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Metascientific Views: Challenge and Opportunity for Philosophy of Biology in Practice

In this paper I take evolutionary biology as an example to reflect on the role of philosophy and on the transformations that philosophy is constantly stimulated to do in its own approach when dealing with science. I consider that some intellectual movements within evolutionary biology (more specifically, the various calls for 'synthesis') express *metascientific views*, i.e., claims about 'what it is to do research' in evolutionary biology at different times. In the construction of metascientific views I see a fundamental role to be played by philosophy, and, at the same time, a need to complement the philosophical methods with many more methods coming from other sciences. What leads philosophy out of itself is its own attention to scientific practice. My humble methodological suggestions are, at this stage, only meant to help us imagine metascientific views that are built with a more scientific, interdisciplinary approach, in order to attenuate partiality, subjectivity and impressionism in describing the scientific community. And yet, we should not be naïve and imbued with the myth of 'data-driven' research, especially in this field: other complex issues about metascientific views call for a serious, constant philosophical reflection on scientific practice.

Keywords: Philosophy of science in practice; Philosopy of biology; Evolutionary synthesis; Interdisciplinarity.

1. Introduction

More than once, through its history, evolutionary biology has tried to get a meaningful and comprehensive snapshot of itself. A few of these crucial moments are defined 'syntheses': these include the Modern Synthesis some decades ago, and the Extended Evolutionary Synthesis today (Laland et al. 2014, Laland et al. 2015). I have studied synthesis for several years now (e.g., Serrelli 2015, 2016a, Eldredge et al. 2016), and I have come to the conclusion that we may usefully define both 'syntheses' as *metascientific views*, in that they consist in claims about 'what it is to do research' in evolutionary biology at different times. Only indirectly they are scientific claims about evolutionary processes, although the two aspects – the scientific and metascientific – are hardly separable (indeed, inseparable) in any chiefly scientific or chiefly metascientific discourse.

I take evolutionary biology as just an example to reflect on the role of philosophy and on the transformations that philosophy is constantly stimulated to do in its approach. In the

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Final version published as: Serrelli E (2017). Metascientific views: Challenge and opportunity for philosophy of biology in practice. Acta Philosophica 26(1): 65-82. ISSN 1121-2179 doi 10.19272/201700701005 [http://hdl.handle.net/10281/148832]

construction of metascientific views I see a fundamental role to be played by philosophy of biology (Serrelli 2016b), and, at the same time, a need to complement the philosophical methods with many more methods coming from other sciences. In other words, I see both a constant opportunity and a call for humility.

The opportunity for philosophy comes, on the one hand, from the fact that metascientific views are perceived as a need by the scientists too, and, on the other hand, from the intrinsic complexity of the effort. A comprehensive and reliable picture of evolutionary biology is, in principle, very useful to evolutionary biology itself as a research enterprise. Fragmentation coming, for example, from compartmentalization and hyper-specialization is often seen as an obstacle to the advacement of the science of evolution in many ways (Sidlauskas et al. 2009). A sense of evolutionary biology as a moving whole can be crucial for many important issues such as biology training, or funding and rewarding policies. The lack of a general picture of evolution, or at least of a sense of communal endeavour, can prevent a researcher from grasping the potential evolutionary relevance of their study case, or from accessing precious resources. In sum, syntheses deserve careful consideration because of their potential 'maintenance effects', ultimately aiding evolutionary biology in pursuing its own knowledge aims.

But metascientific views are intrinsically complex: their achievement requires a great effort of domesticating a huge mass of scientific literature (the latter being, in turn, only one aspect of scientific work); they intertwine metascientific with scientific claims, descriptive with prescriptive aspects, and multiple historical chronologies; and they are often elaborated through conceptual analysis by one or few scientists who cannot but rely on their particular experience and hold stakes in the scientific debate. All these features of metascientific views strongly call for philosophical inquiry and – as I became inclined to remind, like a *mantra* – for an attention to scientific practice (Ankeny et al. 2011, Boumans and Leonelli 2013, Soler et al. 2014). But we should recognize at the outset that philosophy of science is being led out of itself, towards an integration with the methods of other scientific fields. What leads philosophy there is exactly the attention to scientific practice. In fact, the fundamental problem of logical analyses of science is that scientists do not live inside theories, rather, at any particular moment in time, they have different versions or pieces of theory, with which they entertain diverse relationships. Different periods of evolutionary biology can be described as nested sets of concepts and ideas (Fig. 1), but evolutionary biology in 1980, in the 1930s, and at any moment in history, is a working scientific community that has to be studied under more aspects. While rigorous methods such as meta-analysis are used to combine available scientific evidence, rigorous ways of knowing the scientific community seem scarcer.

