Preface

We submitted this manuscript for publication in June 2018. During the extraordinarily hot summer that followed here in Czechia, we came across two remarkable books that can serve as a cupola above our effort. The first is *Extended Heredity* by R. Bonduriansky and T. Day (2018). We regret that it didn't appear several months earlier as it would have received due attention in this volume. Immodestly, we believe our treatise runs in parallel, or as a complement, to many points of the authors' argumentation, especially concerning epigenetics and trans-generation inheritance, i.e., the memory and experience of any living 'thing' and the context thereof, ecological and historical.

The second book is *Darwinism Evolving* by D. J. Depew and B. H. Weber (1996). Here we have no excuse for not having discovered it in the more than two decades since it appeared (Even more embarrassing is the fact that we came across the reference in an article by the Aristotelian philosopher J. G. Lennox). To explain why it fits into our present thinking, we must reveal some of our history. We have long emphasized the historical nature of life by arguing that not only lineages but also *communities* of organisms construct, keep and access vast assemblages of historical memory. These memory pools are much greater than any that can be realized within the short time period of a single lifespan of either an individual or its community, yet non the less may be searched, consulted, and activated whenever external conditions change in ways that require adopting half-forgotten modes of behavior, or even tinkering with such modes so as to invent new ways of coping with the change. External conditions often change much quicker than the appearance (phenotype) of the individual; and as the greater part of external influence comes from cohabitants in the biosphere, this influence may change with every epidemic or invasive species. Thus, the community must be able to search the fitness landscape in which it lives, and through this search co-construct the biosphere, both ways both immediate and extended. In short, living beings must be able to negotiate their entry into the future. Moreover, they can recollect and interpret past experience and select relevant strategies. Under all such circumstances, living beings play an active role in the process. Their internal dynamics and communication contribute to the settling of affairs. If so, the evolution of all forms of life is isomorphic with the history of human culture; and if so, evolutionary biologists are not *sensu stricto* scientists, but interpreters of history—historians, historiographers. Can this claim be broadened to include other forms of life, i.e., should all living beings and lineages be considered interpreters of their history? Our answer on is yes.

Today, the norm of natural science does not study history; its laws and rules are timeless, i.e., valid in all times and places ('universal truths'). It has been therefore very surprising to us that our colleagues stubbornly insist that evolutionary biology is a science of this sort, i.e., comparable to physics. Depew and Weber opened our eyes. They point to the fact that the Whig community of the first half of 19th century, to which Darwin belonged, was devotedly Newtonian, resolved to explain in Newtonian terms even phenomena that could not (then, and perhaps ever) be folded into the rubric of physics. From this perspective, a body (more precisely a mass point) will stay at rest or proceed in linear constant motion so long as a secondary cause (e.g., gravitation, collision, etc.) does not modify its position and/or movement. A mass point has two measurable quantities, mass and momentum, and (since it is a point) it is allowed no inner qualities or movements. The authors argue that devoted English Newtonians also treated living beings, including humans, as 'mass points' (i.e., 'atoms' without inner drives). Secondary qualities (natural selection in C. Darwin and A. R. Wallace; the invisible hand of the market in A. Smith; and the means of production in Marx) are commensurable (at least *per analogiam*) with Newtonian gravity. At that time, the biology of continental Europe was firmly rejected as it worked with inner drives (or even teleology) in living bodies (e.g., Lamarck, Geoffroy) and could not be reconciled with whiggish views. The authors argue that even the statistical physics of the time, which later led to quantum theory and theory of relativity, has not shattered this basic framework, neither have misinterpretations by Darwin's peers at both shores of the Atlantic. Even the Modern Synthesis, then, is an heir, or better, an interpretation of the physical structure of Darwin's original concept. In this treatise, we argue that there remains more to be discovered in Darwinian theory, and that a historical approach that allows for internal drives in organisms, lineages, and communities offers a fuller and more profound understanding of evolution.

G. Tebb, a former student of the famous molecular biologist Kim Nasmyth, recalls that while ruminating over their results, Nasmyth often asked his students: "How will this help you to discover a 'universal truth'?" (Tebb 1998) He had in mind a theory explaining life, the laws ruling its being. Let us commit a miniscule stylistic ('epigenetic') cosmetic of the letter-string: "How will this help you to discover *a* universal truth?" By italicizing the 'a' in the utterance, and removing the 'irony marks', we appropriate the claim and use it to emphasize the notion that struggles toward such an aim may well end in many, often complementary truths. This invites the reader to consider the power of interpretation along with the facts of the world and the interplay thereof: if delicate attention is paid to the relevant cues.

