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RESEARCH

Something Critical Occurs at a Fractional Dimension Between Two and Three... A Proposal for Knitting Together Semiophysics and Biosemiotics

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Abstract
The paper advances a proposal for binding together the insights of biosemiotics and those of semiophysics. The task of achieving an intelligible ontology, in opposition to both mechanical reductionism and metaphysical vitalism, is shared by these two approaches. Yet, there are architectural differences between the two theories. The paper reviews such a differendum, focusing in particular on the cleave between Thom's two-fold construction of saliences and pregnances, and Peircean three-fold categorial construction encompassing firstness, secondness and thirdness. An integrated semiophysical-biosemiotic graph thus encompasses five key categories. This paper suggests to arrange them as a "W" shape so as to chart their possible dynamical interactions.

Keywords Semiophysics · Biosemiotics · Theory of meaning · Salience/pregnance · Firstness/secondness/thirdness

The Task

In what follows a proposal is made for binding together the insights of biosemiotics and those of semiophysics. Now, a similar attempt has also been recently made by Araujo (2022), particularly with reference to von Uexküll and Thom. Araujo's leading idea is that "meaning unfolds a kind of morphogenetic process of an organism's ongoing dynamics with its environment" (ibid. 556). While I welcome Araujo's analysis, and largely subscribe to it, here I would like to suggest a slightly different possibility, namely the fact Thom's semiophysical programme includes an understanding of meaning, not simply as a type of form, or topology, but as an unfolding

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relation between *form* and an *informal* correlate to be specified. This point will be expanded below. For now, let us just quickly recall that René Thom's (1988) project for a semiophysics (*Esquisse d'une sémiophysique*) represents a late and relatively less considered part of the philosopher-mathematician's work. Whereas Thom's name is usually associated with catastrophe theory, his study into semiophysics, which was his last monograph, represents both a continuation *and* a transformation in his previous views. To understand the goal of semiophysics, it is important to keep in mind the subtitle of the book, namely "Aristotelian physics". Thom explicitly aimed at a reprise of Aristotelianism, notably in the direction of a revaluation of common sense, and in pursuit of a formal theory of the concrete. On various occasions, Thom voiced his rejection of the abstractedness of modern and contemporary mathematics and mathematical physics, which, he considered, presents us with an "unintelligible" ontology, and pointed towards Aristotelianism as a remedy.[1]

In addition, I propose to identify a second important source of inspiration for the semiophysical research programme, namely, a *largely unacknowledged* reprise of vitalism. Thom does not call himself a vitalist; yet, as I attempt to unpack below, a number of vitalist motifs can be seen at work in the outlook subtended by his natural philosophy. Arguably the most important hint is Thom declaring his intention to develop a "living mathematics": rather than the sheer application of mathematics to biology (as in biomathematics), what Thom sought to build was a *physics* – here to be understood in the ancient sense of a theory of nature – intrinsically endowed with meaning. It is in light of this that one can understand the motto that gives the title to one of his late general-readership books, *To foresee is not to explain* (Thom, 1991) – namely, the fact that the formal mathematical model of a given system enables us to predict the future states of the system does *not yet* mean that we have really understood what is at stake in the system. In the late 1970s catastrophe theory had been criticized for being "merely" descriptive; Thom (1983) conceded, but he concurrently pointed out that it is not prediction that is the true hallmark of science. Modern physical formal models may be very useful, Thom suggests, but are insufficient to get a complete grasp of natural situations.

What is the nature of the exercise proposed here? An astute reviewer asked whether the paper truly aims to offer a metaphysical solution coming out of the encounter between the two models of semiophysics and biosemiotics, or whether it rather contents itself with exploring a certain syncretistic possibility of combining the two approaches. If Peirce's theory, on the one hand, and Thom's theory, on the other, are considered as completely separate, then there is little scope in trying to merge them or weave them together, and a more fruitful operation would be to try to interpret the one as it appears from the point of view of the other. However, the proposal entertained here is that the actual relation in this Peirce-Thom encounter might be one, not of frontal opposition, but rather of "small difference" between them, albeit

[1] "Je crois qu'il faut partir de la réalité macroscopique usuelle…" (Thom, 1991: 103). Reference to the "usual", the everyday, is very important to understand Thom's approach (as evinced, in particular, in his uneasy relation to Grothendieck's algebraic geometry as well as the mathematical physics of quantum mechanics). It is perhaps not entirely out of place to recall here also Peirce's (1905) epistemology of "critical common-sensism", understood as a peculiar version of the philosophy of common sense. An implicit reference to Hume's empiricism seems to be looming over both authors.

of a peculiar nature that calls for clarification. That is why, in the course of the paper, and in alternative fashion, one model is mobilized to appreciate the other in terms of an incoming difference, a feedback (to speak cybernetically) to which the system must respond. The choice of not sticking with one model throughout enables us to retain the possibility of looking at both of them also from the outside. Considering the possible relations between one theoretical construct grounded in a two-fold structure and another one grounded in a three-fold structure, the problem will always be to move from dichotomy to pluralism – or alternatively, to recognise pluralism within dichotomies. Ultimately, pluralism does not rule out monism, but dichotomy does – at least to the extent that a real monism can only be an immanence where all elements are found on the same level, none of them being endowed with any metaphysical primacy over the others. One possibility to see this might be precisely to consider that there is 'something critical' occurring somewhere in the mid terrain – if one wishes, the 'one medium' – between dichotomy and multiplicity.

Global Affinities and Divergences Between Semiophysics and Biosemiotics

A number of significant affinities between Thom's approach and the tenets of the biosemiotics research programme have been documented. Thomas Sebeok, for one, recognized Thom's work as entirely compatible with biosemiotics, to the point of declaring himself, with a pun, a "Thomist" (Favareau, 2009: 344). Despite that, admittedly, in Thom's late work under consideration there does not seem to be much directly grounded in semiotics, nor particularly in Peircean semiotics, upon which Sebeok's zoosemiotics largely rests. True, Thom does refer to Peirce a couple of times throughout the whole book – however, not only is the reference quite generic, but the even referred title of Peirce's book is got wrong, suggesting not much attention nor involvement with the author. Confusingly, also, Thom (1988: 18) evokes Peirce's notion of *firstness* with reference to the perceptual shock we receive when hearing, for instance, a "tintement de sonnette", which is clearly a misinterpretation of Peirce's category – for Peirce (1893) actually evokes the very similar example of hearing a steam whistle as an instantiation of *secondness*. Indeed, the sense of reaction to a stimulus, Peirce (1893: 5) notes, is "the breaking of one feeling by another feeling," which, as described below, can only come about through secondness.

This and similar considerations suggest that there may be a *differendum* between biosemiotics and semiophysics. To put things into context, let us just recall that biosemiotics is concerned, not simply with sign processes in living systems, but with "the sign aspects of the processes of life itself" (Hoffmeyer, 1998: 82) – in other words, biosemiotics understands life as inherently a semiotic process, and sees semiosis as the very harbinger of it.[2] For its part, semiophysics, by its very designation, seems to contend that the question of meaning is not confined to the domain of biology, but involves (or invests) physics (i.e., *nature*) at large. For instance, *Esquisse* features an extensive discussion of the mill wheel as a case of intelligible ontology (Thom, 1988: § 3.E). As already hinted above, the *differendum* is mirrored in the basic architecton-

[2] "The process of message exchanges, or semiosis, is an indispensable characteristic of all terrestrial life forms" (Sebeok, 1991: 22).

ics of the two theories, which can be summarised as the whole difference that exists between two and three. Indeed, semiophysics is built upon *two* primary categories, namely *salience* and *pregnance*. The former are instances of discontinuity, the latter of continuity. For Thom, the continuous is the ubiquitous underlying process of nature; but, in and by itself, the continuous is devoid of meaning: it is only the discontinuous that marks the inception of something (a "catastrophe" – hence, a special point where something *happens*), which we can grasp with either our senses or our hands. Anything can only "make sense" to the extent that salience, i.e. discontinuity, comes about. It is thus a matter of explaining the relations between continuity and discontinuity. Thom maps the possible interactions of saliences and pregnances in a 2×2 matrix, which we are going to consider more in details below. In short, we can say that, in semiophysics, meaning needs form, and pregnance can stabilize form, conferring structural stability to existing forms, and making them "significant"; but, at the same time, pregnance can also act as a *deforming* force, i.e. as something that pushes current forms *beyond* themselves, and is thus extremely useful to explain the "succession of forms" (i.e., morphogenesis as the *discontinuation* of current forms, and the coming about of new form-taking processes).

