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Organicist Perspectives in Newly Published Biology Textbooks

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At the beginning of the current century, in 2004 to be precise, Carl Woese, an outstanding biologist, wrote, "A society that permits biology to become an engineering discipline, that allows that science to slip into the role of changing the living world without trying to understand it, is a danger to itself. Modern society knows that it desperately needs to learn how to live in harmony with the biosphere. Today more than ever we are in need of a science of biology that helps us to do this, shows the way. An engineering biology might still show us to get there; it just doesn't know where 'there' is". A few pages later, he advised us "Let's stop looking at the organism as a molecular machine". Separately, buried in the Preface of his 1962 influential book, *The Structure of Scientific Revolutions*, Thomas Kuhn wrote "If I am right that each scientific revolution alters the historical perspective of the community that experiences it, then the change of perspective should affect the structure of postrevolutionary textbooks and research publications" (University of Chicago Press, 2nd ed, p. IX). And then he added, "One such effect… ought to be studied as a possible index to the occurrence of revolutions". Leaving aside for the moment the skeptical views of philosophers of science and of biology about paradigmatic changes and scientific revolutions, it could be acknowledged today that Thomas Kuhn was, indeed, correct in justifying substantial changes in the content of textbooks and publications that followed meaningful scientific revolutions.

The shortcomings and deficiencies attributed to the dominance of a reductionist agenda during the second half of the 20th century (the "century of the gene" as Evelyn Fox-Keller characterized it) and even the first decades of the current one on experimental and theoretical biology are increasing steadily. Despite the monumental accumulation of data generated by molecular biology technologies, the "there" Woese was referring to is continuously postponed to an indefinite future by today's scientific establishment. During the second half of the 20th century, the "next ten years" used to be their timely goal; now a days, the 'there' is being transferred to the "next generations of scientists". As a result of these confusions, a consensus is building among empirical and theoretical biologists that the onslaught of reductionism must be openly challenged by a coherent, effective strategy representing worthy alternatives offered by organicist/holistic approaches. Briefly, organicism aims at linking developmental biology and embryology with evolutionary biology from a perspective where *organisms* (both unicellular and multicellular ones) become the center of analysis and synthesis.

Organicism has a history. Since its inception, last century contributions, from among others, by J.S. Haldane, J. von Uexküll, J.H. Woodger, C. Waddington, L. von Bertalanffy, R.C. Lewontin, and S.J. Gould, organicism has been overshadowed by a greedy reductionist approach to biology that benefited from an entrepreneurial strategy that motivated many in its leadership. One of the central tools to that strategy has been the availability of textbooks for undergraduate and graduate education that successfully promoted the message that molecular biology would successfully resolve

all kinds of biological and biomedical puzzles. Textbooks like Molecular Biology of the Cell, and others like it, while educating generations of young minds in the complexity of cell structures and biochemical pathways, both implicitly and explicitly, were instrumental in promoting a reductionist gospel when interpreting biological phenomena. Sociopolitical factors nested at the academic level during second half of the last century helped as well in establishing molecular biology as the law of the land in biological research.

Admittedly, plenty of historical precedents have established that paradigmatic change is not necessarily welcomed in academic circles because of its deleterious impact on the status of scientists and institutions that prefer instead graded, incremental, easily manageable changes.

In this regard, the 2023-2024 years will probably enter the annals of the history of the biological sciences as an important turnaround milestone from the reductionist perception that has dominated academic epistemological thinking in biology in recent decades. Specifically, here are the good news. A book authored by an experienced contributor and editor of Nature Magazine, Philip Ball, entitled *How Life Works* (University of Chicago Press, 2024) and provocatively subtitled *A User's Guide to the New Biology* and another book entitled *Properties of Life* (The MIT Press, 2023) by a highly regarded philosopher of biology, Bernd Rosslenbroich, Head of the Institute of Evolutionary Biology and Morphology at Witten/Herdecke University, in Germany, are already available in libraries. In my opinion, both books qualify as worthy representatives of the organicist/holistic tradition. Philip Ball's book has already been glowingly reviewed by the admirable physiologist Denis Noble in Nature Magazine; Noble considered it as "a must-read for user's guide for biologists and non-biologists alike…". Ball's reference for a need to adopt alternative premises to evaluate the "new biology" of the 21st century is highly significant.