2. Many Methods for Getting to Know a Scientific Community

The intellectual movement called "Extended Evolutionary Synthesis" (EES) can be traced back to Massimo Pigliucci and Gerd Müller (Pigliucci 2007, Müller 2007, Pigliucci & Müller 2010).[2] The extension that the EES suggests refers takes the Modern Synthesis

[2] It would be necessary to assess Pigliucci and Müller's discontinuities and continuities with respect to previous works like Gould's or Stebbins's. This would be particularly important because the EES has the ambition of summoning the pleas that have been accumulating over the

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(MS), temporally located in the first half of the 20th century, as a reference point. A reconstruction of the Modern Synthesis was published in 1980 by Ernst Mayr and William Provine (Mayr and Provine 1980). While the book became the official, although in fact multifarious, account of the MS, the account was paralleled and immediately followed by pleas for an extension of the Modern Synthesis. Some critics, like early Stephen Jay Gould (1980, 1982), were more radical, whereas others, like G. Ledyard Stebbins, adopted a more integrative approach (Stebbins and Ayala 1981; Stebbins 1983).[3]

Müller and Pigliucci wanted to point out some missing elements of the MS that are being added by current evolutionary research. Initially, they both focused on 'organic form' as something overlooked by the 'essentially' genetic MS, then they consciously started a proliferation of reflections on the EES, where they assembled a broader extension beyond the issue of 'form'. In Fig. 1 we see Darwinism, the MS, and the EES represented as successive expansions of "conceptual pillars" (Pigliucci 2007). Notice that these expansions are meant to show not only cumulative growth of knowledge about evolution, but also the various transformations *of* evolutionary biology as a scientific field. The different circles aim at being representative of how working in evolutionary biology was, is, and will be at different times.

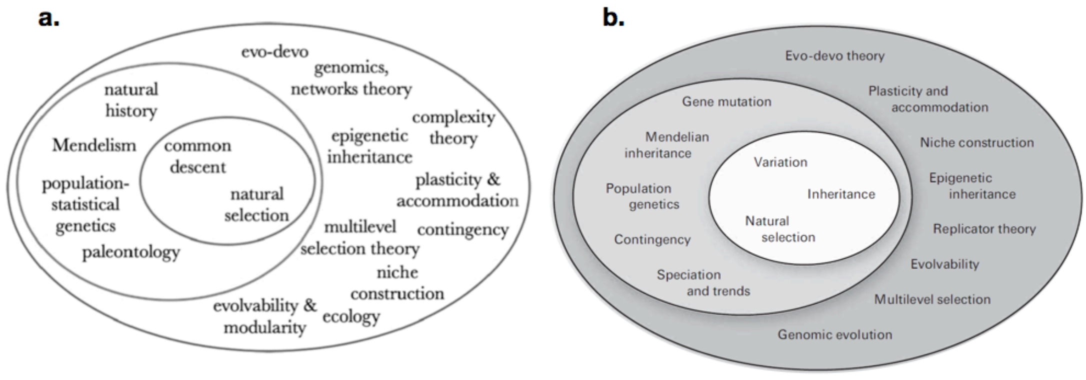

Figure 1. A comparison between the elements of an Extended Evolutionary Synthesis (EES) appearing in two different publications: (a) from Pigliucci (2009); (b) from the collective book *Evolution: The Extended Synthesis* (ed. by Pigliucci and Müller 2010). Each of the two diagrams describes the EES as inclusive of Darwinism (inner circle), the Modern Synthesis (middle circle), and additional concepts (outer circle). A comparison among publications (either with or without diagrams) uncovers dynamism and problematic factors of complexity in the development of a metascientific view.

According to Pigliucci (2007), for example, the MS coincides with evolutionary genetics, as its foundations had consisted in a movement of "crystallization" of a "theory of genes" out of the original Darwinian "theory of form" (p. 2744). Pigliucci supported such a claim with a brief conceptual history of evolutionary biology, summarizing how 20th

years. The analysis is however beyond the scope of the present review, but some disconnects will be mentioned.

[3] Stebbins is also considered among the architects of the MS (Pigliucci 2009, p. 220; Pigliucci and Müller 2010, p. 8; Stebbins 1950). Both Gould and Stebbins, although in different ways, moved towards macro-evolutionary extension of the MS (Serrelli and Gontier 2014). Pigliucci and Stebbins share, besides their interest in extending the MS, their specialization: both are botanists.

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Century Darwinism overcame Lamarckism, and how Mendelism was made compatible with gradual change by means of statistical works by Fisher, Haldane and Wright (*Ivi*, p. 2744). He described the major theoretical contributions by Dobzhansky, Mayr, and Simpson in the 1940s, and then identified some missing elements in the MS, namely: development, studied separately by embryologists (p. 2745); ecology, secluded away as a background condition of evolution (*Ibidem*); implications of the '-omics revolution', and its relationships to neutralism and complex genotype-phenotype interactions (pp. 2745-6); and phenomena such as plasticity, evolutionary capacitance, epigenetic inheritance (p. 2746). An EES would integrate a theory of form back into evolutionary biology (p. 2745). Some "bits and pieces" or "recurring ideas" (p. 2746) that will be part of the EES would be: *evolvability*, hinging on developmental systems' modularity and robustness (p. 2746); *phenotypic plasticity* and the possibility of modes of evolution such as genetic accommodation (pp. 2746-7); *epigenetic and multiple inheritance* (p. 2747); *complexity theory*, revealing organizing principles different from natural selection (*Ibidem*); and *updated adaptive landscapes*, in light of work that reformulates their general shape (pp. 2747-8). Concluding the 2007 paper, Pigliucci anticipated a new, complex, constructive process analogous to the MS itself, a progressive "expansion of theoretical biology (in the broader sense of conceptual understanding of the discipline's foundations)" (p. 2748).