In contrast to Thom's two-fold architectonics, Peirce's semiotics is entirely defined by the existence of *three* basic irreducible categories, which, as Peirce (1867: § 6) expresses himself, "intermediate between the manifold of substance and the unity of being". These are the three "new categories" introduced by Peirce – *firstness*, *secondness* and *thirdness* – which he also characterizes as "cenopythagorean" (*CP* § 2.87)[3]. Peirce takes them to be actually existent in all phenomena, distinct but inseparable,[4] and necessarily always co-implicated with one another, according to various degrees of manifestation and predominance. In the phenomenon (the study of which Peirce calls "phaneroscopy"), the three categories appear nested within one another according to a precise structure of entailment, namely the self-developing architectonics of the "Peircean tree".[5] In such a tree, at each branching the first option remains simple, the second splits in two, and the third in three (Peirce, 1903a, b: 162). Each three-fold division is described by Peirce as entailing two possible degrees (first and second) of "degeneracy" affecting the deployment of a perfect trichotomy. The notion of degeneration is taken in a specific sense from geometry, where two non-parallel lines (in two dimensions) can be considered as a "degenerate" cone (in three dimensions) (Peirce, 1885: 244; 1906: 390). In three successive steps, the tree's unfolding returns ten options, which Peirce uses as a grid to classify signs (Fig. 1). We can say that the Peircean tree exhibits the asymmetric development typical of organic growth, where formations are nested within one another, but not in a homogeneous way. Growth is

[3] Peirce (1906: 373) takes the word *cenoscopy* from Jeremy Bentham, where it is another name for philosophy understood as a general science, in opposition to the other branch of knowledge that includes the special sciences (*idioscopy*). Peirce also fantasized about a secret society of scientific studies named the "Pythagorean Brotherhood," following a kind of synarchic ideal.

[4] The qualification "really distinct yet inseparable" can be found in Leibniz, although Peirce does not refer to him. For his part, Thom (1991: 96) refers to Leibniz as the inventor of the notion of function.

[5] It can be so named by parallelism with the Porphyrian tree, based on growing nested two-fold divisions. Thom (1988: 215-6) reviews the Porphyrian tree, and updates it in light of topological fibration; however, he does not take up Peirce's tree in his elaborations.

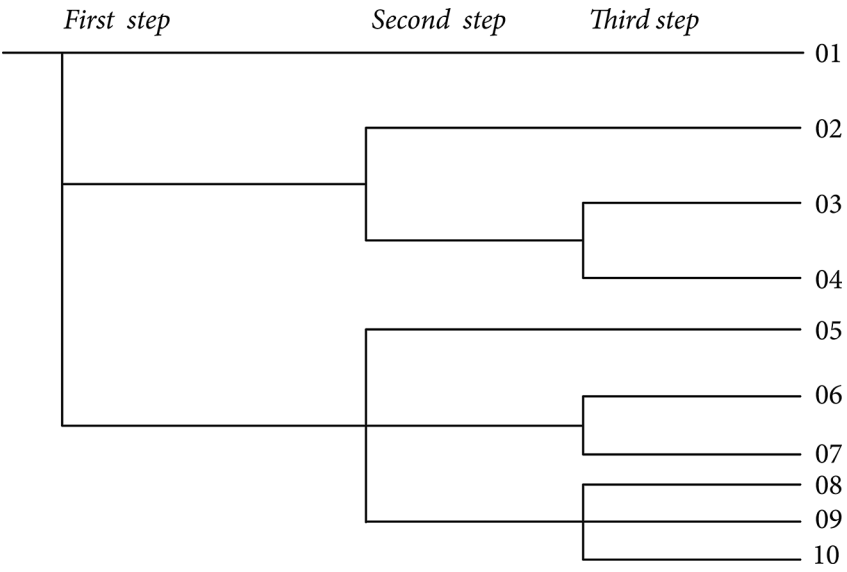

Fig. 1 The peircean tree

always, to some extent, skewed, as it appears enfolded within the previous phenomenon, and unfolds from there following its peculiar logic.[6]

Notwithstanding the architectural differences just considered, there are deeper reasons of accord between Thom and Peirce. Probably, two such motifs stand out: the first one is, as hinted above, the continuist mode of thinking shared by both authors; the second one is, as I submitted, a more or less secret vitalist thread that runs through their work. Concerning the first point, both Peirce and Thom aim to explain discontinuities – such as emergent forms and signs – through one single underlying continuity. Peirce calls his own brand of continuism, "synechism", consisting in the view that "continuity governs the whole domain of experience in every element of it" (Peirce, 1893: 1). Thom, too, is persuaded that every discontinuity presupposes some underpinning continuity, so that both continuity and discontinuity are necessary for the production of meaning.[7] Metaphysically, Peirce is a monist: for him, the continuous is the bottom of things (and, in this sense, we can place him in the Heraclitean tradition of the philosophies of becoming). In Thom's case, the situation is different: while Thom agrees that the ultimate aim of science is to explain the discontinuous through the continuous, the former also appears to be grounded in an evolutionary history endowed with its own necessity – indeed, Thom's argument is that animals

[6] Another important connection to Leibniz can be detected here: the unfolding of the branches is an instantiation of "inflection", the point where curvature turns from convex to concave. The same year Thom published his *Esquisse*, Deleuze (1988) put out his book on Leibniz, where he reconstructed the latter's philosophical system on the basis of the notion of *fold*. Also, Goethe's theory of plants (a foundational text in morphogenesis) is based on the idea of the leaf (*Blatt*) as the basic folded, and unfolding, vegetal element.

[7] It is worthwhile to recall here that a similar "continuist" metaphysics can also be seen operating in Gabriel Tarde, Georg Simmel, and Alfred N. Whitehead.

are evolutionarily wired to the perception of discontinuities; hence, the discontinuous is a vital necessity that cannot just be easily dispensed with. There is a reason why we believe in the existence of forms: that reason is life itself, in the sense that discontinuous forms are the mode in which life is seen operating as well as the mode through which life sees operations. Accordingly, the discontinuous cannot be discounted as simply epiphenomenal. Still, the discontinuous offers only a partial apprehension of a more complete reality, which fundamentally includes the invisible continuities subtending the visible discontinuities. That is why, in his attempt to understand the 'laws of form' (saliences), Thom feels he has to introduce the notion of pregnance as the invisible, the less formalizable yet no less necessary component of structuration and morphogenesis. The relation between the continuous and the discontinuous is, in a sense, the same relation as between the invisible and the visible, or between the virtual and the actual, whereby each actually visible is surrounded a mist of virtual invisibles.[8] This allows both thinkers to argue that existence is not an all-or-nothing phenomenon, but comes in degrees.[9]

Concerning the second point, the question is more delicate, since, as noted, none of the two authors ever explicitly reclaimed vitalism. Still, it is clear that both are working at a philosophy that rejects simultaneously crude materialism *and* spiritualist idealism. Thom never articulated a complete metaphysical programme of his own, while in the case of Peirce there have been endless attempts to categorize his pragmaticism, but when it comes to his prime philosophy we may be legitimated in tagging it as an "idea-realism". Both Peirce and Thom have engaged in an attempt at grappling with the phenomenon of meaning as central to the unfolding of life, with significant parallelisms: for instance, Peirce (1894a: 10) associates symbols with living processes – "symbols grow", he writes. The type of existence of symbols is said by Peirce to unfold as a series-reality, with each symbol producing ever-increasing determinations in its interpretant (hence, becoming increasingly *deeper*)[10]. This notion corresponds to Thom's insight in morphogenesis, where the living aspect of form is embodied in the element of pregnance. The expanse of semiophysics thus appears to be particularly widened by the fact that its continuism corresponds to an emergentist theory in which the thresholds between the living and the non-living cannot be determined in any single straightforward way. The fractional approach proposed here takes up this point in order to suggest that the living has no boundaries but rather thresholds.

[8] Following Duns Scoto, Peirce (1902a, b: 763) defines the virtual as follows: "A virtual X (where X is a common noun) is something, not an X, which has the efficiency (*virtus*) of an X". For his part, Thom argues that science proceed through "plunging the real inside a controlled virtual" [*Il n'y a de science que dans la mesure où l'on plonge le réel dans un virtuel contrôlé*] (Thom, 1991: 122). Bergson and Deleuze are other prominent philosophers who have dwelt extensively in virtuality. The theme of visibility and observability is another recurrent interest to be found *passim* throughout Thom's work.

[9] In 20th-century philosophy, Gilbert Simondon has expressed a similar view with his theory of individuation as a morphogenetic process.