The central message of this book is that—in the realm of the living—allegedly universal truths or 'natural' laws represent various Norms, and that these presumed commandments or causes are rather suggestions (to living beings) or landmarks that help shape behavior, process or structure, in this or that realm of both nature and culture. Acknowledging the Norm, however, also means not piously sticking to it. This is because from the very beginning "the Norm included, not only basic metabolic and genetic processes (those that could have been established in the prebiotic phase), but also a principal novelty that could be introduced by cellular life alone—the exchange and processing of information, both within the cells and from outside" (p. 96 in this book). Living beings develop 'joyfully' around such Norms—endlessly playing, of

which comes resourceful—even extravagant behavior, appearance, ornamentation, communicative tools, etc., all of which display a 'remembering' of the basic rules. Indeed, having rules is necessary to avoid a deadly downfall in a grandiose bonfire of vanities (which may happen on smaller scales). This may indeed be the universal truth of life. The historical uniqueness of an individual, of its community, lineage and ancestors, opens ever-newer state spaces for ever-newer variations of the game. Before all, this truth allows the biological sciences to consider anew the abandoned vernacular truth claim that living beings have their innerness, that they are not merely a result of the push and pull of external, deterministic, physical forces. Such ideas, of course, are not new: they may be as old as the remembered history of humankind—and yet, as with all history, they require reformulation in, and for, each generation.

We illustrate this view through recent achievements in evo-devo, epigenetics, trans-generation inheritance, and/or analogies with human language and culture. The recent avalanche of publications in these areas, together with the development of new techniques such as microscopy, brain imaging and deep sequencing (to name haphazardly a few new branches of biological technique) has amplified the available data on properties of the living; but it has proceeded without a clear idea on how to process this new data into general theories. We believe that what we call the Norm (of biology), i.e., hard biological data gathered into textbooks, presents a necessary but incomplete ground for the endless teeming of Darwin's 'tangled bank'.

We are biologists by education, and members of the Department of Philosophy and History of Science at the Faculty of Science, Charles University in Prague. The fruitful interaction of biologists, historians and philosophers has enabled our work. From this perspective, we follow recent advances in biology—especially evolutionary and developmental—and confront such achievement with ideas spawned by biologists of different historical periods. Paradigms change, often fundamentally conforming to the sociocultural air of the period, techniques become more and more sophisticated, revealing unexpected details of structures and functions of living beings. Yet, the final answer to the deepest question 'What is life?' has remained as evanescent as ever. Depending on their nature, biologists tend to present some ready-made and inveterate cliché pointing towards physical forces, or organization, or natural selection or information—but adding no value. This question cannot be answered solely within the framework of biology. In this book we try to show that answers may develop, supported by recent developments in biology and other sciences as well as from the humanities, through new interpretation of older theories, or naturally through developing new ones.

We tried to follow the most recent developments (our latest references are from Spring, 2018); undoubtedly and necessarily the selection reflects our personal bias. We draw here a map, or better a sketch, of that which we consider challenging for future research, as well as what methodologies might serve to answer those challenges.

In the preface to the previous book *Life as it own Designer* (Markoš et al. 2009, p. vii) we asked three questions concerning life and the evolution thereof: "(1) Where does the novelty come from? (2) What is the essence of evolution? and (3) What is the role of living beings in evolution? Such questions have a lot to do with the two forms of logos—narrative and rational [...]. If novelty is allowed, then history

enters the stage; and if history is allowed then living beings should be taken into consideration as interpreters of the past." We hope to make evolutionary theory ever fuller and more open to new knowledge by employing the methodology of historians.

We are especially grateful to the founders of the Department in 1990—Z. Neubauer (1942–2016), Z. Kratochvíl, and S. Komárek—and to our peers and students who have passed through the Department during these last three decades. F. Cvrčková, our illustrator, and G. Ostdiek, who dampened our transgressions against the English Norm, are our learned colleagues who did more to shape this book than merely performing the jobs mentioned.

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