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Editorial

This Special Issue of the journal is dedicated to the memory of Dr. Susan Noble, wife of one of the chief Editors, Denis Noble. Susan passed away while the final editing of the issue was being completed. She was a mathematical biologist herself, and a co-discoverer (Brown, DiFrancesco, Noble, 1979) of the channel that became the target for the successful angina drug, ivabradine (Servier).

Brown, H.F., DiFrancesco, D., Noble, S.J. (1979) How does adrenaline accelerate the heart? *Nature*, **280**, 235-236.

Preparing this ambitious Special Issue has challenged everyone involved: authors, reviewers, and guest editors. The editors solicited contributions from many leading figures in a broad array of scientific and philosophical disciplines, with emphasis on phenomenological approaches to philosophy (see Section I). The motivating force was the conviction that if we could find a viable bridge for the gap between the "two cultures"[1] of science and philosophy, fundamental problems in each camp could be addressed more fruitfully than ever before and a new kind of science be born. We believe the unprecedented cross-fertilization of ideas from this initiative may furnish seeds from which that new, better integrated, and more effective approach to science may arise.

This Special Issue consists of forty papers. For each one, multiple reviewers were solicited, with at least one reviewer from each "culture" (a scientist and a philosopher). In many cases, several rounds of revision were carried out. Needless to say, this required great patience and dedication of all participants. The editors gratefully acknowledge the contributions of our authors, and of our anonymous reviewers, who worked long and hard on the papers we sent them with no compensation for their efforts. We also wish to thank the Elsevier editorial and production team for the support they gave us in bringing this project to fruition.

We would now like to offer a synoptic overview of the Special Issue, proceeding section by section and paper by paper. Our hope is that the reader will find this unique effort to marry science and philosophy both meaningful and enjoyable.

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1. Introduction

1.1. Beyond Descartes and Newton: recovering life and humanity

Stuart A. Kauffman and Arran Gare

The first contribution functions as a prologue. It provides the historical background and rationale for efforts to naturalize phenomenology, including a brief history of phenomenology, and also, of parallel developments in science. This history justifies the inclusion under this label of the work of philosophers who were not part of Edmund Husserl's school of Phenomenology. While the influential phenomenologist Maurice Merleau-Ponty embraced the work of Schelling and those he directly or indirectly influenced, including A.N. Whitehead, here it is shown why the semiotics of C.S. Peirce (who characterized himself as "a Schellingian of some stripe") and the work of Michael Polanyi and the hierarchy theorists should also be included. It then shows how with the development of endo-science, which assumes that we are part of the world we are striving to understand, science converged with naturalized phenomenology. With this convergence, we have recovered our consciousness and our minds. The far-reaching consequences of these developments are explored. They provide the basis for rethinking the nature of mathematics and its role in science, a new interpretation of quantum mechanics that both advances quantum mechanics and illuminates the nature of consciousness, and the basis for a major rethinking of biology. The notion of "function" in biology is defended, but it is impossible to prestate the emerging new biological functions that constitute the phase space of evolution. No laws "entail' evolution. Consequently, we cannot mathematize the detailed becoming of the biosphere. In its place, a post-entailing law explanatory framework is proposed. Here, *Actuals* arise in evolution to constitute new boundary conditions that are enabling constraints. These create new, typically unprestatable, *Adjacent Possibles,* opportunities for further evolution. The concept of functional closure of an organism making a living in an interconnected world becomes central. The implications of these innovations are shown for the historical reconstruction of evolutionary patterns, for the establishment of statistical laws about extinction events, and for the reintroduction of formal cause laws rather than efficient cause ones.

1.2. "Menaced Rationality": Husserl and Merleau-Ponty on the crisis and promise of science

Jonathan Singer

This article explores natural science from the standpoint of phenomenological philosophy. The author argues that while formal mathematical and scientific truths appear to Enlightenment rationalism as more basic than the lived empirical reality that they describe, they always already depend upon this reality for their

[1] Snow, C. P. 1959. *Two Cultures and the Scientific Revolution*. Cambridge: Cambridge University Press.

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meaning and being. The author notes the implicit conflict within traditional science between its rationalist hope of achieving an absolute knowledge that transcends the contingencies of the concrete world, on the one hand, and its profession of openness to the falsification of its ideas that makes it answerable to that world, on the other. But Singer goes further than contending that science must rely on empirical reality merely as a way of confirming its independent insights. He claims that the abstract truths of science are in fact "*rooted* in the empirical world itself." In supporting this claim, Singer introduces Husserl's and Merleau-Ponty's phenomenological critiques of science, and he suggests that these can actually help science keep its commitment to openness. He further intimates that science has long been plagued by a polarization of subject and object that phenomenological philosophy can help overcome.

