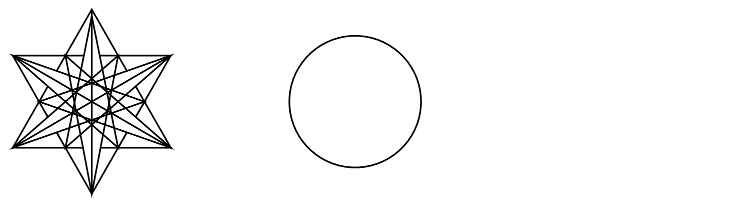
It is not enough to show that behaviour *is* a form, thus establishing in principle how vital significance could emerge from the physical order[51]; we also have to understand how behaviour is the perception *of* form, i.e. how it expresses a sense already nascent in the physical world. Thompson offers the beginnings of such an account with Petitot's description of morphogenesis as a process of *symmetry-breaking*, in which nonlinear dynamic systems generate qualitative discontinuities through bifurcations at critical points.[52] However, Thompson does not develop the implications of this claim. I will now take up this description of morphogenesis in order to clarify the ontological status of physical form and its relation to perception.[53]

---

[50] *Ibid.*, 154 n. 10; my emphasis.
[51] *Ibid.*, 71.
[52] *Ibid.*
[53] My account will differ in important ways from that of Petitot, but I lack the space to discuss these differences here. Suffice it to say that Petitot's qualitative discontinuities are macro-physical epiphenomena which "play no role in properly physical *explanations* at the microlevel." Thus "they would be of no interest at all were it not for the existence of subjects whose perceptual organs

3. Symmetry-Breaking and Morphogenesis

It should come as no surprise that symmetry is connected to order and form. However, the exact nature of this connection may surprise you.[54] Consider the three figures in Fig. 2. Which of these three is the most symmetrical, and which is the least?



A B C

Fig. 2

Mathematicians define symmetry as *invariance under a transformation*: the greater the number of transformations that leave a thing unchanged, the higher its degree of symmetry.[55] The star in Fig. 2A is symmetrical (which is to say *invariant*) under six rotations and six reflections (*i.e.*, "flips" or "mirrorings" across a given axis). The circle in Fig. 2B, on the other hand, is symmetrical under an *infinite* number of rotations around its center and reflections across axes passing through its center; thus it has a much higher degree of symmetry than the star on the left. And the uniform, white field in Fig. 2C is *even more* symmetrical than the circle; it is

---

are tuned in correspondence to them." Jean Petitot and Barry Smith, "Physics and the Phenomenal World," in *Formal Ontology*, (ed.) R, Poli and P. M. Simons (Dordrecht: Kluwer, 1997), 246; emphasis in original. Thus Petitot, unlike Thompson (*Mind in Life,* 417–31), seems to deny the possibility of genuine "emergence" or "downward causation." On my account, on the contrary, qualitative discontinuities or *asymmetries* appear at all spatiotemporal scales, from micro- to macro-, and play a key role in our scientific explanations—both as *explanandum* and as *explanans*.

[54] For accessible introductions to symmetry and the genesis of form in nature, see Ian Stewart and Martin Golubitsky, *Fearful Symmetry* (Oxford: Blackwell, 1992) and Philip Ball, *Nature's Patterns: A Tapestry in Three Parts* (New York: Oxford University Press, 2009).

[55] Stewart and Golubitsky, *Fearful Symmetry*, 28.

invariant under rotations and reflections around any axis, as well as translations (shifting or sliding in the plane) in any direction.

Contrary to what we might expect, then, greater symmetry does not imply greater order or structure.[56] On the contrary, the greatest symmetry belongs to structureless uniformity (like the homogeneous field in Fig. 2C). Form arises through the *breaking-up* of this uniformity, the introduction of *differences* which break one or more of its symmetries: the circle breaks the limitless symmetries of the uniform field by introducing a privileged point, the center, which is the axis of all symmetrical rotations, and through which the axes of all symmetrical reflections must pass; the star breaks these symmetries still further by introducing certain privileged axes which were not present in the circle.

