« 8 » By enabling us to think of planetary emergencE/Y as immanent ontogenic development (as chicken and egg arising *together* in the systemic conservation of "chickening," §36), natural drift leads to a vision of the future in which "we" cannot continue to exist without myriad more-than-human becomings, many of which operate beyond (human) sensibility. Indeed, as Bruno Latour highlights:

> "If there is a climate for life, it is not because there exists a res extensa within which all creatures reside passively. The climate is the historical result of reciprocal connections, which interfere with one another, among all creatures as they grow. It spreads, diminishes, or dies with them […] we last as long as those entities that make us breathe." (Latour 2017: 106)

We drift together or not at all.

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nition as "collectively-producing systems that do not have self-defined spatial or temporal boundaries. Information and control are distributed among components. The systems are evolutionary and have the potential for surprising change."

What is Special about Natural Drift as an Organism-Centered View of Evolution

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> Abstract • Jorge Mpodozis presents natural drift as an organism-centered view of biological evolution. Currently, many other research programs in biology and philosophy of biology pursue organismic perspectives in evolution. We consider some of the features appearing in the article in this light in order to highlight what is special in Mpodozis's proposal. We contend that collaborations among research programs would be valuable and suggest that the major contribution of natural drift for organismic projects lies in its dynamic organizational features.

« 1 » Jorge Mpodozis nicely presents a renewed short version of the natural-drift idea that was advanced in Chapter 5 of *The Tree of Knowledge* by Humberto Maturana and Francisco Varela (1984), and further developed by the author together with Maturana (Maturana & Mpodozis 2000). This work was a major undertaking in theoretical biology, as the autopoiesis perspective had focused on autonomy and identity as primary elements in the characterization of the living, and had considered that reproduction and evolution were just derivative, or secondary, aspects of life. Therefore, clarifying the place and role of reproduction and evolution in autopoiesis was a challenge for the theory.

« 2 » Natural drift is a critique of the neo-Darwinian interpretation of adaptation as optimization of traits. Rather, this theory emphasizes the idea that adaptation is conserved in the form of structural coupling between the organism and its medium, which

determines the course of both ontogeny and phylogeny (Bich & Etxeberria 2013). In contrast with the externalism of the standard evolutionary theory, in the sense that organismal traits are conceived of as designed by natural selection, this approach is "internalist": the structure of the organism determines which changes are possible in each time step, so that environmental perturbations act only within the plasticity or the degrees of freedom of the system (§5) and they are meaningful depending on the current structure of the system. The system structurally changes in those interactions, always within the range of variants enabled by its structure.

« 3 » The autopoietic approach has developed an organism-centered view since its beginnings in the 1970s and has, as such, many points of convergence and common interests with more recent developments of what is now perceived as the "return of the organism" to the life sciences in general and to evolution in particular, after a period marked by molecularization, e.g., Etxeberria & Umerez (2006), Nicholson (2014), Walsh (2015), and Baedke (2019). By reading Mpodozis's target article, one may be led to believe that genetic determinism is a prevalent view in current biology or philosophy of biology. In some ways, that view is still, sadly, very powerful. However, there is also a very broad spectrum of criticisms of genetic reductionism in the current scientific and philosophical literature of the life sciences. We would like to highlight that initiatives within fields like evo-devo (Müller & Newman 2003), eco-evo-devo (Sultan 2015), or niche construction (Laland, Matthews & Feldman 2016) are also engaged with organism-centered approaches to evolution.

« 4 » We wonder whether Mpodozis's effort to develop an evolutionary view based on the dynamic and systemic properties of organisms may support the idea that organisms are active agents in their environments (as it seems, according to §8 and §9). For example, it may be worthwhile to study the points that the natural-drift approach and the agential approach based on affordances developed by Denis Walsh (2015) might have in common, although there may be differences based on the notion of structural determinism.

« 5 » All in all, both views would probably coincide in the way Mpodozis explicitly favors behavior over genetics as the driver of evolution, which we read as an agential understanding of evolution. This feature is one of the most distinctive ones of the extended evolutionary synthesis (EES), where the relevance of environmental factors is emphasized as opposed to an excessive focus on the genetic perspective (Pigliucci 2009; Fábregas-Tejeda & Vergara-Silva 2018). In both views, organisms are the result of a historical process extending from conception to death, and in which the gene, the environment, chance and the whole organism are continuously involved (Lewontin 1983). Richard Lewontin and the niche-construction view maintain that environmental conditions themselves are largely structured by organisms, in what is sometimes understood as a reciprocal causation (Baedke, Fábregas-Tejeda & Prieto 2021). Given the internalist emphasis of structural determinism, according to which the behavior of organisms as autopoietic systems is largely independent of the environment, we ask whether the natural-drift approach can accept that reciprocity. In short, the question would be: Since environmental influences on organisms do not causally intervene in their constitution, but are merely perturbations, does natural drift support the idea that organisms are active in their environment? Q1