Rosslenbroich's book equally qualifies in my view as a "must-read opus" while being dedicated, instead, to a more scholarly qualified readership composed of graduate students, post doctorates as well as for academic biology professors. In five well-referenced Chapters, the book accurately and convincingly compels the readership to consider, even adopt, a novel approach to evaluate philosophical trends and empirical evidence about life at large. As explicitly stated in its subtitle, namely, *Toward a Theory of Organismic Biology*, Rosslenbroich concludes that the time is ripe to move Biology into an elevated stage of rigorous analysis and integration comparable to that adopted by the so-called Exact Sciences. In his own words, Rosslenbroich states that "My impression – and also my thesis – is that biology today develops, or should develop, toward such a synthesis concerning knowledge from analytical research on the one hand and an organismic understanding of life on the other" (p. 67). He further concludes that "the extensive knowledge of details in structures, functions and genetic processes provides a new opportunity to understand integrative and systemic functions. The chance for an organismic conception of life on a scientific basis has never been as good as today". This is the central message of the book. For this aim to be achieved will require the formulation and testing of theories that when proven wrong or defective be either abandoned or modified, a practice that have been ignored throughout the last half century under the epistemological and financial influence of a reductionist approach to Biology. Rosslenbroich is therefore attempting to synthesize the modern insights of Biology with an organismic conception of life.

Rosslenbroich's detailed description and scholarly treatment of a variety of biological topics qualifies as an almost-textbook for anyone interested in epistemological, historical and even sociological approaches to basic subjects in the biological sciences. Young and old biologists interested in an updated, realistic view of how organicism advantageously addresses and offer solutions to the many controversial issues enlivening basic biological phenomena will have their desire fulfilled. Rosslenbroich adopts a hierarchical interpretation/approach to levels of biological organization in an accessible language.

The theoretical and empirical contributions by Lamarck, Schwann and Schleiden, Mendel, Darwin, Virchow and their followers during the 19th century were adopted by researchers who from the very beginning of the 20th century expanded knowledge within Biology, with especial emphasis on phenomena happening at the cellular level of biological complexity. The explicit rationale for this choice of target was built around the notion that to explain biological phenomena it had to be done from the bottom-up strategy. This favored the growth of knowledge in empirical disciplines like biochemistry, genetics, and cellular structure. Despite the generous, almost extravagant, human-power and financial investments that reductionist approaches enjoyed for over half a century, their shortcomings have become obvious and, therefore, they will require a rearrangement of

funding priorities. It is time for organicism to become, again, a welcomed participant in the theoretical and empirical solutions in the biological scene.

The reductionist approach dominating theoretical and empirical biology was almost unanimous in the 20th century. Dissenting voices proposing the primacy of the organism as an alternative to the cellular, genetic, and molecular (gene-centered) explanations of phenotypes based on a one-sided reductionist perspective were offered by inspirational biologists especially in the UK and continental Europe (von Bertalanffy and Paul Weiss were the most prominent among them). Unfortunately, in some cases due to political factors (which are also a part of the constrains affecting biological development), those worthy organicist alternatives to the reductionist approach were summarily dismissed or de-emphasized. Recently, well-deserved credit has been given among others to the views of Conrad Waddington, who dealt in basic biological aspects of development in multicellular organisms in the 1940s and 50s, and to David Smithers who as early as in the 1960s presented solid arguments against what he called *cytologism* when dealing with the cancer puzzle. It is expected that professional historians of biology will soon provide an unbiased, detailed interpretation of the monumental epistemological mistakes made by leading entrepreneurial, empirical cancer researchers who influenced funders to adopt a narrow, for profit-based perspective when dealing with scientific and public health policy.

In sum, the availability of two well-conceived and written publications about the biological sciences based on the once ignored organicist perspective should allow the emergence of a new breed of scholars who would provide a more balanced view of the complexity of hierarchical levels of biological organization.