One might expect that the problem of how nature generates pattern and form would be to explain how symmetry arises out of chaos and disorder. But in fact, disorder is much more symmetrical than order. If a beautiful bronze sculpture is melted down into a uniform pool of liquid metal, its form and structure are lost—but it gains a great deal of symmetry. Thus the question of the genesis of form is not how symmetry arises out of disorder, but rather how the symmetry of disorder gets *broken* in determinate ways to produce the characteristic *a*symmetries of the forms we find in nature.

If nature were completely symmetrical, there would be no phenomena to study—and no one to study them. A perfectly symmetrical nature would be perfectly uniform, entirely devoid of differences. When we seek to understand the order we find in nature, we are asking after the origin of nature's differences or asymmetries. We are asking why things are different in one place than they are in another, or why they are different now than they used to be. Thus the basic question of Modern science is not "Why is there something rather than nothing," but "Why is there *difference* rather than indifference or uniformity?"[57]

Mechanistic science attempts to explain difference in terms of identity, by analyzing complex forms into collections of discrete, self-identical parts, and assuming that each part must be determined in advance by its own discrete cause. (SB, 160–61/174)

---

[56] Ball, *Nature's Patterns*, Part 1: Shapes, 21–25.

[57] Timothy van Gelder and Robert F. Port, "It's About Time: An Overview of the Dynamical Approach to Cognition," in *Mind as Motion*, 26.

Thus differences are turned into *things* or positive beings, and each thing is caused by a prior thing. It follows that a complex phenomenon must have an equally complex cause. Every difference must be the product of some prior difference: an asymmetrical effect must be the product of an equally asymmetrical cause, and symmetrical causes must have equally symmetrical effects.[58] This is true of *linear* systems, in which causes and effects are proportional. However, it is characteristic of *non*linear systems that they exhibit *symmetry-breaking bifurcations*: the emergence of behaviours that are less symmetrical than their causes.

Consider for example the phenomenon of Bénard convection that we discussed above. Before the onset of convection, there is no large-scale motion in the fluid. This fluid is highly disordered, which means that it is highly uniform or *symmetrical* in both space and time. There is no way to distinguish one region of the fluid from another, or to distinguish the state of the system at one time from its state at any other time. The onset of convection is a symmetry-breaking bifurcation, in which the system loses a number of spatial and temporal symmetries: the pattern of convection rolls differentiates the fluid into different spatial regions; and the *periodic* motions of the fluid establish a privileged rhythm or temporal interval which demarcates different temporal regions in the system's dynamics. Notice that the onset of convection is driven by a simple temperature gradient, which is considerably less asymmetrical (in both time and space) than the pattern of convection rolls. In a nonlinear system, effects can be *more asymmetrical* than their causes. The spatiotemporal form of the convection rolls is not given in advance or imposed on the system from the outside. Instead, it come "for free" when the symmetry of the system is broken.

The human experience of order and form is that they take work to produce and maintain.[59] Thus we are accustomed to thinking of

---

[58] This principle was formulated explicitly by Pierre Curie in 1894: "When certain causes produce certain effects, the elements of symmetry of the causes must also be found in the effects they produce. When certain effects exhibit a certain dissymmetry, this dissymmetry must also be found in the causes that gave rise to them." Pierre Curie, "Sur la symétrie dans les phénomènes physiques, symétrie d'un champ électrique et d'un champ magnétique," *Journal de Physique* III (1894), 401; my translation. See also Stewart and Golubitsky, *Fearful Symmetry*, 7–8.

[59] This is the root of Descartes' doctrine of "constant creation," which holds that nature will cease to exist without God's constant intervention. See René

form as a positive quantity that must be added to things, a shape that must be imposed on indifferent or even recalcitrant matter. In nature, however, form arises by *subtraction*—through the *loss* or *breakdown* of spatial and temporal symmetries. Form is not a positive being, but a difference, a negation. The phenomenon of symmetry-breaking shows that being is not a pure plenitude or positivity that requires a subjectivity to insert negation into it[60]; on the contrary, nature is self-articulating, self-differentiating.[61] Thus the opposition between being and non-being is overcome along with that between form and matter. Being is no longer defined by self-identity, but rather by self-differentiation. The opposite of being is not non-being or negation, but rather the *absence* of negation: uniformity or indifference.[62]

4. Symmetry-Breaking and Sense-Making

So far, I have offered an account of form as asymmetry, and of symmetry-breaking as the autoproduction of form in nature. It remains to show how this account can help us to understand the relation between physical form and vital significance, or perception and the world that it perceives. We wish to understand, on the one hand, how the perceptual world is rooted in the world of inanimate form, from which it emerges and which it never truly leaves; and on the other hand, how perception is a *creative* act, which expresses the form of its inanimate surroundings precisely by transforming or *integrating* it into a new kind of motor significance.

