



1007

**Can Darwinism Be “Generalized”
and of What Use Would This Be?**

by

**Georgy S. Levit
Uwe Hossfeld
Ulrich Witt**

The *Papers on Economics and Evolution* are edited by the Evolutionary Economics Group, MPI Jena. For editorial correspondence, please contact: evopapers@econ.mpg.de

ISSN 1430-4716

Max Planck Institute of Economics
Evolutionary Economics Group
Kahlaische Str. 10
07745 Jena, Germany
Fax: ++49-3641-686868

© by the author

Can Darwinism Be “Generalized” and of What Use Would This Be?

by Georgy S. Levit ^{*)}, Uwe Hossfeld ⁺⁾, Ulrich Witt ^{§)}

July 21, 2010

Abstract

It has been suggested that, by generalizing Darwinian principles, a common foundation can be derived for all scientific disciplines dealing with evolutionary processes, especially for evolutionary economics. In this paper we show, however, that the principles of such a “Generalized Darwinism” are not those that in the development of evolutionary biology have been crucial for distinguishing Darwinian from non-Darwinian approaches and, hence, cannot be considered genuinely Darwinian. Moreover, we wonder how “Generalized Darwinism” can be made fruitful for evolutionary economics given that its principles are but an abstract hull that does not suffice to explain actual evolutionary processes in the economy. To that end specific hypotheses are required which neither follow from, nor are necessarily compatible with, the suggested abstract principles. Accordingly, we find little evidence in the literature for the claim that Generalized Darwinism can enhance the explanatory power of an evolutionary approach to economics.

Key words: Darwinism, evolution, evolutionary economics, “Generalized Darwinism”, variation, selection, retention.

JEL code: B25, B40, B52

^{*)} University of King’s College (Halifax); george.levit@dal.ca

⁺⁾ AG Biodidactics, Friedrich Schiller University Jena; uwe.hossfeld@uni-jena.de

^{§)} *corresponding author*, Max Planck Institute of Economics, Jena; ulrich.witt@econ.mpg.de

1. Introduction

In reflecting on evolutionary phenomena in their respective domains, many disciplines borrow conceptual tools from Darwinian evolutionary biology. Evolutionary economics is no exception. It is popular, for example, to construct analogies to natural selection particularly in the neo-Schumpeterian literature (see, e.g., Nelson and Winter 1982, Metcalfe 1998, Windrum 2007, Andersen 2009, Chap. 12). More recently it has been argued, however, that it is not only possible but also indicated to go metaphors and analogies. It is claimed that general principles of evolution can be derived through isolating abstraction from the Darwinian theory that explain evolution in the biological domain and non-biological domains, e.g. that of economics, alike (Hodgson and Knudsen 2006a, 2010). The claim that “Darwinism involves a general theory of all open, complex systems” (Hodgson 2002) ties in with an ongoing debate in the philosophy of science originally triggered by Dawkin’s (1982) vision of “Universal Darwinism”. In that debate, variation, selection, and inheritance (for the latter also the terms “replication” or “retention” are sometimes used) have been postulated by some writers as domain-independent general principles (see Campbell 1965; Dawkins 1983; Hallpike 1985, 1986; Wilkins 1998; Wimsatt 1999; Hull 2001; Crozier 2008). These principles also form the core of “Generalized Darwinism”, an approach propagated in a series of works by Hodgson and Knudsen (2004, 2006a, 2006b, 2010) with special reference to evolutionary economics.

With their recent manifesto “In defense of Generalized Darwinism” in this journal (Aldrich et al. 2008) several prominent scholars have endorsed such an encompassing approach to evolutionary economics. Its tacit presumption is a fundamental homology between evolution in nature and evolution in the economy -- “social evolution *is* Darwinian” as Hodgson and Knudsen (2006a) have put it. In practice, the homology assumption provides a basis for also adopting other domain-specific, biological concepts in an abstract disguise. For example, the biological notions of genotype and phenotype are transformed into an abstract “replicator-interactor” dichotomy which is then suggested as general analytic tool in evolutionary theories (Hull 1988; Hodgson and Knudsen 2004, 2006b).

The claims pro Generalized Darwinism have stirred some opposition in evolutionary economics. Buenstorf (2006), for example, argues that the concept of selection based on a replicator-interactor distinction contributes little to understanding industrial evolution: “The homology between biological inheritance and the replication of routines is achieved at the price of abstraction from economically relevant details.” On the basis of his “ontological continuity hypothesis” Witt (2003, Chap. 1; 2004; 2008) claims that the Darwinian theory is relevant for understanding economic evolution, albeit not in the form of abstract one-fits-all principles but rather as a meta-theory about how man-made evolution could emerge from, and is molded in, evolution in nature. The notable difference here is that, as a result of the intervention of human intelligence, intentionality, creativity, and knowledge accumulation, the rules of man-made evolution are likely to differ from those of biological evolution. Supporting the continuity hypothesis, Cordes (2006) points to the fact that biological evolution has created a human “behavioral repertoire” which forms the bedrock of cultural evolution and gives rise to specific adaptation dynamics for whose understanding the abstract principles of variation, selection, and inheritance contribute little, if anything. Vromen (2008) notes that “Hodgson and Knudsen do not counter this critique by dismissing the extra substance that Witt’s continuity hypothesis adds ..., but by diminishing the ontological substance of their own Generalized Darwinism.... The

price they have to pay for this is that it leaves their Darwinian principles with virtually no content.”

