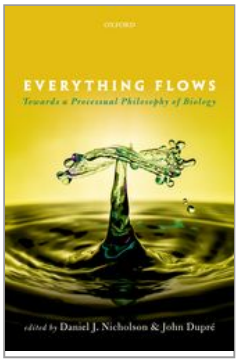

Everything Flows: Towards a Processual Philosophy of Biology
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Print publication date: 2018
Print ISBN-13: 9780198779636
Published to Oxford Scholarship Online: July 2018
DOI: 10.1093/oso/9780198779636.001.0001

(p.xi) Foreword

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> [T]here is really no ‘thing’ in the world.
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> —David Bohm (1999: 12)
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> [O]ur mind has an irresistible tendency to consider the idea it most frequently uses to be the clearest.
>
> —Henri Bergson (1946: 214)

There is a notable lack of substance, not in the writing you will find in this book, I assure you, but out there in the domain of the living. Let’s face it: there is no thing in biology (or, as Bohm would have it, in the world). Things are abstractions from an ever-changing reality. Reality consists of a hierarchy of intertwined processes. If life is change, then the activities driving this change are what we must explain. Yet we lack concepts and experimental approaches for the study of the dynamic aspects of living systems. This severely limits the range of questions we ask, most of the time even without our realizing. The problem is so obvious it is rarely ever talked about. There are very few explicitly processual theories in biology today. As a practising biologist, I’ve always found this utterly baffling and disappointing. We remain strangely fixated on explanation in terms of static unchanging entities.

The prime example of this substance fixation in biology is our love affair with genes, those particulate agents of heredity and development. It is all too easy for biologists to slip into deterministic and preformationist language, where genes represent some sort of enduring essence of an ephemeral living body. As a result, the mysterious source of gene agency remains unexamined and unexplained. Another example is our insistence that proper ‘mechanistic’

explanations of living organisms must be formulated at the level of component molecules, which we take to be unchanging at the timescales relevant to the processes we study. James Ladyman and Don Ross (2007), in their book *Every Thing Must Go*, call this the metaphysics of ‘microbangings’, small entities causing their effects by bumping into each other. Ladyman and Ross point out that this view is outdated and inconsistent with the dynamic view of the world given to us by modern physics.

Our fixation on static things leads to fallacious patterns of reasoning, within biology and elsewhere. The French process philosopher Henri Bergson alluded to this in the quote above, while Alfred North Whitehead (1925: 52) put it more explicitly by calling it ‘the fallacy of misplaced concreteness’. This consists in the unwarranted reification of objects, which become fundamental and replace the underlying dynamic reality in our thinking. This fallacy is deeply engrained in our cognitive habits. From a very early stage of development, we learn to distinguish objects, to isolate them from their context. Cognitive linguists George Lakoff and Mark Johnson (1980: 30–2) have suggested that this reflects a tacit commitment to a doctrine of ‘containment’: we treat the world as a container of objects that change properties or location and interact with one another. Each object is in turn a container with smaller objects **(p.xii)** inside, and so on. This doctrine is fundamental to our thinking; it forms the basis of set theory and relational logic. It is very deeply rooted in our human nature: all western languages share it, even ancient ones. To identify an object as a container, we must establish its boundaries as precisely as possible. Where and when does it begin? Where and when does it end? We instinctively crave for clear and rigorous answers to such questions.

However, modern science suggests that reality is simply not like that. The world is full of fuzzy boundaries. Seemingly unchanging entities keep on emerging and decaying if we consider them over a long enough time span. Moreover, it is impossible to say precisely when they truly become what they are and when they cease to be themselves. Or where they begin and where they end. This problem of identification and individuation is beautifully illustrated by the ancient Greek thought experiment about the ship of Theseus. According to the legend, the ship was preserved by the Athenians for centuries upon Theseus’ return from his journeys. In the process, each plank of the hull was replaced when it started to rot, until none of the original planks was left. Just as in our own bodies, the substance that makes up the ship is constantly replaced. Does this mean that the ship changes over time, or does it remain the same? As this conundrum illustrates, we need criteria for recognizing, individuating, and classifying processes. We need more accurate and adequate thinking tools that let go of the abstraction of the object. In short, we need to transcend the limitations of substance-based thinking. This is what the book you have in your hands sets out to do.

This is not armchair philosophy, nor is it an exercise in speculative system building. This book outlines a processual research agenda for theoretical biology with direct and wide-ranging implications for practicing biologists. It connects to specific areas of inquiry, such as cancer genetics, evolutionary theory, developmental biology, and the neuroscience of olfaction. It is written in a language that makes it accessible not just to philosophers but also to experimentalists. And, perhaps most importantly, it challenges many of the substance-based assumptions that hamper progress in specific domains. These fundamental assumptions about the world shape the research questions we pursue and the explanations we accept as satisfactory.

Unfortunately, modern scientific curricula have long forgotten to teach students about these hidden aspects of science. Even worse, the format of scientific meetings and papers is designed deliberately to sweep these philosophical foundations under the rug. They have become invisible, barred from the conscious attention of many researchers. In ignorance of their own metaphysical assumptions, scientists are falling back on naïve, often neopositivist preconceptions that severely constrain their thinking and keep their minds closed to the possibility of unconsidered alternatives. This is a terrible shame. If this book succeeds in doing only one thing, I hope that it will be to ignite a lively and public discussion among researchers in the life sciences about our underlying philosophical worldviews and their limitations.