[10] Peirce distinguishes a sign's *breadth* (indicating the totality of referred objects) from its *depth* (indicating the totality of expressed characters of the object).

As Seen More in Details

Before advancing a proposal to reconcile the two categorial constructions at stake, a few more details are needed. Peirce takes the trichotomy underlying his whole system of thinking from Kantian philosophy.[11] The categories of Firstness, Secondness and Thirdness are introduced by Peirce around 1867, and are increasingly understood by him as existing *in re*.[12] One finds endless reformulations throughout Peirce's work, such as for instance:

> the first will be that whose being is simply in itself, not referring to anything nor lying behind anything. The second will be that which is what it is by force of something to which it is second. The third will be that which is what it is owing to things between which it mediates and which it brings into relation to each other. (Peirce 1887–8: 170)

Elsewhere, Peirce even more concisely writes: "Three elements are active in the world: first, chance; second, law; and third, habit-taking" (1887-8: 208). The same are also variously named Freedom, Constraint, and Purpose (1887-8); Originality, Obsistence, and Transuasion (*CP* § 2.89); emotion, effort and apprehension (1891); feeling, reaction, and thought (1885; 1894). In sum, *firstness* designates a form of existence that is spontaneous, fresh, pure and absolute, *secondness* refers to reality as determined into being by some external force (such as in the "force of law", to echo a famous example by Peirce), whereas *thirdness* evokes the capacity to relate two items thanks to some relating medium. It is upon such a categorial background that Peirce's theory of sign and sign classification rests, and must be examined. The sign appears to him as an unbreakable triad encompassing its own constituent elements: (1) the Representamen, or the "other", the "replica"; (2) the Interpretant, the medium, sometimes referred as the "cognition produced in the mind"; (3) the Object, "thing signified", or "an" (to be joined to the "other" as second to first, thanks to third). In each sign, a "third" element must always be present as a connecting medium between first and last. This way, the medium is what keeps together quality and quantity, unity and multiplicity. All semiosis needs such unbreakable trinity, whereby each one of the three elements cannot be taken in isolation without changing its nature. The most general trichotomy of signs (which is then nuanced into ten more specific types) exhibits a clear isomorphism with the three categories and the three components of sign: for indeed, the *icon* is a type of sign that exhibits the qualities of the representamen's object, the *index*, a sign that reflects a real connection of the representamen

[11] On the obduracy of three, Peirce himself says: "Kant, the king of modern thought, it was who first remarked the frequency in logical analytics of trichotomies or three-fold distinctions. It really is so; I have tried hard and long to persuade myself that it is only fanciful, but the facts will not countenance that way of disposing of the phenomenon." (1885: 242).

[12] Peirce refers to the Medieval doctrine of realism, siding with the latter, in opposition to nominalism. More precisely, Peirce's ideas seem to have progressively shifted towards realism over the years, so that by the 1890s he had become a stern defender of a realism of ideas. Nearly contemporaneous to Peirce, Gabriel Tarde constructed a whole social theory based on a not too dissimilar metaphysics, which he dubbed "applied idealism".

with its object, the *symbol*, a sign that determines its interpretant in view of a purpose (Peirce, 1894: 5). At the same time, isomorphism does not mean equivalence, because it would be otherwise impossible to account for the mixes (for instance, as all other signs, an icon falls in the domain of thirdness, although it is the sign that most evokes the nature of firstness, and so on).

In Thom's semiophysics, what appears unbreakable is the interaction of saliences and pregnances. From this perspective, semiophysics results in a theory of couplings – or, as I suggest to call them, *social encounters*. I suggest the term "social" to designate situations that entail both a degree of determinism *and* a degree of indetermination. For instance, basic biological phenomena such as symbiosis, predation, parasitism, sexuality, etc., but also cultural phenomena such as the arts or the news (Thom, 1990), can be reconstructed on the basis of saliences as "individuated forms" coming into contact with pregnances as "propagative actions". The world of pregnances is the world of intensive magnitudes, whereas saliences designate modes of extensive existence. Thom (1988: 53–55) charts the four possible topological outcomes of such encounters as follows:

(1) Salience–> Salience. This is the world of *collisions*, as formalized by modern physics. At this level, some form of determinism seems possible, although we realize here that the whole of modern physics covers at most only one fourth of the field of semiophysics, and it is doubtful whether saliences can ever exist alone without evoking a pregnant quid.
(2) Pregnance–> Salience. This encounter gives rise to *figuration*, whereby a given form comes to be the "figure" of the pregnance investing it. It is an instance of "embodiment", where meaning derives directly from the way the pregnance is figured in the salience.
(3) Salience–> Pregnance. Thom calls this occurrence a *pre-programme*. In a sense, it is the complementary (yet not symmetrical!) solution to the previous situation, where a salience develops itself so as to "take advantage" of the pregnance bound to invest it. Thom also notes that a salience will naturally tend to act as a potential obstacle to the propagation of a pregnance; but this is precisely the reason why it can also channel the pregnance into a desired direction (canalization) or towards a sought-after effect.
(4) Pregnance–> Pregnance. A conflict of pregnances is quite unlike a conflict of saliences. Thom indicates that it results in a situation of *generalized catastrophe*. A generalized catastrophe is the moment when form gets literally pulverized, and turns to background: it marks the appearance of a new phase within an initially homogenous milieu, and is, potentially at least, a highly creative situation – we can think of it as implying a kind of "general reset" of the system's state.

Examining the matrix, it is possible to say that Thom's architectonics is more similar to Uexküll's *Funktionskreis* model of animal-environment interaction than to Peirce's cenopythagorean trinity. Indeed, Uexküll's functional circle is grounded in the *two* basic components of *receptors* of the perception marks selected from the object (*Merkmal*) and *effectors* of the effect marks imparted upon objects (*Wirkmal*), so that "certain qualities of the object become thereby carriers of perception marks

and others carriers of effect marks… [ultimately,] the effect mark extinguishes the perception mark" (von Uexküll, 2010 [1934]; Brentari, 2015). The selected traits of the object that the animal's perceptual ability confers to it can be described, in Thom's parlance, as saliences, whereas the specific significations attached to the biological "connection" of the animal to its Umwelt represent the value of one or more vital pregnances at stake. At the same time, Uexküll, who was keen on explaining the occurrence of biological meaning through the musical notions of resonance, melody and counterpoint, also showed how meaning can become stratified by adding and compounding more layers (that is, if we want, more pregnances) through semiotic triangulations, whereby various animal worlds become effectively imbricated (or captured and enveloped by one another). That is why, for instance, it is not rare to see that, throughout the animal domain, the acts of hunting, eating and copulating can "resonate" with one another. In this vein for instance Uexküll (2010: 176) describes the case of the brown ground beetle, where male and female go hunting together, next copulate, and soon after the female eats the male ("in the females' environment, the carrier of meaning 'friend' has changed to 'food' without changing its constitution in the least" – a clear example of a transfer of pregnance). Or, in the case of the anglerfish (*Lophius piscatorius*), the fish has evolved a biological lure that is not a visual replica of any specific prey, but rather a "very simplified imitation of this prey in the environment of the predatory fish for which the *Lophius* fishes" (ibid., 181) (in other words, the anglerfish's Umwelt has come to englobe its prey's Umwelt by mapping the latter's pregnances, notably the prey's preys).

Discussion

For Peirce, signs always exist as "replicas": each time we read a letter "e", Peirce (1904: 303) says, it is always the same "e" we are dealing with. This remark is important because it suggests that signs must always be approached as *populations*, never as individuals. Most errors in semiotic analysis likely derive from missing this point, so that one is led into a fallacious belief in the individuality of signs. In fact, signs are always general entities, or, more precisely (following Peirce's idea-realism), *actually-existing general entities*.[13] That is why there is no clear break between perception and interpretation: the fact that we can perceive, not only individual realities, but also directly general realities, in practice means that perception is never the pure recording of data, since it already involves interpretation, or "reasoning" – although the primary type of reasoning is, as Peirce would say, not "self-controlled". Perception is "forced upon my acceptance" as a process I can never entirely control, but this does not happen without simultaneously "thirdness pour[ing] in through every avenue of sense" (1903b: 211), to the effect that any purely mechanistic explanation of perception would be misguided.[14]

[13] Deleuze's notion of "multiplicity," or "manifold," reprised from Leibniz and Bergson, clearly resonates here.

[14] On this point, Peirce appears to be corroborated by the neurosciences: notably, see the study of visual perception (Land and Tatler 2009).