1.3. Why natural science needs phenomenological philosophy

Steven M. Rosen

In the third introductory paper, Steven M. Rosen suggests that developments in physics, science's premier discipline, point unmistakably to science's need for a new philosophical foundation. By following the historical trajectory of the two main branches of modern theoretical physics—relativity theory and quantum mechanics—Rosen demonstrates that, in the end, neither field of research can successfully deal with the fundamental problem of discontinuity that is common to them. These fields in fact converge in confronting the ultimate challenge of bringing unity to physics by solving the riddle of quantum gravity, but this is precisely where discontinuity becomes wholly unmanageable. Rosen argues that the discontinuity plaguing theoretical physics is essentially symptomatic of the merging of subject and object anathema to the Cartesian philosophy in which conventional physics is rooted. The author introduces an alternative philosophical foundation that is well suited to the non-Cartesian phenomena of contemporary physics: *phenomenological philosophy*. This approach is elaborated through Maurice Merleau-Ponty's concept of *depth*, and then brought into focus for use in theoretical physics via qualitative work with topology and hypercomplex numbers.

2. Physics

2.1. Yet another time about time – part I: an essay on the phenomenology of physical time

Plamen L. Simeonov

The section on physics begins with the essay of Plamen L. Simeonov, a personal reflection on the concept of time in physics from multiple physical, mathematical and phenomenological perspectives. It seeks to extract the essential tenets from the diverse, often hidden or arguable assumptions underlying a number of hypotheses and theories about time in physics. It continues the argument of papers in our introductory section, in particular Steven M. Rosen's, while focusing on the problem of time in our understanding of the fabric of the Universe. By contrasting some of the major theories and hypotheses in physics, the paper emphasizes the interpretation of time phenomena, and paradoxes associated with the *different sorts and levels of logic* used for addressing the same issues in natural sciences, mathematics and philosophy, as well as physics itself. As in visual illumination at different frequency levels, different images result. Simeonov believes that the *systatic*[2] application of creative queries from all these domains, in the fashion of Laplace, Poincaré, Einstein and Tesla can push physics out of its current stasis by asking *new question*s related to its foundations. This integrative and mutually enriching process between science and philosophy could initiate a fruitful development and coalescence of both. A major conclusion reached in Simeonov's survey is that most claims about the nature of time in both physics and philosophy appear tractable within their own domains and reasoning frameworks, but hard when bringing together (for instance) quantum theory and relativity. Paradoxes and logical incompatibilities between the different conceptions involve i) experimentally validated facts, or ii) implicit "second-order" logics in a particular field, inapplicable elsewhere. Therefore, one way to resolve such differences and conflicts is to make these explicit, and test them in a broader context. The corresponding frames of reference, their possible interfaces and the remaining gaps of knowledge need to be identified and realized in an integrated representation of time. The failure of physics (so far) to overcome the dichotomy between relativity and quantum mechanics has led to an enduring crisis. To remain a foundational discipline, it will have to transcend its own boundaries and prepare for thorough revision and expansion. This goal may be achieved through intensifying the exchange between natural sciences, mathematics and philosophy, unified under the new thought of a growing research community, gathered for a fourth time since 2010 and a third in this journal: Integral Biomathics. We believe that if physicists, and scientists in general, become aware of other modalities which this focused issue on phenomenological philosophy tries to reflect, this will help them find wider perspectives and new ways to look at their own challenges. Perhaps exploring the problem of time, which is central for all these disciplines, can trigger an accelerated exchange and groundbreaking discoveries in all of them that will eclipse the scientific revolutions of the Twentieth Century.

2.2. A complexity basis for phenomenology: how information states at criticality offer a new approach to understanding experience of self, being and time

Alex Hankey

This paper presents a new analysis of the criticality at the heart of the regulation of complex biological systems. It shows that a system at criticality constitutes a perfectly self-observing system, which reduces its own quantum wave packets, and provides the basis for a completely new kind of information, different from digital information. The key properties of the new information states include an internal loop of information flow, and high, long-range coherence. The former property has several consequences: it accounts for the sense of 'self', for Husserl's internal sense of time passing, and for Heidegger's 'being in time'. The latter property, long-range coherence means that the new information states constitute an integrated information theory based on gestalts. Such states support all aspects of the cognizance of *experience*.

2.3. A new kind of relativity: compensated delays as phenomenal blind spots

Susie Vrobel

A phenomenological approach to science is presented by Susie Vrobel in this article about relativity in first-person descriptions of the Universe. It introduces the novel concept of an *observpant* (observer-participant), which differs from the present objective tradition of third-person descriptions of the world. The author

[2] i.e. related to a combination or synthesis.

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