My own scientific trajectory has been inspired and shaped, in an absolutely crucial way, by such philosophical considerations. As a child, I was very strongly committed, both emotionally and intellectually, to a view of static preservation. I am writing these words while on vacation in my hometown of Tschiertschen, a small mountain village in the Swiss Alps. I can assure you that there is a strong and deeply ingrained resistance to change in rural Swiss society. Like many of my country people, I also wished to preserve the beauty of the mountain environment I grew up in and the **(p.xiii)** wealth and orderliness of its society. It seemed perfect to me as it was. Thinking this through, however, I became aware of the suffocating dread of such a vision. This was a very visceral realization. Everything that is beautiful and exciting about the mountains I love has its basis in the dynamical processes that shape them: eon-long upheaval and erosion, the wild torrents so much appreciated by the Romantics, the unpredictability of the weather, and a tradition of tough high-altitude life, flexibly adapting to ever-changing and harsh environmental conditions. To me, static preservation, a freezing of the current state, no matter how precious, kills all that is beautiful, all that is exciting. The illusion of stability is just that: an illusion, and a perilous one at that. This realization was itself a slow and gradual process, not a sudden epiphany. And it has guided my journey of exploration ever since.

It guided me during my undergraduate training as a geneticist, which occurred in a staunchly reductionist molecular biology research environment. I suffered from the strongly antiphilosophical attitude around me, but was not able to express my dissatisfaction explicitly and convincingly. I wish I had known more about process thinking back then, to give my doubts and qualms focus and rigor. Who knows if this would have changed anything, as most of my colleagues didn't even feel that there was a problem. Worse still, they thought that molecular biologists didn't need any philosophy at all, since they were dealing with hard empirical facts! It didn't help to point out that this is itself a philosophical statement. In fact, nowadays scientists often use the term 'philosophical' in a derogatory manner, to describe questions that may or may not be interesting, but are definitely not answerable given our current state of research. Science, it is believed, will increasingly replace philosophy by making such questions answerable. This attitude has always bothered me. It creates a kind of intellectual monoculture that focuses only on the lowest-hanging fruit: the motto of science as the art of the feasible, taken to an unhealthy extreme.

Everybody around me was obsessed with the same question: how to decode the logic of gene expression during development by studying the regulatory sequences on the DNA that are thought to implement this logic. I felt that my colleagues ascribed an almost magical agency to those sequences. The central idea was (and to a large extent still is) that there is some sort of 'code' that can be read out of the DNA and that will result in a particular pattern in the embryo at some stage of development. Everybody was looking for the genetic program formed by this code: preformationist thinking par excellence! And yet very few people seemed to believe that their underlying assumptions were problematic and warranted philosophical scrutiny. When I looked for postgraduate advisors, I deliberately sought out (and was lucky to find) a number of exceptions to this widespread rule of wilful, self-imposed philosophical ignorance.

The most eclectic of these was Brian Goodwin, an unorthodox and open-minded thinker if there ever was one. Brian brought me into contact with process thought in the form of Husserl's and Merleau-Ponty's classic phenomenology, as well as with his own theory of biological structuralism (e.g. Webster and Goodwin 1996). On the one hand, I found these views tremendously fascinating and inspiring, fundamentally altering and refocusing my thinking about ways of becoming in embryology. But on the other, I felt that these approaches were a bit vague and detached from current experimental practices. Luckily, around the same time I learned the mathematical and conceptual tools of dynamical systems theory from Brian, Nick Monk, and my doctoral supervisor, John Reinitz. These tools could be combined in a powerful way with **(p.xiv)** quantitative experimental work to study the processes of pattern formation. During this stage of my career my interests decidedly moved away from the molecular details and the substance-based approach of molecular developmental genetics.

This ended up causing a string of problems that I didn’t anticipate at the time but which are obvious to explain with the benefit of hindsight. Many of my applications for postdoctoral fellowships, and then for grants that might fund my newly established independent research group, were rejected. Papers came back from journals too, often unread or with strange, uninformative, and even hostile reviews. It wasn’t only that the editors and referees thought that my research was flawed. They didn’t find it interesting at all, and mostly didn’t even make an effort to understand the question. It took me a while to realize that the problem I had wasn’t scientific but philosophical! Sadly, scientific reviewers are often so stuck in the habits and traditions of their field that they can’t think of research being worthwhile if it does not neatly fit into one of their familiar categories.

This is when process thinking itself became a central and fixed part of my research agenda. Publishing our philosophical arguments has allowed me not only to detect weaknesses and find a better grounding for my own thinking, but also to better explain why I do what I do to my colleagues. And slowly I’m beginning to see an effect. Over the last decades I’ve been happy to observe interest shifting towards dynamical systems modelling in developmental biology. Reviewers who state that ‘nothing can ever be learned from a model’ still exist, but have become exceedingly rare these days. In fact they appear to be a species on the verge of extinction. An increasing number of my colleagues have overcome the scepticism they initially exhibited and now tolerate, or even actively support, the processual research agenda a small minority of us have been pursuing for years.

This recent trend is tremendously encouraging. Quite clearly, the time is ripe for more process thinking, not only in developmental biology but across the life sciences. This is why I am so excited about the collection of essays in this book. It is an important and timely endeavour. I hope it will inspire young biologists in particular to open their minds, to widen their intellectual horizons, and to adopt new philosophical perspectives. I also hope it encourages them to ask radically new questions, build new conceptual frameworks and theories, and develop new experimental approaches that directly address the fundamentally processual nature of living systems.

Enjoy the read! I certainly did.

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Klosterneuburg, Austria, 16 August 2017