Before this background, the present paper sets out to do two things. First it will go beyond the criticism launched against Generalized Darwinism so far by showing that its very core – the identification of Darwinism with the principles of variation, selection, and inheritance – is highly problematic (an argument that can also be leveled against Dawkin’s Universal Darwinism). To conceptualize evolution by means of these abstract principles not only comes at the price of abstracting from economically relevant details as Buenstorf (2006) criticizes, but also at the price of abstracting from crucial biological “details”. In biology, it depends on the specific features of the processes by which genetic information is varied and inherited whether different theories about variation, selection, and inheritance qualify as Darwinian, non-Darwinian, or even anti-Darwinian (see Levit, Meister & Hossfeld 2008). These features require specific hypotheses and addenda (left out by the suggested abstraction) which ultimately decide about the fit with the logic of Darwinism and the empirical evidence that has been gathered for it. The three principles that remain as allegedly unifying framework after the isolating abstraction has been carried out are but an empty hull that lacks own explanatory substance.

Second, and in recognizing the history of evolutionary theorizing in biology, the paper will examine more closely the very idea inspiring Generalized Darwinism. This is the claim that the abstract principles identified by Generalized Darwinism are helpful in, or even necessary for, building up an encompassing evolutionary theory in economics. To invoke abstract principles “top-down” to construct a theory of evolution, e.g., for the economic domain means, of course, that hypotheses on the “details” of the particular domain must be found that account for the specific conditions of, say, economic processes. However, such specific hypotheses are neither logically implied by, nor necessarily compatible with, the abstract principles. Doubts may therefore be raised as to whether Generalized Darwinism offers any advantage in arriving at the specific hypotheses essential for explaining economic evolution. It seems worth noting in this context that evolutionary biology, the very discipline from which Generalized Darwinism borrows its principles, has never taken resort to the research strategy the proponents of Generalized Darwinism suggest for evolutionary economics.

Accordingly, the plan of this paper is as follows. Sections 2, 3 and 4 give an overview over three different phases in the development of Darwinism. Each of these phases is indicative of significant changes in the central tenets that the Darwinians were forced to accept in view of the problems emerging from the specificities discovered in the various interconnected research activities reaching from the paleontological record to the molecular processes governing life and reproduction. In this process, the principles of variation, selection, and inheritance did play a role. But they were neither the only general principles considered relevant, nor did they serve as the criterion distinguishing Darwinian from non-Darwinian interpretations. In the light of these insights, section 5 turns to a discussion of the prospects and limitations of the top-down approach suggested by the proponents of Generalized Darwinism for the development of evolutionary economics. Section 6 presents the conclusions.

2. Darwin and “Classical Darwinism”

Darwinism is a dynamic and complex theoretical system consisting of several necessary, interconnected postulates and numerous theoretical addenda and specific hypotheses. A

difficulty that arises in defining Darwinism results from the fact that the theory of natural selection achieved its logical consistency and conceptual maturity only decades after Darwin's death. For that reason, an appeal to Darwin's own writings is not necessarily the best way to determine whether a particular concept in question is, or is not, "Darwinian" in character. To account for this complication it is necessary to distinguish different, historically contingent, phases of "Darwinism" (and of anti-Darwinian concepts) in biology. The majority of historians of biology agree that there are three major phases in the growth of Darwinian thought (Reif 2000; Reif et al. 2000).

The first is Classical Darwinism, represented by Darwin's *The Origin of the Species by Means of Natural Selection* (1859), subsequent works, and their immediate reception among biologists. Pushing the idea of organic evolution and common descent, Darwin's contemporaries grappled with how strictly to interpret the relative importance of the principle of natural selection, the concept of inheritance combining both hard and soft ('Lamarckian') mechanisms, and the postulate of gradualism. By the end of the 19th century, this had led on the one hand to the refinements of neo-Darwinism (eliminating Lamarckian notions and Darwin's pangenesis). On the other hand, nourished by incoherences within the Darwinian theories and unresolved puzzles left by classical Darwinism, the interpretation of exactly the "details" of the various principles and their relative importance led in the subsequent decades to the heydays of alternative and rivaling theories of evolution. The result was a temporary eclipse of selectionism in evolutionary biology (Bowler 1983). Only with the break-through of the Synthetic Theory of Evolution in the late 1930s (the so-called Modern Synthesis) the essential difficulties could be overcome to a certain extent. It was one more step to Darwinism as it is now: a logically coherent and empirically applicable research program. In this form it is able to integrate classical genetics, population genetics and molecular genetics, systematics, evolutionary morphology, developmental biology, palaeontology etc. on a selectionist basis while, at the same time, acknowledging the importance of non-selectionist factors of evolution, especially isolation, chance events, and population size.¹

Turning to Classical Darwinism -- the starting point of this long development -- the seminal act was Darwin's and Wallace's introduction of the "principle of natural selection" as a hypothetical mechanism of biological evolution (Darwin and Wallace 1858; Hossfeld & Olsson 2009). But Darwin's (1859, 1872) selectionist model included the Lamarckian hypothesis of the inheritance of acquired characters as a source of biological variability. Darwin's influential German disciple, Ernst Haeckel, expressed this very clearly.² Haeckel argued that it was Lamarck who formulated already a scientific theory of evolution, and he coined the very term "Lamarckism" (as opposed to Cuvierism, a theory demanding constancy of species) for it. The general theory of descent aims at a complete and harmonic picture of evolution by reducing all its phenomena to "the only physiological process of nature, the transmutations of species" (Haeckel 1866, p. 167). The theory of natural selection, by contrast, reveals the exact machinery,

¹ This means that "... selection is regarded as important, but only as one of several evolutionary factors" (Reif et al. 2000).

² Since Haeckel's name became a synonym for Darwinism among continental scholars, his interpretation – encouraged by Darwin himself – can be taken as representative for what "Darwinism" meant at these early times. It also reflects, of course, the major problems that classical Darwinism faced.

the “mechanical causes” of transmutation (evolution) and explains its directionality. Accordingly, Lamarck should be appreciated, Haeckel claimed, for promoting general evolutionism, while Darwin must be praised for his causal explanation of the theory of descent. Yet what Haeckel considered “Darwinism” also included elements that we would now refer to as Lamarckian, viz. the inheritance of acquired characters (Hossfeld 2010).