The vital dynamism is, in Peirce, directly related to the number three: differently from a balanced, static quadrangle, in each occurrence of semiosis the mediating interpretant (which, on the one hand, designates the object and, on the other, signifies its qualities) becomes, on its turn, the incepting point of the next sign, turning into the representamen of another object for another, "more definite" interpretant. This way, just like life, semiosis seeks to grow and expand into an open series, with no end in sight. This is particularly visible in the succession of *symbols*:

> A symbol is essentially a purpose, that is to say, is a representation that seeks to make itself definite, or seeks to produce an interpretant more definite than itself. For its whole signification consists in its determining an interpretant; so that it is from its interpretant that it derives the actuality of its signification. (Peirce, 1904: 323)

"A symbol, once in being, spreads among the peoples" (Peirce, 1894: 10). In semiophysics, such an inherent tendency to spread is embodied by pregnances, which behave like flows and fluxes, but also potentially as quantic jumps. Pregnances travel by and far, and may even exhibit "non-locality". It is in this sense that Thom's succession of forms shares an important similarity with Peirce's succession of signs. Thom also makes an effort to render the 2×2 interaction matrix as dynamic as possible (*souple*, as the French would say). For instance, as already pointed out, the circuit "Pregnance–> Salience" is not symmetrical to the circuit "Salience–> Pregnance": the former (figuration) can perhaps be rendered as an instance of "interpretation", in the sense that the ensuing form "interprets" ("embodies", maybe even "performs") the pregnance that has invested it, whereas the latter is better understood as a type of "camouflage" whereby a salience takes advantage of a certain "semblance" in a way that valorizes some invisible pregnance subtended to it. The role of visibility is crucial in these processes. The pregnant is, almost by definition, *the invisible*, as we can only properly "see" (perceive) saliences, while non-local pregnances are looming large over our existential situations. To have it with Derrida, the pregnant is, thus, "hauntological": *something* haunts form (ontology), which cannot be made sense of except as a kind of ambivalent *pharmakon*, for which an entire art of posology must be invented (Derrida, 1972, 1993).[15]

[15] A quick note is necessary to vindicate Derrida here. The latter's conception of *hauntologie* appears to me as indeed apt at illuminating the peculiar status of pregnance. Unfortunately, it is known that, in 1992, Thom co-signed a letter criticizing the decision of a certain university to confer an honorary degree to Derrida. Suffice to re-read that letter to have a clear indication that its drafting (logically to be attributed to its first signature, Hans Albert) was dictated above all by envy and resentment, that is, bad feelings. The arguments used against Derrida in the letter boil down to the usual allegations of obscurity, plus the fact that Derrida uses puns in philosophy. Now, it is not compulsory to study Derrida if one doesn't like him, but to decry the fact that others like him, is simply ridiculous. By signing the letter, Thom contradicted himself gravely, particularly vis-à-vis what he himself says in his 1991 interview with Emile Noël, and which I believe contains the better part of his judgment: "La philosophie, la vrai, ce n'est pas très facile… [elle] exige beaucoup d'efforts relativement techniques" (Thom, 1991: 59). Ironically enough, Thom indicated as instances of "true philosophy" those of Husserl and Heidegger, on which Derrida wrote profusely. In the end, it remains perplexing, and a bit sad, that Thom failed to notice the fecundity of Derrida's playfulness in philosophy: possibly, many other readers have recognized Derrida's greatness as residing

Thom (1990) also uses the images of "defect" and "flaw" (*défaut*) to illustrate the work of pregnance on salience. Taking the term from crystallography, a defect corresponds to the occurrence of "local irregularities" in a lattice structure. When it comes to manifestations of life, a defect of form can appear for instance as a *wound*, from which blood spills (Thom, 1991: 111). The image of the bleeding *blessure* (so central to Bataille's whole poetics…) has a clear vital signification in animal life. This explains why the vagaries of form and deformation involve both plasticity and elasticity: living forms are engaged in a dialogue with an environment that "imprints" them, but also constantly need to resist all those transformations that might be threatening – hence, their "resilience" in the face of looming catastrophes. To get a better grasp of the social encounters of saliences and pregnances, semiophysics distinguishes the logic of the *imprint* and the logic of *conditioning*. As concerns the former, we can take a "character" to be either a person in a story, or the distinctive features of someone's personality. In both cases, we have to do with a "typographic" act: such is the act of *charaxeín* (imprinting). Tellingly (and in a proper semiophysical sense), the same Greek verb covers actions as diverse as the gestation inside the mother's womb (pregnancy; the womb being also known as matrix) and the minting of coins. One is reminded here of the famous injunction issued by the Delphi oracle to the Cynic philosopher Diogenes of Sinope, *Paracharáxe to nómisma* – "Deface (or defile, counterfeit) your currency" – which, crucially, can also be read as: "Change your customs".[16] Such a necessity to "change one's currency," to *take measures* in order to transform oneself, is both extremely literal and, more amply, existential: *Du mußt dein Leben ändern* (so Rilke). At times, it comes upon one's intellectual and emotional life in painful or awkward ways – as in the sadly known "mid-life crisis".[17]

Conditioning is best known through the notorious Pavlovian "conditioned reflex". Semiophysics, in particular, explains conditioning as a transfer of a pregnance from one salience to another. So, for instance, the biological pregnance "hunger", with all its specific reactions (salivation etc.), can be transferred from the salience "food" to the salience "bell". Such achievement is what Thom (1988: 21) calls a "subjective investment", whereby "la pregnance alimentaire de la viande s'est propagée par contiguïté [i.e., by proximity] à la forme auditive saillante du tintement de sonnette". In a

precisely in his being nothing more and nothing less than the *enfant joueur*, which remains so coessential to all theorizing.

[16] The son of a banker, Diogenes got embroiled in a scandal involving the debasement of currency, apparently illegally changing the percentage of the various metals in minted coins – which, when the forgery was discovered, were officially defiled. As a consequence, he was forced into exile, losing citizenship and all his material properties. The Delphi oracle gave him an advice that, on the face of it, sounded like a repetition of his fault, but can perhaps be best understood as a homeopathic remedy pointing towards a more conscious self-transformation of one's values – indeed, Diogenes, the Cynic, became the most implacable enemy of all societal self-deceptions, the first in a long series of parrhesiastic figures in Western culture. And interestingly, according to a variant of the story (because, after all, myths only exist in variants), Diogenes consulted the oracle *before* committing the crime, which makes the oracle's exhortation even more dangerously ambiguous (the oracle: an integral semiotic machine…).

[17] This is also what happens when one realizes one is no longer capable of contributing anything worthy to one's own scientific field. There are several interview passages where Thom describes such a situation in his personal experience, which led him to "leave" the domain of pure mathematics and devote its attention to more general "models generators", amongst which, semiophysics (see e.g. Thom, 1990, 1991).

sense, conditioning involves a more general mode of "hijacking" a certain pregnance, diverting it from one salience to another. Such a dynamics is not wholly dissimilar from parasitism. The logic of the parasite is reconstructed for instance by Serres (1980) with a graph that highlights how the parasite is a "guest" who needs to get by (*para*) the grain (*sitos*) before the "host" gets there, thus diverting the nutrition flow to its own advantage. The semiophysical import of the operation can be described as a *virtualization* of one salient configuration through the *actualization* of a different one (See Fig. 2 in Brighenti, 2017).

Both imprint and conditioning seem to evoke, in different ways, purposefulness. To the same extent, a notion of purpose can be said to be required by Thom's analysis. Still, Thom seems to have difficulties in showing clearly how purpose *emerges* from the interaction of saliences and pregnances. Semiophysics might be more successful in showing how it is *embedded* within it. Indeed, purpose comes to be presupposed in the 2×2 diagram, notably via the pre-programme notion. There are, however, other notions Thom deploys to carve out a space for purposefulness, including the topological condition of "coincidence of the co-folds" in a double-hysteresis cycle.[18] Topologically speaking, Thom claims, it is not the means that determine the end, but rather the end that creates its own means to "coincide". Still, it seems that Thom's project of developing an "intelligible ontology" cannot be fully attained until the notion of purposefulness comes to be more clearly grounded in the basic diagrams of salience and pregnance. Inevitably, this entails some form of "reductionism", to the extent that that element exceeding dualism must be brought back into it. Vice versa, we could take an "emergentist" perspective, and observe how something emerges out of two that goes beyond it, as one of those unfinished "prisoners" statues by Michelangelo, fighting for their own liberation from a lower dimension, slowly conquering a new, higher one. For his part, Peirce denies that the notion of purpose, which subtends thirdness, can be surrogated in any way; he resolutely holds that it must be considered a primary constituent of all phenomenal relations. Peirce insists *ad abundantiam* on the fact that semiosis, as inherently triadic in nature, can never be reduced to a model of collision (i.e., secondness). Semiosis is not simply relational or interactive, rather, it presents a relation or interaction in which something is "served" to someone else. The interpretant, in this sense, corresponds to what the biologist Portmann (1990) called the "viewing eye", namely the presence of the relation inside the animal itself, which transforms part of the animal's body into a representamen: "The surface's display is a part of the presentation of self of a living being…" (Portmann, 1990: 25; see also Jaroš and Brentari 2022).