Descartes, "Meditations on First Philosophy," in *The Philosophical Writings of Descartes*, (tr.) J. Cottingham, (Cambridge: Cambridge University Press, 1895), Meditation III, especially 33/AT VII 49; see also N, 12/30.

[60] Merleau-Ponty criticizes this Sartrean ontology in *The Visible and the Invisible* (VI, 50ff/74ff). There may be an element of self-criticism here, as Merleau-Ponty seems at times to have held this view himself. For example, he writes in *Phenomenology of Perception* that time "only exists when a subjectivity comes to shatter the plenitude of being in itself…and to introduce non-being into it." (PP, 444/483)

[61] David Morris describes this as a "negative-in-being" ("The Nature of Meaning," 338–39).

[62] There is a strong parallel here with Hegel's ontology. See, *e.g.*, *Phenomenology of Spirit*, (tr.) A. V. Miller (Oxford: Oxford University Press, 1977), Chapter 1: Sense-Certainty.

We saw above that living bodies enact the significance of their surroundings through a sensorimotor loop in which the organism's movements determine what it perceives, and what it perceives determines how it moves.[63] However, this sensorimotor loop can only operate in the context of an asymmetrical environment. Merleau-Ponty observes in the *Phenomenology of Perception* that a "truly homogeneous area, offering *nothing to perceive*, cannot be given to *any perception*." (PP, 4/26; emphasis in original). In a homogeneous area, the body's exploratory movements produce no corresponding changes in its sensory field; the organism receives no perceptual response to the motor "questions" it poses to its surroundings. Thus it is the asymmetry of the body's environment that makes the perceptual regulation of movement possible. This asymmetry is the very *texture* of reality, which allows the living body to get a perceptual *grip* on its surroundings. This explains the fact, often cited by Merleau-Ponty, that the smallest possible percept is a figure on a background (PP, 4/26): it is the *difference* between figure and background that makes each perceptible as such.[64]

Returning to Thompson's example of bacterial chemotaxis, we can now see that strictly speaking, it is not the sucrose *molecule* that takes on significance for the motile bacterium, but rather the sucrose *gradient*—that is, the *differences* in sucrose concentration that the bacterium encounters through its own movements. In a field of homogeneous sucrose concentration, there would be no indication that sucrose has any significance for the bacterium.[65] It is only in a field of *asymmetrical* sucrose concentrations that the organism can demonstrate a preference for higher concentrations. The organism enacts the vital significance of its environment by responding in different ways to the differences it encounters through its own movements. Thus it is precisely these *differences* or *asymmetries* that are revealed as salient or significant for the organism.

The mathematician's definition of asymmetry as variation under a transformation is an abstract one: it says nothing about how to

[63] Thompson, *Mind in Life*, 47.

[64] Waldenfels, "Perception and structure," 24.

[65] Of course, the bacterium might behave differently in a homogeneous field of sucrose than in a homogeneous area without sucrose. But here again, it is precisely the *difference* between these two environments that would reveal the significance of sucrose to the bacterium.

discover *which* of the infinite transformations we could apply to a given system will reveal that system's asymmetries. But we have now discovered the roots of this abstract definition in embodied perception: bodily movement is the original "transformation" which discovers asymmetries in its surroundings by producing variations in the body's perceptual field. The particular asymmetries a body perceives will depend on its particular way of moving, the unique motor habits it has developed over the course of its life. As our movements become more complex and asymmetrical, so too does the world we perceive. Thus the organism and its world grow together dialectically, each driving the other to become more articulated and determinate through its own increasing determinacy. This is the growth of *sense*: the self-articulating field of differences that make a difference to the organism.