Darwin read the proof-sheet of Haeckel’s opus magnum and approved Haeckel’s interpretation of his own theory, albeit he also expressed concerns about Haeckel’s boldness in stating the theory.³ Haeckel had indeed made some strong claims. One was related to the progressive nature of evolution, where he argued that natural selection gradually, but permanently works to perfectionate the organisms’ organization. It is well known that Darwin to some extent supported the idea of evolutionary progress. On the other hand, he was extremely cautious in formulating this idea and stated that the naturalists are in disagreement about “what is meant by an advance in organisation”. Haeckel, who was influenced not only by Darwin but also by natural philosophy, knew these doubts but did not take them seriously. Another of his bold statements related to the idea of internal and external constraints in evolution echoing the idea of orthogenesis.⁴ Darwin modestly supported the idea of “constraints”, but again, Haeckel made it a “strong argument”.

With his elaborations Haeckel contributed, in a sense, to the sharpening of controversial points arising from Darwin’s original concept. Haeckel, as other early Darwinians, was aware of the fact that selection, variation, and retention played a role (though at the time they were not spelled out as general principles), but the exact mechanisms underlying them still needed to be specified. In trying to do so, he remained speculative, supporting ideas of natural selection combined with the concept of environmental influences on the organism’s heredity, evolutionary constraints, and the idea of progressive evolution – all compatible with the abstract principles. Thus, it was not by these principles that the further fate of selectionism was decided upon.

3. Darwinism eclipsed: alternative evolutionary theories and the space of logical possibilities

Between 1859 and the century’s turn emerged what Romanes (1895, p.12) termed “neo-Darwinism”, i.e. “the pure theory of natural selection to the exclusion of any supplementary theory.” The best known advocates of this theory were Wallace and Weismann who purified selectionism from Lamarckian elements. Weismann (1885) put selection and perpetuation of favorable characteristics at the central place and introduced a new theory of heredity to replace

³ “I received a few days ago a sheet of your new work, & have read it with great interest. You confer on my book, the ‘Origin of Species’, the most magnificent eulogium which it has ever received, & I am most truly gratified, but I fear if this part of your work is ever criticized, your reviewer will say that you have spoken much too strongly.” Letter 5193 - Darwin to Haeckel, 18 Aug [1866] (Darwin’s Correspondence Project)

⁴ The concept of orthogenesis is often combined with selectionism and/or inheritance of acquired characteristics. In contrast to the claim that natural selection operates on a very copious or even inexhaustible material generated by an unconstrained variation, orthogenesis holds that variation is constrained and proceeds only in one out of many potential direction within each phylogenetic line.

Darwin's pangenesis.⁵ In the following years, the exact causal relations of evolutionary events (the issues of direct and indirect inheritance, the role of mutation, constraints, geographic isolation, selection, and questions concerning evolutionary progress) became the focal point of discussions between various scientific schools.

Due to the incomplete and sometimes even contradictory data of paleontology, anatomy/morphology, biogeography, systematics, and genetics, the reconstruction of evolutionary history and evolutionary mechanisms still had to be provisional and even speculative (Gould 1977, 2002; Bowler 1983, 1992). Failure to convincingly answer the questions concerning heredity, variation, evolutionary progress, and orthogenetic series indicated that Darwinism as a theoretical system was still incomplete. This weakness meant water on the mills of theories of evolution considered rivals of Darwinism. Indeed, in the heydays of these rivals in the first decades of the 20th century, a situation prevailed in evolutionary biology in which the Darwinian theory of natural selection became just one of an entire set of more or less plausible theories of how evolution proceeds. The large variety of theories – in their majority these were complex theoretical systems combined the elements of selectionism with non-selectionist ideas – almost exhausted the “space of logical possibilities” (Zavarzin 1979) for explaining phylogenetic history.

One of the theories was neo-Lamarckism often seen as a major alternative to selectionism. By claiming that acquired characteristics are heritable, neo-Lamarckians suggested a logically consistent explanation for the high rate of evolutionary change and the appearance of complex adaptive structures. (The Darwinians had difficulties with explaining these phenomena on the basis of their core assumption of variation being random.) However, the majority of the 20th century Lamarckians did not reject completely the idea of natural selection and other evolutionary mechanisms. To the contrary, they often combined the inheritance of acquired characteristics with the Darwinian idea of natural selection, orthogenesis, mutationism, etc. Furthermore, neo-Lamarckism itself never represented a monolithic theory and the notion of the inheritance of acquired characteristics is not more than a kind of ‘umbrella-concept’ for several different explanations of the evolutionary mechanism.⁶

A second theory that became especially popular in the first half of the 20th century and that was partly rivaling with Darwinism was based on the idea of directed evolution (orthogenesis). It came in more than twenty different variants (Levit & Olsson 2006). Although some of them included finalistic ideas (see Mayr 1982, p. 959), the common denominator of all of them was the idea of morphological, molecular, or other constraints supposed to guide

⁵ Weismann's (1885) hypothesis of the germ plasma that excluded heredity of acquired traits (“Weismann's barrier”) was, however, no less speculative than Haeckel's Lamarckian mechanisms. Indeed, neo-Darwinism became one of several Darwinian schools, and Darwin himself was quite critical about it.