The Proposal

Something critical occurs at a fractional dimension *between* two *and* three. As soon as we install our gaze in the critical space of such a fractional space, we can appreciate the tension between, on the one hand, the conflation of dynamics towards a lower, more coherent level (Peirce's secondness) and, on the other, the divergence

[18] "C'est par cette coïncidence des coplis que s'exprime la finalité du processus antérieur… par rapport au processus postérieur" (Thom, 1988: 67−8).

(or explosion) of the dichotomy into a fully-fledged multiplicity (Peirce's thirdness, with Peircean tree ramifications). What we see emerging in the fractional dimension between two and three, is precisely the gap where that "for whom" or "to whom" inhabit, a "joint gap" so essential in order to have what might be called a "dedication" of the sign (i.e., Peirce's interpretant).[19] On its turn, the dedication itself is always indicative of some intensive reality – in semiophysical terms, a pregnance. What must be attained, and which can only be attained by growth beyond two, is that "new element" (*kainòn stoicheîon*) which might as well be called *the visible*. Semiosis can, in this sense, be said to necessarily unfold in a medium of visibility: the visible is that "third" towards which gazes converge, and from which they depart. It is a trajectology *with added value*. We can retrace such a situation roughly with a "W" shape, where Peirce's (upper) and Thom's (lower) basic categories are knitted together in a five-pointed diagram, as in Fig. 2.

Originality, obsistence and transuasion can only be imperfectly (i.e., fractionally) matched with salience and pregnance – but here lies the interest of W-shaped theorizing: all vectors and circuits through the five categories can be described as entanglements and disentanglements from lower to higher, and correspondingly from higher to lower, dimensions, through a logic and a dynamics of prolongations – where a prolongation designates an essentially synechistic category. It is known that the Aristotelian distinction between *homeomeres* and *anhomeomeres* mattered a lot to Thom (1988: 156). Beyond these difficult words, essentially, what is at stake is the distinction between a qualitatively homogeneous ensemble (a formation rather than a form,

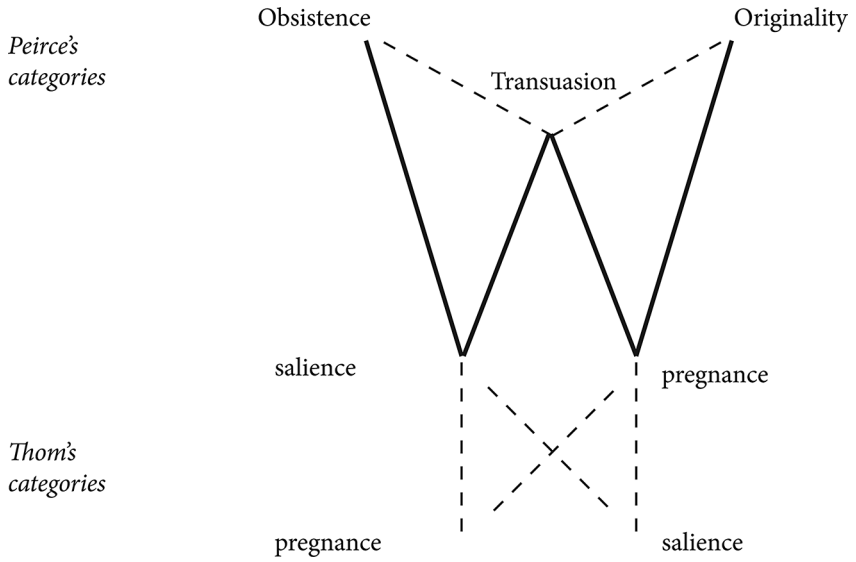

Fig. 2 The W shape

[19] There is, of course, a difference between signs emitted as signals addressed to someone and signs received by someone as indicative of something; in both cases, though, we can speak of a "dedication" of the sign, to the extent that the latter must, in its inherent structure, always include a "viewing eye", a "perspective", or, with Peirce, a "respect or capacity" through which it can be received.

such as for instance, bone marrow, in Aristotle's example)[20] and a heterogeneous ensemble of different formations, which exhibits a proper form, and whose unity is functional (such as, a face, or a hand). Homeomeres are stable elemental compositions, homogeneous media, whereas it is with anhomeomeres that heterogeneity makes its way into the living substance: the anhomeomere is a compound of discontinuous parts, which, taken in isolation, fail to constitute the organ. An anhomeomere, in other words, cannot be further divided without changing its nature (a face is itself not made of smaller faces, etc.). Arguably, in this sense, Aristotle offers the first natural theory of "double articulation" (as Hjelmslev will call it in linguistics), whereby a single anhomeomere is composed of, and layered upon, different homeomeres: the anhomeomere is a new, "actual" form, made of the subtended differentiated formations, thus functioning as the "limit" of its constituting homoeomeres (that are organs only "potentially"). The discontinuous, we may also gloss, emerges as a patchwork of continuities. Now, the W-shape, to the extent that it displays the joint gap between pregnant original qualities and obsistent saliences, enables us to see precisely the constitution space of anhomeomeres, and take notice of their emergence out of homeomeres, thanks to the conquest of the transuasional dimension.

Once the W-shaped stage is set, it becomes possible to consider the movements that are inherent in it. Now we can retrace Thom's four combinations to see how they prolong into the Peircean categories. Figure 3 illustrates the first movement, arguably the simplest one. The trajectory Thom designates as "Salience to salience" *unproblematically* prolongs into Peircean secondness. Still, the world of classic physics can already be approximated with "the lower threshold" of semiotics (Eco, 1975: § 0.7) because, even when we are in the basic situation of collision between extensive solid bodies, the possibility remains open that salience *unpredictably swerves* towards transuasion, to which, all things considered, is never a complete foreigner. The point is that we cannot resist searching for some significance even in a trivial clash of *blobs* – for instance (as evidenced by the fact that Thom spends some time making the calculations of how one such clash ends) we cannot resist wanting to know which blob "wins": even a kinetic moment is already evoking a (virtual) pregnance. The fact that pregnances are intensive magnitudes in practice means that even at degree-zero their existence can be "haunting" the situation.

The second movement, as illustrated in Fig. 4, retraces the trajectory Thom calls "Salience to pregnance", which corresponds to a semiophysical pre-programme. Insofar as this movement appears as a deliberate plan, i.e. as a ruse or an *artifice of nature*,[21] it can be seen as entailing a further, "below normal" prolongation towards thirdness (such as, for instance, in the ubiquitous phenomenon of *canalization*). At the same time, if we look at the situation from the perspective of a logic of obstacles, it is noteworthy to recall that what remains of a purely obsistential nature in

[20] Although homeomeres are, strictly speaking, formless, Aristotle attributes to them a "logos", defined as the list of actions and reactions that the homeomere exhibits whenever it is perturbed (Thom, 1988: 192). Reading this idea with Deleuzian lenses, one would be tempted to say that the homeomere is a Spinozist concept, whereby bodies are not to be defined according to form or function, but according to lists of affections.

[21] Significantly, Spinoza's project of ethics is entirely premised on a similar expanded naturalism, where nature is regarded as entirely imbued with artfulness (as, for instance, and typically, in the logic of poison).