This account of how sense emerges from physical form allows us finally to offer a non-idealistic interpretation of Merleau-Ponty's thesis that form can only be conceived as an object of perception. That is, the concept of asymmetry gives us the language which Merleau-Ponty lacked to describe nature as perceptual without making it dependent on a mind or a subject.[66] In speaking of asymmetry, we have always already installed ourselves at the level of perception: we cannot conceive of a *difference* in nature except by reference (implicit or explicit) to a *bodily movement* that would reveal this difference. This is not to say that the living body *creates* or *constitutes* the differences it discovers in nature. On the contrary, it is nature's self-differentiation that creates the living body. Thus perception emerges from and presupposes a world of differences of which it is not the source. However, it is only by moving that the living body discovers these differences. Thus we cannot give an account of nature that is not an *embodied* account, that does not take up the point of view of a moving body situated *within* the nature it describes.[67]

Does this conclusion not throw us back into the skepticism we were trying to avoid? In saying that we can only know nature from

[66] See Toadvine, *Merleau-Ponty's Philosophy of Nature*, 24.

[67] Compare Thompson's claim, quoted above, that "Physicochemical phenomena, considered from the first-order vantage point of physics and chemistry, *do not implicate a point of view* in the way that biological phenomena do." (*Mind in Life*, 154 n. 10; my emphasis) I am arguing that physicochemical phenomena are best understood not as synthetic wholes composed of atomic parts, but rather as differences or asymmetries, which *do* imply a point of view.

our own finite perspective, are we not admitting that we cannot know nature at all? We have become accustomed to the Cartesian promise of a "view from nowhere"—a non-perspectival account of the natural world. But in fact, this mechanical ontology takes up a very particular perspective on reality: that of a creator contemplating her creation. Though it long ago ceased to appeal to God as an explicit hypothesis, mechanistic science continues to appeal implicitly to a God's-eye-view of the cosmos. It thus remains "metaphysical" in the Heideggerian sense: the truth of this world lies elsewhere; we can understand nature only by transcending it. Mechanistic science claims to strip nature of all anthropological predicates in order to arrive at an account of reality as it exists "in itself." But in fact, nothing could be more anthropological than this way of describing nature *as if human beings had manufactured it*.

A nature that can only be known from the outside cannot truly be known at all, but only mastered and controlled.[68] It has no meaning of its own, and so it can only have a meaning imposed upon it. To reject this ontology is to affirm that nature has its own endogenous sense which is not constituted by consciousness. It is precisely this nascent meaning that we have discovered in the phenomenon of asymmetry. The autoproduction of sense in nature takes place through symmetry-breaking, in which natural wholes articulate themselves into parts or regions, creating differences out of indifference and form out of uniformity. These differences are neither things nor ideas, neither atoms nor artifacts. They cannot be known by a disembodied mind, but only perceived by a living body. The scientist who seeks a causal explanation for the complex forms she observes in nature is thus engaged in a perceptual project. Her aim is to allow the natural phenomenon to show her which differences make a difference to it; but this will often mean learning to perceive differences that had been invisible, and to

[68] It is only from this point of view that the problem of how to naturalize phenomenology—that is, of how to reconcile the human being as knower/manipulator with the human being as object of knowledge/manipulation—arises. However, the Cartesian ontology that gives rise to this problem also makes it impossible to resolve. This is what prompts Merleau-Ponty's search for a new ontology: "a milieu which is common to philosophy and the positive sciences…where our activity and our passivity, our autonomy and our dependence no longer contradict one another." (TT, 13) I have argued here that the phenomena of form and morphogenesis, understood as asymmetry and symmetry-breaking, open up just such a milieu.

ignore differences that had seemed significant. This is precisely what mechanistic science fails to do: it has decided in advance how nature is to be divided, in terms that are drawn from human *techne* rather than from the observation of nature itself. It is thus a perceptual stance that refuses to be educated by the world that it perceives. In overcoming Cartesian ontology, we will also overcome the opposition between philosophy and the natural sciences, assigning to them both a single project: not to discover the real world behind the world that we perceive, but to allow nature to educate our powers of perception.[69]

noah.mossbrender@mcgill.ca

[69] An earlier version of this paper was presented at the 2012 meeting of the Canadian Society for Continental Philosophy. I am grateful to Maxime Doyon, Marie-Eve Morin, and Iain Macdonald for their comments and questions on that occasion. I would also like to thank David Morris for his helpful comments on the penultimate version of this article.