⁶ The differences related in particular to the question of how the heritable features can be acquired and what is the exact mechanism of inheritance. Of the two major neo-Lamarckian approaches, the first approach – developed by Lamarck himself – claimed that an organ adapts or loses its adaptive value according to its actual functional value in everyday life (favourite example: the blindness of cave animals). The second approach favored the idea of a direct environmental effect on the organism's heredity, an approach known as Geoffroyism.

phylogeny in such a way that the mechanism of natural selection becomes superfluous either for explaining evolution as a whole or for explaining certain periods of phylogenetic history. The majority of advocates of directed evolution proceeded from the assumption that organisms are predisposed to vary in certain directions and that such biases determine major transitions in evolution. They were convinced that these directions are empirically observable in the paleontological record and clearly definable. Accordingly it was assumed that evolutionary events follow certain clearly defined laws and restrictions and that evolution proceeds to a significant or predominant extent in a non-adaptive fashion. In other words, orthogenesis was strongly coupled with the idea of non-adaptive trends in evolution.⁷

A third major anti-Darwinian theory in evolutionary biology was saltationism – which is still influential today. The advocates of saltationism (e.g. Bateson, Goldschmidt, Schindewolf) rejected the Darwinian idea of slowly and gradually growing divergence of characteristics as the only source of evolutionary change. They did not necessarily deny gradual variation or natural selection any relevance, but claimed that major changes in the “body plans” come into being as a result of sudden, discontinuous and unique changes, e.g., in a series of macro mutations. The latter are held responsible for the sudden appearance of new higher taxa, while the small variations resulting from natural selection are supposed to be responsible for the adaptations below the species level, i.e. the “fine tuning” adjusting organisms to their environment. Hence, they are considered of secondary importance.

Finally, there still existed a theory that became known as old-Darwinism (as opposed to neo-Darwinism). Insisting on Darwin’s original approach, it combined neo-Lamarckism, orthogenesis, mutationism, and selectionism. By that time, the proponents of old-Darwinism were trying to figure out the exact role of all these mechanisms in the evolutionary process (see Levit and Hossfeld 2006 for details). Taking Darwinism and all its rivals of the time together, they convey an impression of how rich the logical possibilities for making sense of evolutionary change in the biological domain are. There is no logical restriction implied by the three “Darwinian” principles – as can be seen from the fact that they are shared by all these variants. The relationships between the various explanatory approaches and their mutual (in-)compatibility are determined by a plethora of other doctrines.⁸

⁷ Although they often used an own terminology, many scientists contributed to the orthogenetic approach. Some (like Berg 1926) coupled the concept of orthogenesis with saltationism and the idea of direct environmental impact on the organism’s heredity (“Geoffroyism”, see Levit & Hossfeld 2005).

⁸ Thus, pure neo-Lamarckism and *strict* selectionism are not mutually compatible, because the inheritance of acquired characteristics already guarantees adaptive changes and natural selection loses its shaping role. (In the presence of adaptive mutations, natural selection becomes a secondary evolutionary mechanism.) Saltationism and mutationism are incompatible with all historical forms of Darwinism, because evolution cannot be gradual and saltational at the same time. The latter two approaches are incompatible with orthogenesis, because evolutionary changes cannot be random and directed at the same time. Orthogenesis, in turn, is the more difficult to align with Darwinism, the more constrained the random process of variation is imagined to be.

4. Modern Darwinism: the Synthetic Theory and the Expanded Synthesis

In the first third of the 20th century, Darwinism and all its scientific rivals appeared to be on equal terms regarding their plausibility. Accordingly, many outstanding evolutionary biologists of those times subscribed to some form of a “synthetic” theory combining various selectionist and non-selectionist arguments in a way that tried to explain the diversity of the living world by some major mechanisms of evolution combined with various auxiliary mechanisms. To some extent this was in accord with Darwin’s own appeal to additional hypotheses, but made the resulting theoretical systems awkward, sluggish, and sometimes even amorphous. In the understanding of the early “synthesizers” certain principles (for example, the principle of natural selection) were valid for certain domains or levels of biological reality, but not for others.

Before this background the selectionist turn of evolutionary biologists worldwide from the mid 1930s onwards came suddenly and was remarkably radical (as if all of them were passionate Kuhnian revolutionaries). All of a sudden it was recognized that the nature of inheritance and variation could be re-interpreted in the light of a new genetics. Following at re-interpretation, it was realized that biological systematics could be incorporated into a general theory of evolution involving also the fields of palaeontology and evolutionary morphology. The paleontological data fitted the new explanatory paradigm developed in molecular genetics and microsystematics. Moreover, it became clear that the theory not only covered the findings at the population level, but could also explain many macroevolutionary phenomena without appealing to saltationism, orthogenesis, or neo-Lamarckian mechanisms.⁹

The “synthetic theory of evolution” was based on three crucial assumptions: (1) natural selection is the major direction-giving factor in evolution; (2) random mutations and recombinations cause variation and therefore imply the incorporation of genetics into the theory; (3) geographic isolation is the most important mechanism separating populations (Junker & Hossfeld 2009). The original “Origin-of-Species-Darwinism” (Darwin 1859, 1871) served as a motivation and a paradigmatic framework, but did not concur anymore with the newly established theoretical system. In forming an alliance with genetics, the synthetic theory of evolution not only enriched itself, but also restricted the panoply of concepts that previously appeared potentially or actually acceptable. The concepts of inheritance of acquired characteristics, orthogenesis, and saltationism were rejected as incompatible with what established itself now as mainstream “Darwinism” in the form of the synthetic theory. Thus it were the architects of the “second Darwinian revolution” (as Mayr 1991 called it) who for the first time drew an ultimate and clearly defined line between “Darwinism” and its actual and potential rivals.

Yet, the synthetic theory did not solve all problems and retrospectively appears to be too simplistic. There were still a whole range of phenomena which remained unexplained. For example, the “phylogenetic explosions” that had been observed by Schindewolf and Beurlen in the paleontological record (Beurlen 1930) remained a puzzle. Eldredge and Gould (1972) took this problem up again and proposed the well known concept of punctuated equilibria as a solution. This was first thought to represent an alternative to the gradualism of the synthetic theory of evolution, since the authors initially intended to demonstrate that there are domains of evolution inaccessible for gradualism. However, recent accounts of the problem have shown that

⁹ See Mayr (1982), pp. 607 and Levit et al. (2008b).

evolution is both gradual and punctuated since even accelerated evolutionary transitions are gradual processes at the micro-evolutionary level (Bokma 2002, Gould 2002, Kutschera & Nicklas 2004). What still is an issue, though, is the exact role of species selection and group selection from the empirical and the theoretical points of view (Reif et al. 2000).