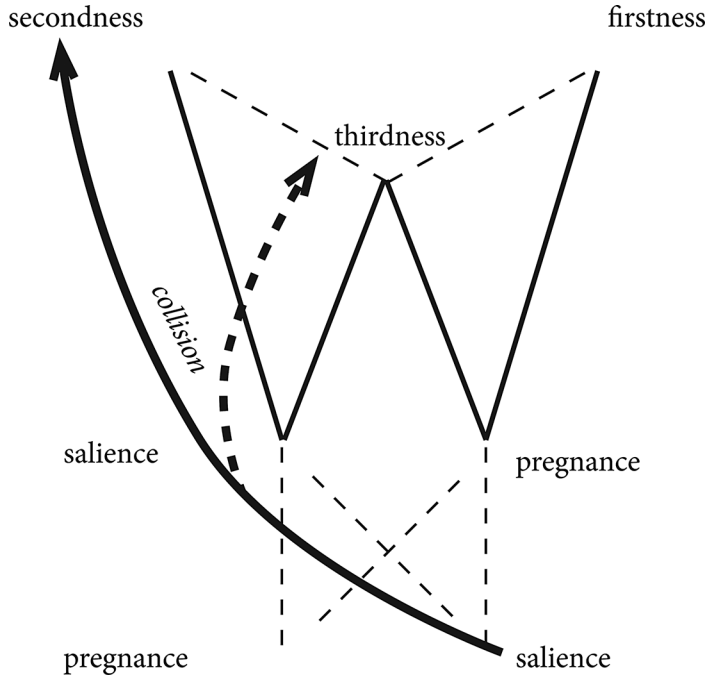

Fig. 3 Movement no. 1, salience to salience prolonging into secondness, and swerving towards thirdness

this movement is the salience's capacity to limit and "reign in" the diffusion of a pregnance (like a dam). Interestingly, in Fig. 4, starting from a pregnance, there is no other way to attain secondness except through a movement of *quantum tunnelling*. Quantum tunnelling is used by Thom (1988: 29) as a model to understand the dynamics of pregnance within a subject ("affectivity"). For instance, the basin of the subject's affectivity can have such a shape where the "released" state (i.e., excitation) is found at a lower level than the "base" state, but cannot be easily reached because that normal state is surrounded by relative energy peaks (conversely, after the release there must be a slow accumulation of forces that builds back to the normal state). Quantum tunnelling thus appears as a "shortcut" that enables a given dynamic to reach an end-state which energetically should be considered as out of reach because of the very topology of the entailed "potential well". The same effect could perhaps also be characterized as a logic of "heritage," whereby the possibility of reclaiming certain salient configurations amounts to a *retrodictive rescuing* of transuasion (as in tense "future perfect progressive").

Figure 5 represents the third semiophysical movement, spanning pregnance and salience. As considered above, the achievement of figuration consists of a salience's conquered capacity to *perform* a pregnance, in other words to interpret and express it. This explains why the movement of figuration naturally prolongs into thirdness, which has oversight on the interpretation of the ensuing representamen, as well as on the interpretant's capacity to signify (the quality) and designate (the object). However, since the expression of qualities that the figurating salience enacts also has

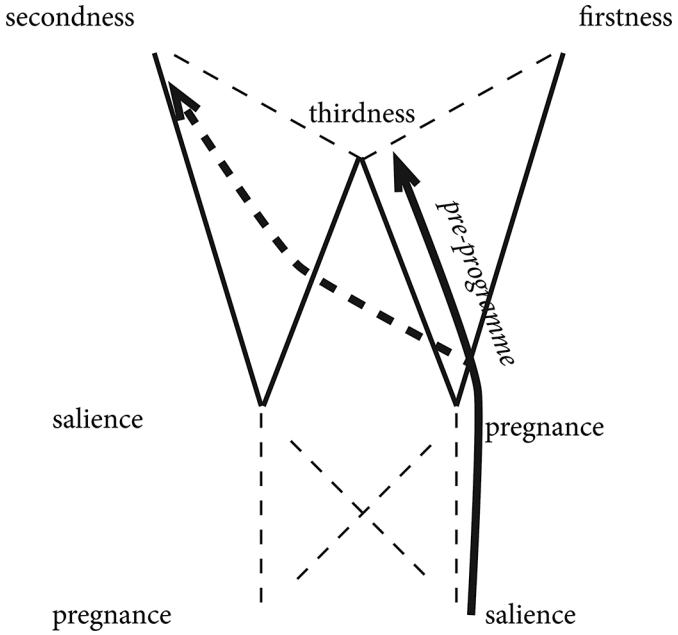

Fig. 4 Movement no. 2, salience to pregnance prolonging into thirdness, and quantum-tunnelling to secondness

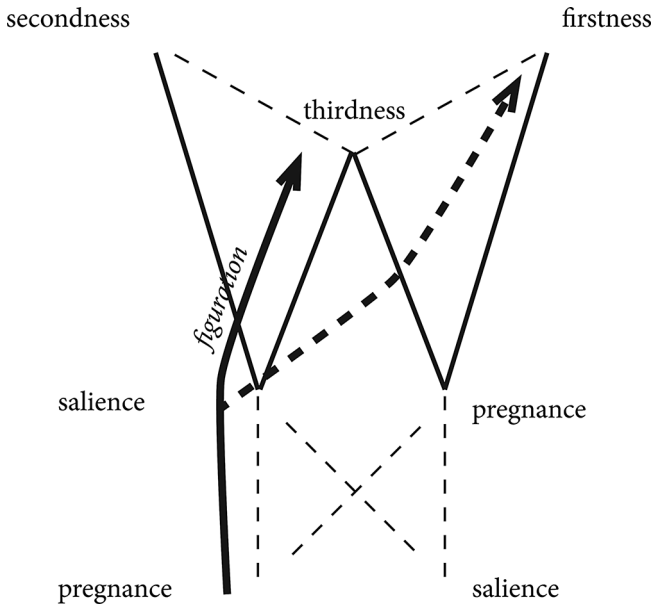

Fig. 5 Movement no. 3, pregnance to salience prolonging into thirdness and quantum-tunnelling to firstness

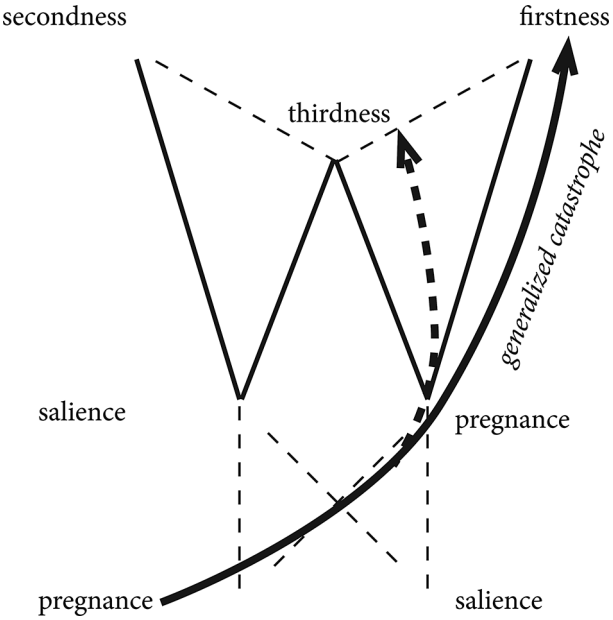

Fig. 6 Movement no.4, pregnance to pregnance prolonging into firstness and swerving towards thirdness

the nature of an exhibition of likenesses, the third movements simultaneously points towards the category of firstness, again to be attained in invisibility, through quantum tunnelling.

The fourth and final basic movement in semiophysics occurs in the case of a "social" encounter of pregnances. Figure 6 depicts Valery's dictum quoted by Thom (1991: 109), "the background is but impure form" [*le fond n'est qu'une forme impure*]. Such a situation is typical of moments when form undergoes a crisis. A conflict of pregnances, or the becoming self-conflictual of a single pregnance, leads to "generalized catastrophe".[22] This catabolic situation is always to be seen as a "liberation", in that it preludes to a system's global restructuring. What most pertains to pregnance, is its very *trajectology*, attached to its non-locality requirement. Pregnance, as an invisible underlying continuity, can be said to be *here*, *there*, *everywhere*. Certainly, then, the prolongation of the fourth movement in the Peircean categorial zone is chiefly directed towards firstness, insofar as the latter equates with the qualitative feeling of freedom and absoluteness (*absolutus*, i.e., literally, lacking ties). However, to the extent that pregnance is itself the bridging medium of the universe, the fourth movement must also account for a virtual swerve towards thirdness, whereby the pregnant becomes the true receptacle of meaning. Topologically, the capacity of a form to endure, i.e., to resist external perturbations, depends on the basin of its attrac-

[22] Considering the geometry of the attractors, Thom (1977: 45) distinguishes *conflict catastrophes* (where there is competition between two different attractors) and *bifurcation catastrophes* (where a single attractor becomes self-conflictual).

tor. In this respect, Thom (1977: 99–100) distinguishes, on the one hand, *static* forms endowed with simple boundaries and exhibiting structural stability and, on the other hand, *metabolic* forms, whose boundaries are much more complex and are consequently extremely sensible to even minor perturbations.[23] Understandably, it is out of the perturbation of metabolic forms that the situation of generalized catastrophe may ensue.[24]

If what just said sounds somewhat abstract, then it can be interesting to consider some recent threads in biology providing a wealth of consonant ideas. Indeed, some illustrations of the W-shape diagram and its dynamics can be found here. During the second half of the 20th century, molecular biology was sternly "genocentric", focused on DNA sequencing and DNA transcription processes according to the linear scenario outlined in 1953 by James Watson and Francis Crick with their double-helix model. The dominant paradigm, grounded in the encoding and decoding lexicon, held protein synthesis to be strictly subordinated to mechanistic explanation. The dynamics envisaged by classical molecular biology corresponds to the first movement "salience to salience leading to secondness", where the whole thing can be broken down into sequences of action and reaction. But the genocentric consensus has appeared increasingly untenable in light of phenomena such as DNA transposition and recombination, gene methylation, chromatin folding and chromatin modifications, horizontal gene transfer across species, and so on. All these biological facts muddle linearity, and have led to talks about a "post-genome" (or at least, post-genocentric) era. Most significantly for us, they hint to the presence of intensive pregnances at the heart of the living process.