« 6 » Another example of this internalism may be seen in the way the notion of adaptation appears in (§16 and Footnote 6), as well as the way in which the term "niche" is used in "the dynamics of the organism–niche relation" (§2). The latter suggests a slightly more dichotomous view of the organism–niche relationship than what is usually considered in works exploring niche construction in the EES approach. However, the degree of linkage or merging between organisms and environments is currently a subject of debate (Baedke 2019), to which autopoiesis and natural drift may fruitfully contribute.

« 7 » With respect to the organism–niche relationship, the notion of adaptation that Mpodozis proposes (§16 and Footnote 6), which relies on the concept of "ways of living," (§§18, 29), suggests a form of teleological essentialism in the understanding of ways of living such as those illustrated by alligatoring, humanning, ducking, or chickening. A similar view can also be seen when considering the class of actions that constitute the flow of actions of a given individual (belonging to a species) or the way the process of speciation is portrayed as occurring in a single step. In relation to this point, during the first half of the article, Mpodozis argues against both genetic determinism and environmental determinism. However, a form of determinism is presented in his understanding of both drift and change. Using determinism to address causality is problematic in claims such as "A drift is a deterministic process" (§16), and "The course of structural change […] is determined by the flow of actions that the living being has performed" (§14). The former is questionable, since drift and determinism seem to be opposite concepts, and the latter is problematic, since the course of evolution (and biological change in general) cannot be said to be determined by any particular factor, be it behavioural or genetic; the contrary would require strong evidence.

« 8 » Something we found particularly interesting and would like to see further developed is the author's conception of systemic reproduction (§§21–23). Q2 It is worth exploring notions of reproduction that go beyond the model of copying and replication (as in Maturana & Varela 1984), as they could also take into account the relationships of material overlap between generations, such as those that appear in cell mitosis or in viviparous reproduction, and the way in which organisms rely on one another to reproduce (Minelli 2016; Griesemer 2017). As reproductive processes reveal many aspects of how life is organized collectively, and those have been largely neglected by current biology, they need to be considered in a systemic way.

« 9 » One point of concern is the many ways in which drift appears in the text. We feel confused about the differences between structural, ontogenetic, phylogenetic and natural drift. What do those phenomena have in common as processes to be called drift? And how do they relate to the well-known idea of genetic drift in population genetics – where it is usually described as one of the main factors of evolution alongside selection, mutation, and migration, and which involves chance (Millstein 2021) – which is absent from the discussion? Q3

« 10 » We admit that there are other aspects of Mpodozis's article with which we do not concur. One of them has to do with the use of "vitalistic" as a negative term (§1). Maturana and Varela were most keen to disassociate their position from vitalism in their early presentations of autopoiesis, and went so far as to adopt a mechanistic language and to speak of organisms as autopoietic "machines." However, vitalism has a complex tradition with a long and convoluted history, and some of the achievements of the life sciences are indebted to vitalism.[1] While logical positivists and other approaches in the philosophy of science were quite sanguine about vitalism, their attitudes were not sufficiently supported by empirical evidence. Still, Maturana and Varela tried to steer clear of that issue by criticizing vitalism without much argument. Therefore, neither poorly founded criticisms of vitalism nor the mechanistic perspective and language for talking about cells are of interest for the community currently trying to advance the organism-centered approach to evolution.

« 11 » By discussing convergences with and divergencies from many other organism-centered research projects in biology and in the philosophy of biology, our main argument in this commentary should have become clear: For the notion of natural drift to make an impact in the literature, its proponents need to engage in finding bridges or "trading zones" with other projects that have a similar spirit. The understanding and adoption of natural drift as a relevant evolutionary process would benefit from making contact and engaging with other proposals responding to similar issues, in order to clarify how the terminology used is related to that of other accounts. This would help strengthen clear convergences and enrich the project in those aspects where an original and novel contribution is being made. In particular, the theory of natural drift can certainly add a dynamic and organizational dimension to organism-centered projects in biology.

1| See the forthcoming collection edited by Christopher Donohue and Charles Wolfe (2023) for a detailed analysis of relevant philosophical alternatives to mechanism and mechanistic explanation in the 19th and 20th centuries, including vitalist and organicist ones.

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