Still another problem posed to the synthetic theory that requires further clarification and possibilities for further expansions is the whole complex of issues around developmental biology and its relations with other biological disciplines (Hall et al. 2003). The most recent synthetic movement of an “ecological developmental biology” tries to integrate the whole range of relevant disciplinary domains in a further extension of the classic synthetic theory of evolution (see, e.g., Gilbert & Bolker 2003). In that light, for example, allelic variation in the structural genes is no longer the only source of variation. There are also two other sources of variation accessible for natural selection, namely allelic variation in the regulatory regions of genes and “developmentally plastic variation” (Gilbert & Epel 2009 pp. 318f). The latter can be crucial for macro-evolutionary processes producing the variations associated with phyla and classes of species.

This example shows that the occurrence of variation as such does not mean much as to whether it is to be considered a Darwinian principle or not. Depending on how the nature of variation is interpreted, the results of its combination with the principle of selection will also vary. The “devil is in the details” (Vromen 2007) indeed, and amendments to a general concept like variation that seemed of only technical character turn out to make a radical difference with respect to whether biological evolution is explained in a Darwinian or a non-Darwinian way.¹⁰

It is not our purpose here to give a full account of the directions in which the synthetic theory currently expands. The examples are rather given to demonstrate that contemporary evolutionary theory development continues to be driven by bottom-up modifications, syntheses, and enrichments. It expands partly by accounting for elements that were previously considered anti-Darwinian, but that can now be made sense of by the discovery of yet other evolutionary mechanisms consistent with the general framework of modern Darwinism. This is not to say, though, that “anything goes” provided only the principles of variation, selection, and retention are complied with. It is the specific combination of the particular evolutionary mechanisms and their “details” that matter for whether or not an extension of the complex theoretical system is “Darwinian” in nature.

¹⁰ Contemporary mainstream “Darwinism” also reflects on whether, and to what extent, elements of rivaling approaches could play a role within an expanded synthetic theory. For instance, there is a debate revolving around the role of developmental and evolutionary constraints (e.g., Wimsatt & Schank 1988) which reminds of the idea of orthogenesis. Neo-Lamarckian ideas are reconsidered in view of the debate concerning epigenetic phenomena (Jablonka & Lamb 2006). There is still a principle difference, though, between neo-Lamarckian soft inheritance and epigenetics so that the selectionist foundations of the theory are not compromised, see Haig (2007) and Gilbert (Gilbert & Epel 2009, p. 449). Also mutationist-saltationist conjectures draw new attention among geneticists.

5. How Useful Is Generalized Darwinism for Evolutionary Economics?

The brief review of the developments in evolutionary biology in the previous sections shows that different variants of the theory of variation, selection, and inheritance played a role in almost all approaches that have been influential over the past 150 years in biology, whether Darwinian, non-Darwinian, or even anti-Darwinian. For this very reason we have argued that variation, selection, and inheritance as such are nothing particularly “Darwinian”. However, a critique of misleading labels and intellectual lineages that raises the more momentous question of whether Darwinism can be “generalized” at all is not the only point we want to make. In our view, a critical assessment of the very research strategy suggested by Generalized Darwinism for evolutionary economics is also warranted. This strategy is based on the claim that the three abstract principles derived by isolating abstraction from findings in the biological domain are governing “all complex population systems (in the biological and social worlds)” (Hodgson 2009). Hence, evolution is conceived of as a homologous process in different disciplinary domains – among them, in particular, the domain of evolutionary economics. (It is only on the basis of this homology hypothesis that abstract principles gained inductively in one disciplinary domain can be usefully deployed to deduce explanatory hypotheses on evolutionary processes in other disciplinary domains.)

There are several problems with this strategy. First, the homology postulate is an empirical claim. It is far from being self-evident, since an abstraction arising from a bottom-up discourse in one particular discipline is influenced by the domain-specific (ontological) conditions of that discipline which are not necessarily the same elsewhere. Hence, the claim needs to be supported by empirical evidence for each disciplinary domain for which its validity is asserted. As far as evolutionary economics is concerned, the proof is lacking. The best way to confirm the asserted homology with evolutionary biology would be the demonstration that the principles of variation, selection, and inheritance emerge identically from isolating abstraction in a “bottom-up” discourse reflecting specific research results on evolutionary processes in the economy. (On *a priori* grounds there is no reason to expect that such a bottom-up discourse would indeed lead to exactly the principles suggested by Generalized Darwinism rather than, say, the principle of orthogenesis or principles not even discussed in evolutionary biology.)

However, such a bottom-up discourse is precisely the opposite of what the proponents of Generalized Darwinism have in mind. Their idea is to invoke variation, selection, and inheritance in a top-down fashion as principles governing economic evolution and, assuming their validity, to search for suitable “auxiliary hypotheses” by which the abstract scheme can be filled with economic explanatory substance (see Aldrich et. al. 2008). This brings us to a second problem arising for practical attempts to apply Generalized Darwinism in evolutionary economics. As was outlined in the previous sections, in the development of Darwinism there is nothing comparable to a top-down approach. Indeed, the lesson that can be learned from the leading evolutionary science is that evolution is a complex process whose explanation requires a similarly complex network of specific hypotheses. In biology this emerged from an extremely broad, rich, and controversial discourse spanning from the details of the paleontological record to the findings of molecular biology. It was the attempt to give the complex network of specific hypotheses a coherent causal and functional structure that eventually led to the formulation of general principles – not the other way round. One may wonder what evolutionary biology would look like today, had it proceeded in a top-down fashion starting just from the abstract principles of variation, selection, and inheritance. Why should what appears a strange idea with regard to

evolutionary biology be a promising idea when it comes to other domains like that of evolutionary economics?