Epigenetics, first envisaged by Waddington (1940) and currently described as the "biological embedding of experience" (Aristizabala et al., 2019), has revealed that much goes on outside and around genes that is not amenable to linear genetic determination. The complexity of living forms derives not so much from the genes themselves as much as from the regulation of their expression. And the genome activity itself cannot be understood without considering the densely packed chromatin structure surrounding chromosomes, along with the epigenetic landscaping in which it unfolds. The study of chromatin domains has for instance found that preferential internal chromatin interactions are in many species structured as "topologically associating domains" or TADs (Beagan and Phillips-Cremins 2020). These biomolecular condensates lack membranes and appear as concentrates of proteins and nucleic acids kept together by phase separation as liquid compartments. Protein transcriptions decisions that determine gene expression and gene regulation are taken in, or rather *by*, TADs, functioning as temporary, even ephemeral molecular assemblies

[23] "Mais si la perturbation augmente au point de bloquer le métabolisme sous-jacent, de détruire la récurrence de la dynamique-fibre, un phénomène nouveau et brutal intervient alors; la forme se dissout presque instantanément en un continuum de formes élémentaires de structure interne plus simple, formes statiques ou formes métaboliques d'attracteurs plus petits en dimension que l'attracteur *c* initial (catastrophe catabolique)" (Thom, 1977: 100). Intriguingly, Thom also speculates that, to the extent that memory can be described as a form, it must certainly be a metabolic one (to the contrary, a stable form would make memory unusable).

[24] And, in this sense, metabolic forms remind us the structural condition of metastability, as conceptualized by Gilbert Simondon in his theory of individuation.

sometimes described as "committees" or "flash mobs" (Ball 2023: 201). Even bacteria – which, to have it with Shapiro (2007), are "small but not stupid" – work with pregnances. And across the tree of life, from archea through prokaryota to eukaryota, protein interactome connectivity turns out to become more *uncertain*, for the simple reason that eukaryotic interactome handles much more information, information at a different scale. This is what enables causal emergence and the increase in resilience of macro-nodes (Hoel et al. 2020). We see here at work the semiophysical movement "salience to pregnance prolonging into thirdness": with these assemblies, new molecular forms appear that guide intensive components towards certain global states that are needed by the system.

At a different level of organization, cells, tissues and animals, too, exhibit dynamics that suggest the presence of pregnances. Developmental and synthetic biologist Michael Levin has, in partnership with several collaborators, studied the behaviour of cellular collectives in anatomical morphospace in order to evince a naturalistic theory of cognition as something that long predates brain structures. Informed by molecular biology, bioengineering, biorobotics, and the study of natural and induced chimerism, Levin's work suggests that there is, not simply emergence of higher levels of organization out of lower levels, but also purposeful action of the higher levels towards coordinating the lower levels in view of attaining global goal states (Pezzulo & Levin, 2016). What life presents us with is, in other words, not only emergent causality, but also proper *causal emergence*, namely the concentration of causes at larger scales, despite (or perhaps precisely thanks to) the noise present at lower scales (Comolatti and Hoel 2022), thus achieving "independence from implementation details" (Clawson & Levin, 2023: 470) (and intriguingly, this reminds us of Peirce's (1891) doctrine of tychism, which holds that regularity is evolutionary, so that there is progressive consolidation of causality over time through the tendency to contract habits as part of the push towards growing complexity: law is not the cause, but the product of the process). Complex systems are thus said to be guided by a "virtual governor" that has no physical location in the system, and can be understood as a propagative, non-local pregnance representing the "teleonomy" inherent in life:

> Evolution does not simply make hardwired machines that execute a predetermined set of steps… Instead, it produces hardware that can execute error minimization, traversing novel paths in morphological and transcriptional spaces… to achieve… target morphologies. (Clawson & Levin, 2023: 468)

The teleonomy notion does not imply fixism, quite to the contrary, it helps explaining the incredible versatility of life and its capacity to keep assembling modules and patterns reliably – such as for instance in the deployment of stem cells to regenerate limbs (an activity known as "pattern completion") – but also creatively, as seen in the capacity to come up with surprising "re-purposing" solutions to unforeseen situations.[25] In the terms exposed above, these performances are based on the attrac-

[25] Such is the case of "xenobots", cultured skin cells from frog embryos (clawed frog *Xenopus laevis*) that have spontaneously reassembled into a previously inexistent animal exhibiting meaningful behaviour (Kriegman et al., 2020).

tor basins of given pregnances, which semiophysical systems encapsulate as well as elaborate. Overall, the space of "possible beings" now looks much wider than previously thought, including "hybrots" (such as rat neurons connected to a computer chip) and "animats" (artificial non-preprogrammed animals made of nonbiological material). Among the various complex movements, which cannot be fully untangled here due to lack of space, it may be interesting to consider the quantum tunnelling towards firstness that characterises pregnances investing saliences. This is a clear example of how uniqueness (firstness) can be attained by working on the "figurational" possibilities of a pregnance. A new being will always show up as a quantum leap whereby a novel figurational equation is proposed (Goldschmidt's "hopeful monster" may be recalled).

It seems clear that an intense social life invests complex systems. Social life is not simply located between associated creatures, but prolongs inside them as well. Even the most bizarre and quixotic creature is, in its manifesting teleonomy, an exercise of collective intelligence. So, once thirdness is considered as the attainment of a salience in its capacity to figurate a pregnance, the self-assembling capacity of living entities must be recognized as a semiotic process of veritable self-interpretation. The memory of "setpoints" or goal states to be pursued ("engrams", to retrieve Richard Semon's venerable terminology) follows a logic, not so much of "heredity", but of "heritage" in the sense described above (namely, the retrodictive rescuing of thirdness). This also explains why living things always deal with conflicts of pregnances, which, as we know, prelude to the possibility of generalized catastrophe, with death (*sive* invisibilisation) as a catabolic way out. But here also lies the enduring relevance of vitalism, and its promises for a new scenario, not only beyond genocentrism, but also beyond organocentrism.[26]

Conclusions

An integrative framework has been discussed for knitting together the insights of biosemiotics and those of semiophysics. Differences and similarities between the two approaches have been reviewed, and an ideational effort has been made to situate the theoretical gaze in the gap – or, if one prefers, the open field – between the two disciplines. Such a new space appears shaped as a *W* letter, with five key points, embodying all the difficulty, but also the potential, of mapping two onto three, and vice versa. Following Peirce, there must be a break between two and three (hence, a fracture); at the same time, though, all continuist thinkers (among which, the "synechist" Peirce

[26] As Levin (2021: 8) has recently put it: "We can now readily construct hybrid systems which have any percentage of robotics tightly coupled to on-board living cells and tissues, which function together as one integrated being. How many living cells does a robot need to contain before the living system's 'true' cognition bleeds over into the whole? On the continuum between human brains (with electrodes and a machine learning converter chip) that drive assistive devices (e.g., 95% human, 5% robotics), and robots with on-board cultured human brain cells instrumentized to assist with performance (5% human, 95% robotics), where can one draw the line – given that any desired percent combination is possible to make? No quantitative answer is sufficient to push a system 'over the line' because there is no such line." The great lesson of vitalism that still holds true (even though, of course, we need to reconstruct vitalism beyond the pittfalls of its classical formulations) is precisely that "there is no such line", so that we need to restructure our view of life as not coinciding with the boundaries between the organic and the non-organic.

himself) cannot desist from the effort of explaining discontinuity on the basis on *some* non-local continuity, whether visible or invisible (or, if one wishes, through life and death). That is why the four dynamics of semiophysics can be seen as prolonging into the three-fold structure of the semiotic ontology. The nature of a *prolongation* is precisely that of a co-articulation of continuity and discontinuity: and I submit that it (the prolongation) is precisely what can make natural phenomena "intelligible" at all. Consequently, the proposed *W*-shaped schema can be regarded as a continuation of the semiophysical programme, with a focus on the specific problem of the explanation of finality, purposefulness, directedness, or teleonomy – in short, with the domain of Peirce's categorial Third. While semiosis can only be built on the basis of the category of thirdness, and thirdness must be seen as a primary and ubiquitous phenomenon throughout nature, it matters that we become able to track its intimate imbrications with continuity, thus with the semiophysical salience-pregnance ontology. In this sense, through the lenses of *W*-shape theorizing it becomes possible to evince the natural process through which vital dynamics of emission and impregnation are put into a perspective that organises them.[27]

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Declarations

Competing Interests The authors declare no competing interests.