A third problem we see relates to the necessity in Generalized Darwinism's top-down approach to arrive at "auxiliary hypotheses". (Such hypotheses are needed because, by its very nature, Generalized Darwinism lacks disciplinary substance.) By taking the validity of its abstract principles for granted, Generalized Darwinism factually turns into a search heuristic inviting to find something equivalent to, or reminiscent of, variation, selection, and inheritance at the disciplinary level. On purely logical grounds this is a possible way to proceed – as much as it is possible to start from any other general principles and to look for suitable auxiliary hypotheses on "the details". But there is a non-negligible risk involved in such a top-down approach of inducing systematic heuristic biases, since the validity of the principles cannot be proved by only searching for supportive auxiliary hypotheses. The interpretation of reality can be seriously biased by selectively recognizing only those elements that seem to fit the logic of the chosen principles or by constructing disciplinary correlates that actually misrepresent the economic conditions.

In relation to the criticism raised against a top-down approach, a final problem we would like to draw attention to is the question of what Generalized Darwinism is actually able to deliver in terms of explanatory power for evolutionary economics. This power hinges on the quality of the "auxiliary hypotheses". Stoelhorst (2008) has argued that the three principles of Generalized Darwinism can be seen as part of an (abstract) explanans of an evolutionary explanation that can be put to work in the economic domain only, if it is clear what the explanandum is going to be. One may add that it is precisely in specifying the explanandum that domain-specific "details" have to be entered and elaborated on. But, as Stoelhorst notes, this has not been clarified in the writings on Generalized Darwinism. In our view it is not accidental that the already quite numerous publications on Generalized Darwinism offer so little on the crucial "auxiliary hypotheses".¹¹

In their manifesto in defense of Generalized Darwinism, Aldrich et. al. (2008) do not mention any specific implications of their approach for explaining evolution in the economy. They posit that domain-specific substance can be developed on the basis of the reflections about the unit of selection. In that context they refer to the replicator-interactor dichotomy and discuss it at an abstract level. Interactors are defined as in Hull (1988, 408) as "an entity that directly interacts as a cohesive whole with its environment in such a way that this interaction causes replication to be differential". Replicators are defined as entities that are replicated in a way that "involves a causal relationship between two or more entities, where there is substantial similarity between the original and the replicated entities, and where information concerning adaptive solutions to survival problems is passed from one set of entities to another". But what are the replicators and interactors at the concrete economic level and how precisely are they varied, selected, and inherited, and how does all this contribute to understanding man-made evolution?

¹¹ Stoelhorst draws a different conclusion. He suggests to specify the explanandum in terms of an abstract notion of evolution as a "process of change that leads to adaptive complexity" (ibid. p. 347). This is again a notion distilled from evolutionary biology by isolating abstraction. Stoelhorst does not point out in what kind of economic processes "adaptive complexity" could figure as explanandum.

In the extensive discussions of interactors and replicators in their most recent book, Hodgson and Knudsen (2010) do not explain in any detail how replication and interaction work and bring about evolutionary processes in the economy. In terms of concrete applications, their reflections basically come down to suggesting certain pairings of interactors and replicators.¹² It is left open, however, how the developed categorizations lead to explanations of concrete economic evolutionary phenomena. In a paper inquiring more deeply into the role of firms as interactors, Hodgson and Knudsen (2004) argue that habits and routines, which are more or less specific to individual firms, replicate under the influence of selection forces. But again, neither the selection forces nor the assumed selection and replication mechanisms are explained in any detail. The authors mention the Price equation (Price 1970; see also Frank 1995). Yet they do not demonstrate what causal explanations can be derived regarding specific evolutionary processes in economics.¹³

In view of the problems that have been pointed out in this section, the rather thin outcome of the ambitious top-down approach of Generalized Darwinism in terms of concrete, new explanations offered for evolutionary phenomena in economics may not come as a surprise. By comparison with the successful bottom-up research practice in evolutionary biology one may infer that the reason for the disappointing outcome lies in the nature of proceeding top-down from abstract principles with uncertain validity for economics to suitable auxiliary hypotheses representing the domain-specific, economic explanatory substance. If so, the recommendation for evolutionary economics would be to focus on analyzing the huge variety of specific evolutionary processes in the economy at a concrete level, and only when explanatory progress has been made at that concrete level to engage in a (bottom-up) discourse of how the complex set of specific hypotheses can be organized into a more coherent causal and functional structure. That discourse may eventually lead to the formulation of general principles. Since all of the specific economic processes are instances of man-made evolution, it may eventually turn out, that general principles akin to economic evolution relate to the core features of human adaptiveness: individual and collective learning, experimentation, insight, inventiveness, and the restless motivations driving these human forms of adaptations. If so, to understand and explain how these features shape the specific, evolutionary processes in the economy may be more important than finding out whether the abstract hull of Generalized Darwinism can be stretched to fit them.

¹² Examples that are given for pairings of interactors vs. replicators are, among others, {organizations vs. routines/habits/genes}, {human groups vs. habits/genes}, {individuals vs. habits/genes}, and {scientific institutions vs. scientific/technological knowledge}, {states vs. laws}, {families/tribes vs. customs}, see *ibid.*, Table 7.2 and Table 8.1.

¹³ Hodgson and Knudsen repeatedly emphasize the broad agreement of their selectionist assumption with the line of argument in Nelson and Winter (1982). Yet they do not show what explanatory conjectures their Generalized Darwinism is actually able to contribute beyond those obtained already formulated by Nelson and Winter on the basis of only a loose analogy construction to the notion of natural selection.

6. Conclusions

In a recent series of publications, “Generalized Darwinism” has been proposed as a new overarching research strategy that is based on the assumption of a fundamental homology between evolution in nature and the evolution of the economy. The principles of variation, selection, and retention that have been distilled from evolutionary biology by isolating abstraction are claimed to be generally valid. It is suggested to apply these abstract principles as a unifying framework for all evolutionary theories. By a brief reconstruction of the different historical forms of Darwinism we have shown that the identification of these abstract principles with Darwinism is misleading. Moreover, on a priori grounds other principles – non-Darwinian or even anti-Darwinian ones like, e.g., orthogenesis, saltationism, or neo-Lamarckism -- could claim a similar plausibility in explaining *economic* evolution.