[27] Interestingly, the philosophy of David Hume has been described by Deleuze (1956) as a vast attempt to put the cause-effect relationship *at the service of* the means-ends relationship (specifically, deploying the notions of institution and legislation as structuring media of social interaction).

References

Araujo, A. (2022). René Thom, reader of Jakob von Uexküll (Meaning as topological Space). *Biosemiotics*, *15*, 555–573.

Aristizabala, M. J., et al. (2019). Biological embedding of experience: A primer on epigenetics. *Pnas*, *117*(38), 23261–23269.

Beagan, J. A., & Phillips-Cremins, J. E. (2020). On the existence and functionality of topologically associating domains. *Nature Genetics*, *52*, 8–16.

Brentari, C. (2015). *Jakob von Uexküll: The discovery of the umwelt between biosemiotics and theoretical biology*. Springer.

Brighenti, A. M. (2017). The visible. *Frontiers in Sociology, Sociological Theory*, *2*(17), 1–11.

Clawson, W. P., & Levin, M. (2023). Endless forms most beautiful 2.0: Teleonomy and the bioengineering of chimaeric and synthetic organisms. *Biological Journal of the Linnean Society*, *139*, 457–486.

Comolatti, R., & Hoel, E. (2022). Causal emergence is widespread across measures of causation. *arXiv*. https://doi.org/10.48550/arXiv.2202.01854

Deleuze, G. (1956). *Hume*. Radiophonic Conference. https://www.radiofrance.fr/franceculture/podcasts/les-nuits-de-france-culture/gilles-deleuze-presente-la-pensee-du-philosophe-david-hume-6664626

Deleuze, G. (1988). *Le Pli. Leibniz et Le baroque*. Minuit.

Derrida, J. (1972). *La dissémination*. Seuil.

Derrida, J. (1993). *Spectres de Marx*. Galilée.

Eco, U. (1975). *Trattato di semiotica generale*. Bompiani.

Favareau, D. (Ed.). (2009). *Essential readings in biosemiotics*. Springer.

Hoel, E., et al. (2020). Evolution leads to emergence: An analysis of protein interactomes across the tree of life. *bioRxiv*. https://doi.org/10.1101/2020.05.03.074419

Hoffmeyer, J. (1998). Biosemiotics. In Paul Bouissac (Ed.), *Encyclopedia of semiotics* (pp. 82–85). Oxford University Press.

Jaroš, F., & Brentari, C. (2022). Organisms as subjects: Jakob von Uexküll and Adolf portmann on the autonomy of living beings and anthropological difference. *History and Philosophy of the Life Sciences*, *44*(3), 1–23.

Kriegman, S., et al. (2020). A scalable pipeline for designing reconfigurable organisms. *Pnas*, *117*(4), 1853–1859.

Land, M. F., & Tatler, B. W. (2009). *Looking and acting: Vision and eye movements during natural behaviour*. Oxford University Press.

Levin, M. (2021). Technological approach to mind everywhere (TAME): An experimentally- grounded framework for understanding diverse bodies and minds. *arXiv*. https://doi.org/10.48550/arXiv.2201.10346

Peirce, C. S. (1867). On a new list of categories. In E. C. Moore (Ed.), (1984) *Writings of Charles S. Peirce. A chronological Edition. Vol. 2 (1867–1871)* (pp. 49–58). Indiana University Press.

Peirce, C. S. (1885). One, two, three: Fundamental categories of thought and of nature. In C. J. W. Kloesel (Ed.), *Writings of Charles S. Peirce. A chronological Edition. Vol. 5 (1884–1886)* (pp. 242–248). Indiana University Press.

Peirce, C. S. (1887–8). A guess at the riddle. In Peirce Edition Project (Ed.), (2000) *Writings of Charles S. Peirce. A chronological Edition. Vol. 6 (1886–1890)* (pp. 166–210). Indiana University Press.

Peirce, C. S. (1891). The architecture of theories. In Peirce Edition Project (Ed.), *The Essential Peirce. Selected philosophical writings. Vol. 1 (1867–1893)* (pp. 285–297). Indiana University Press.

Peirce, C. S. (1893). Immortality in the Light of Synechism. In Peirce Edition Project (Ed.), (1998) *The Essential Peirce. Selected Philosophical Writings. Vol. 2 (1893–1913)* (pp. 1–3). Indiana University Press.

Peirce, C. S. (1894). What is a sign? In Peirce Edition Project (Ed.), (1998) *The Essential Peirce. Selected Philosophical Writings. Vol. 2 (1893–1913)* (pp. 4–10). Indiana University Press.

Peirce, C. S. (1902a). Synechism, fallibilism, and evolution. In J. Buchler (Ed.), (1955) *Philosophical Writings of Peirce* (pp. 354–360). Dover.

Peirce, C. S. (1902b). Virtual. In J. M. Baldwin (Ed.), *Dictionary of philosophy and psychology. Vol. 2* (pp. 763–764). Macmillan.

Peirce, C. S. (1903a). The categories defended. In Peirce Edition Project (Ed.), (1998) *The Essential Peirce. Selected Philosophical Writings. Vol. 2 (1893–1913)* (pp. 160–178). Indiana University Press.

Peirce, C. S. (1903b). The nature of meaning. In Peirce Edition Project (Ed.), (1998) *The Essential Peirce. Selected Philosophical Writings. Vol. 2 (1893–1913)* (pp. 208–225). Indiana University Press.
Peirce, C. S. (1904). New elements. In Peirce Edition Project (Ed.) (1998) *The Essential Peirce. Selected Philosophical Writings. Vol. 2 (1893–1913)* (pp. 300–324). Indiana University Press.
Peirce, C. S. (1905). Critical Common-sensism. In J. Buchler (Ed.), *Philosophical Writings of Peirce* (pp. 290–301). Dover.
Peirce, C. S. (1906). The basis of pragmaticism in the normative sciences. In Peirce Edition Project (Ed.), (1998) *The Essential Peirce. Selected Philosophical Writings. Vol. 2 (1893–1913)* (pp. 371–397). Indiana University Press.
Pezzulo, G., & Levin, M. (2016). Top-down models in biology: Explanation and control of complex living systems above the molecular level. *Journal of the Royal Society Interface*, *13*, 20160555.
Portmann, A. (1990). *Essays in philosophical zoology. The living form and the seeing eye*. Edwin Mellen.
Sebeok, T. A. (1991). *A sign is just a sign*. Indiana University Press.
Serres, M. (1980). *Le parasite*. Grasset.
Shapiro, J. A. (2007). Bacteria are small but not stupid: Cognition, natural genetic engineering and socio-bacteriology. *Studies in History and Philosophy of Biological and Biomedical Sciences*, *38*, 807–819.
Thom, R. (1977). *Stabilité structurelle et morphogénèse*. InterEditions.
Thom, R. (1983). *Paraboles et catastrophes*. Flammarion.
Thom, R. (1988). *Esquisse d'une sémiophysique*. InterEditions.
Thom, R. (1990). *Entretien avec Jacques Nimier*. https://web.archive.org/web/20070117160505/http://perso.orange.fr/jacques.nimier/entretien_thom.htm
Thom, R. (1991). *Prédire n'est pas expliquer*. Flammarion.
von Uexküll, J. (2010 [1934]). *A foray into the worlds of animals and humans. A theory of meaning*. University of Minnesota Press.
Waddington, C. H. (1940). *Organisers & genes*. Cambridge University Press.