The crux with such allegedly unifying abstract principles derived by isolating abstraction from findings in other domains is that they provide but an abstract hull. In order to become a useful heuristic device, they need to arrive at domain-specific explanation which, in turn, would require to add substance by hypotheses on the disciplinary “details” of actual evolutionary processes, e.g. in the economy. This is, of course, what is done in the first place in a bottom-up research strategy as it has fruitfully been practiced in the development of Darwinism in evolutionary biology. In a final section, doubts have therefore been raised as to whether the top-down approach propagated by Generalized Darwinism can overcome its inherent limitations and develop into a fruitful research strategy for evolutionary economics.

Acknowledgements

Support by the *Deutsche Forschungsgemeinschaft* (Ho 2143, 9-1) for Hossfeld and Levit’s research on the history of evolutionary biology is gratefully acknowledged. The authors also wish to thank the *Situating Science: Works in Progress* discussion round at the University of King’s College, Halifax (Levit) and G.Hodgson, J.-W. Stoelhorst, and Jack Vromen for vivid discussions on the controversy (Witt).

References

- Aldrich H.E., Hodgson G.M., Hull D.L., Knudsen Th., Mokyr J., Vanberg V.J. (2008) In defense of Generalized Darwinism. *J Evol Econ* 18: 577-596.
- Andersen, E.S. (2009) *Schumpeter’s Evolutionary Economics*. Anthem Press, London.
- Berg L. S. (1926) *Nomogenesis or evolution determined by Law*. Constable, London. (2nd ed. 1969, M.I.T Press, Cambridge & London).
- Beurlen, K. (1930) *Vergleichende Stammesgeschichte*. Borntraeger, Berlin.
- Bokma F. (2002) Detection of punctuated equilibrium from molecular phylogenies. *Journal of Evolutionary Biology*, 15(6): 1048-1056.

- Bowler, P. J. (1983) *The eclipse of Darwinism*. The John Hopkins University Press: Baltimore & London.
- Bowler, P. J. (1992) *The non-Darwinian revolution*. The Johns Hopkins University Press, Baltimore & London.
- Buenstorf, G. (2006) How Useful is Generalized Darwinism as a Framework to Study Competition and Industrial Evolution? *J. of Evol Econ*. 16, 511-527.
- Campbell, D.T. (1965) Variation and Selective Retention in Socio-cultural Evolution. in: Barringer, H.R., Blankenstein, G.I., Mack, R.W. (eds.), *Social Change in Developing Areas: A Reinterpretation of Evolutionary Theory*. Schenkman, Cambridge, MA., pp 19 - 49.
- Cordes C. (2006) Darwinism in economics: from analogy to continuity. *J Evol Econ* 16:529-541.
- Crozier, G.K.D. (2008) Reconsidering Cultural Selection Theory. *Brit. J. Phil. Sci.* 59, 455 - 479.
- Dawkins, R. (1983) Universal Darwinism. in: Bendall, D.S. (ed.), *Evolution from Molecules to Man*. Cambridge University Press, Cambridge, 403 - 425.
- Darwin Ch. (1859) *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. John Murray, London
- Darwin Ch. (1871) *The descent of man, and selection in relation to sex*. John Murray, London
- Darwin Ch. (1872) *On the origin of species* (6th ed.). John Murray, London
- Darwin Ch., Wallace A.R. (1858) On the tendency of species to form varieties; and on the perpetuation of varieties and species by natural means of selection. *J Proc Linn Soc Lond* 3:45-63.
- Eldredge, N. and Stephen J. Gould. 1972. Punctuated Equilibria: An Alternative to Phyletic Gradualism. In Schopf, Thomas J.M. (ed.), *Models in Paleobiology*, pp. 82-115. Freeman, Cooper and Co., San Francisco.
- Frank, S.A. (1995) George Price's contributions to evolutionary genetics, *Journal of Theoretical Biology*, 175: 373-388.
- Gilbert S.F., Epel D. (2009) *Ecological Developmental Biology*. Sunderland: Sinauer Associates.
- Gilbert SF, Bolker JA (2003) Ecological developmental biology: preface to the symposium. *Evol Dev* 5(1):3-8
- Gould, S. J. (1977) *Ontogeny and phylogeny*. The Belknap Press of Harvard University Press, Cambridge.
- Gould, S. J. (2002) *The structure of evolutionary theory*. The Belknap Press of Harvard University Press, Cambridge.
- Haeckel E. (1866) *Generelle Morphologie der Organismen*. 2 Bde. Berlin: Georg Reimer.
- Haig D. (2007) Weismann Rules! OK? Epigenetics and the Lamarckian temptation. *Biology and Philosophy* 22:415-428.
- Hall B.K., Pearson R. and Müller G.B. (2003) *Environment, Evolution and Development: Toward a Synthesis*. MIT Press, Cambridge, MA.
- Hallpike, C.R. (1985), "Social and Biological Evolution I. Darwinism and Social Evolution", *Journal of Social and Biological Systems*, Vol. 8, 129-146.

- Hallpike, C.R. (1986), "Social and Biological Evolution II. Some Basic Principles of Social Evolution", *Journal of Social and Biological Systems*, Vol. 9, 5-31.
- Hodgson, G. M. (2002) Darwinism in economics: from analogy to ontology. *Journal of Evolutionary Economics*, 12:259-281.
- Hodgson G. M. (2009) Agency, Institutions, and Darwinism in Evolutionary Economic Geography. *Economic Geography*, 85(2): 167-173.
- Hodgson, G. M. and Knudsen, Th. (2004) The firm as an interactor: firms as vehicles for habits and routines. *Journal of Evolutionary Economics*, 14:281-307.
- Hodgson, G. M. and Knudsen, Th. (2006a) Why we need a Generalized Darwinism, and why Generalized Darwinism is not enough. *J of Economic Behavior & Org.* 61, 1-19.
- Hodgson, G. M. and Knudsen, Th. (2006b) The Nature and Units of Social Selection. *J. Evol. Econ.* 16, 477 - 489.
- Hodgson, G.M. and Knudsen, Th. (2010) Darwin's Conjecture – The Search for General Principles of Social and Economic Evolution. forthcoming.
- Hossfeld, U. & L. Olsson [Hrsg.] (2009): Charles Darwin. Zur Evolution der Arten und zur Entwicklung der Erde. Frühe Schriften zur Evolutionstheorie. Suhrkamp Studienbibliothek 13, Suhrkamp, Frankfurt a. M.
- Hossfeld, U. (2010): Ernst Haeckel. Biographienreihe absolute, Freiburg i. Br.: orange press.
- Hull, D.L. (1988), *Science as a process: an evolutionary account of the social and conceptual development of science*, Chicago: University of Chicago Press.
- Hull, D.L. (2001), *Science and Selection: Essays on Biological Evolution and the Philosophy of Science*, Cambridge: Cambridge University Press.
- Jablonka E. and Lamb M. (2006) *Evolution in Four Dimensions*. MIT Press.
- Junker Th, and Hossfeld U. (2009) *Die Entdeckung der Evolution (2nd Ed.)*. Darmstadt: WBG.
- Kutschera U. and Nicklas K.J. (2004) The modern theory of biological evolution: an expanded synthesis. *Naturwissenschaften*, 91: 255-276.
- Le Dantec, Félix. (1909) *La crise du transformisme*. Félix Alcan Éditeur, Paris.
- Levit, G. S. and Hossfeld, Uwe (2005) *Die Nomogenese: Eine Evolutionstheorie jenseits des Darwinismus und Lamarckismus*. *Verhandlungen zur Geschichte und Theorie der Biologie* 11:367-388.
- Levit G.S., and Hossfeld U. (2006) The Forgotten "Old Darwinian" Synthesis: The Evolutionary Theory of Ludwig H. Plate (1862-1937) *NTM International Journal of History and Ethics of Natural Sciences, Technology and Medicine*, 14:9-25.
- Levit G.S., Olsson L. (2006) "Evolution on Rails": Mechanisms and Levels of Orthogenesis. *Annals of the History and Philosophy of Biology* Vol. 11, pp. 97-136.
- Levit G.S., Meister K., Hossfeld U. (2008) Alternative Evolutionary Theories from the Historical Perspective. *Journal of Bioeconomics*, 10(1): 71-96.

- Levit G.S., Simunek M., Hossfeld U. (2008b) Psychoontology and Psychophylogeny: The Selectionist Turn of Bernhard Rensch (1900-1990) through the Prism of Panpsychistic Identism. *Theory in Biosciences*, 127:297-322.
- Mayr, E. (1982) *The growth of biological thought: Diversity, evolution and inheritance*. The Belknap Press of Harvard University Press, Cambridge.
- Mayr E (1991) *One long argument: Charles Darwin and the genesis of modern evolutionary thought*. Harvard University Press, Cambridge, Mass.
- Metcalf, J.S. (1998) *Evolutionary Economics and Creative Destruction*, Routledge, London.
- Nelson, R.R. and Winter, S.G. (1982) *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge.
- Price, G.R. (1970), Selection and covariance, *Nature*, 277: 520-521.
- Reif, W.-E. 2000 'Darwinism, gradualism and uniformitarianism' *N. Jb. Geol. Paläont.*, 11:669-680
- Reif, W.-E., T. Junker & U. Hossfeld (2000): The synthetic theory of evolution: general problems and the German contribution to the synthesis. *Theory in Biosciences* **119** (1): 41-91.
- Romanes, G.J. (1895) *Darwin and after Darwin: Post-Darwinian questions: Heredity and Utility*. Ago: Open Court.
- Stoelhorst, J.W. (2008), The explanatory logic and ontological commitments of generalized Darwinism, *Journal of Economic Methodology*, 15: 343-363.
- Vromen, J. (2007) Generalized Darwinism in Evolutionary Economics – The Devil is in the Details, *Papers on Economics and Evolution* # 0711, Max Planck Institute of Economics, Jena.
- Vromen, J. (2008) Ontological Issues in Evolutionary Economics: The Debate Between Generalized Darwinism and the Continuity Hypothesis, *Papers on Economics and Evolution* # 0805, Max Planck Institute of Economics, Jena.
- Weismann, A (1885) *Die Kontinuität des Keimplasmas*. Jena: Gustav Fischer.
- Wilkins, J.S. (1998) The Evolutionary Structure of Scientific Theories. *Biol Philos* 13, 479-504.
- Wimsatt, W.C. (1999) Genes, Memes and Cultural Heredity. *Biol Philos* 14, 279 - 310.
- Wimsatt, W.C and Schank, J. C. 1988. Two constraints on the evolution of complex adaptations and the means for their avoidance. Pp.213-273 in M. Nitecki (ed.) *Progress in Evolution*, The University of Chicago Press, Chicago.
- Windrum, P. (2007) Neo-Schumpeterian Simulation Models. in: H. Hanusch, A. Pyka (eds.), *Elgar Companion to Neo-Schumpeterian Economics*, Edward Elgar, Aldershot, 405-439.
- Witt U (2003) *The evolving economy. Essays on the evolutionary approach to economics*. Edward Elgar, Cheltenham.
- Witt U (2004) On the proper interpretation of 'evolution' in economics and its implications for production theory. *J Econ Methodol* 11(2):125-146.
- Witt U (2008) What is specific about evolutionary economics? *J Evol Econ* 18:547-575.
- Zavarzin G.A. (1979) The space of logical possibilities in the diversity of bacteria and their phylogenies. *Priroda* 6: 9-19 [in Russian]