The idea of an EES enjoyed some success in the last few years. For example, several scientific journals reviewed the EES book (Pigliucci and Müller 2010) as a research proposal (Plutynski 2011; Reiss 2011; Travis 2011; Witteveen 2011; Handschuh and Mitteroecker 2012). Some scientists accepted the challenge of imagining how the EES will eventually be (Brooks and Agosta 2012), possibly pointing out neglected extensions (Boto 2010; Weber 2011). Some scholars used the EES perspective to look at evo-devo (Love 2009; Medina 2010), at population genetics (Akey and Shriver 2011), and at other fields (Noble 2011; Danchin 2013; L.A.B. Wilson 2013), and many focused on epigenetics (Danchin et al. 2011; Schrey et al. 2012, Dickins and Rahman 2012). The socio-cultural sciences showed an interest in the extension of the MS as well (Mesoudi et al. 2013; Laland et al. 2009).

At the same time, the EES became the object of interesting controversies. Single concepts of the EES have been questioned with respect to their scientific validity, relevance, or innovativeness (Reiss 2011). Coyne (e.g., 2009) questions, for example, the real evolutionary incidence of epigenetic inheritance due to the short life of epigenetic changes over generations. Some pillars create different factions concerning their compatibility with long-standing knowledge (e.g., for evo-devo, Minelli 2010 vs. Laubichler 2010). But many other issues are more exquisitely metascientific: they are about the science, not the world. Fields such as "population genetics" or "ecology" or "evo-devo" that are listed among EES conceptual pillars are metascientific concepts rather than scientific ones (more will be said on this below). Another purely metascientific debate is the one concerning *the age* of 'pillars': claims for additions to the MS are also claims for the long absence of some ingredient, for example ecology, from the field of evolutionary biology. Such absence is typically contested by groups of scientists who claim to have always taken ecology (or whatever pillar at hand) into consideration, or who point out forerunners. The timing of virtually each and every

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concept is a matter of metascientific quarrel between different members of the scientific community. There is also a more fundamental disagreement about the EES as such. Müller and Pigliucci (2010) observe two opposite reactions to the EES: the "nothing-substantially-new" position and the "more-change-is-needed" position. The first position is seen as being represented by scientists such as Douglas Futuyma and Michael Lynch. Futuyma (2011, 2014) thinks that evolutionary biology had absorbed and incorporated discoveries throughout its history, without the need for a formal reconsideration of evolutionary theory, and Lynch (2007) sees a multiplication of things to explain more than of explanations. The second position, expressed in papers such as Craig (2010, 2011), is against extending the MS because elements such as evo-devo would completely overthrow it: the MS would not be amendable. Although some of the cited workers actually have nuanced opinions, some of them did indeed express themselves in sharp contrast with the EES through various media (e.g., Coyne 2009). Proponents of the EES usually explain away such a diffuse dissent by the conservative inertia or active homeostasis of science, 'paradigmatic' almost in a Kuhnian sense. It is evident, in my view, that ongoing controversies on the EES mingle scientific and metascientific aspects.

How do we get insights about the shifting state of something so broad, fragmented, and lively such as evolutionary biology? An obvious obstacle to the achievement of a metascientific consensus is what could be called the scientist-field disproportion. Evolutionary biology is vast in terms of involved people and labs all over the world, with their diversity and ever-changing boundaries. All sorts of science are being done in the world: do they fit the mind and the reach of one or few experts? How can we know what all those people are doing?

Massimo Pigliucci (2009), to explain shifts in his list of concepts (Fig. 1), acknowledges a particular meeting (the "Altenberg meeting", Pigliucci & Müller 2010) as an occasion for him to expand his thinking about evolutionary theory. Taking the cue from this, we ought to think that, in general and inevitably, concepts are included by the author partly as a function of contingent biographical and professional factors, such as the particular field of specialization, the network of professional contacts, the encounters that happen, or even some kind of personal taste. Factors like these are also subject to change over lifetime. All this speaks about the disproportion between any scientist's point of view and the necessary task of mapping the field, at any time in history.[4] Just think to how huge and fast-growing the scientific literature is today. A metascientific view aspires to describe the web of networks of researchers and labs that constitute evolutionary biology, i.e., people, along with their actions and knowledge, their instruments, the different media and various kinds of connections among them, and also, in part, the larger contexts in which they work and operate. When we are interested in an empirical concept such as phenotypic plasticity, then, we want to know for example where, when, how, and how much phenotypic plasticity was effectively studied in relation to evolution. And it is not even enough to know how frequently phenotypic plasticity is mentioned, or who are the most cited 'experts' of it. Before being able to demonstrate

[4] To the scientist-field disproportion we will add, in the next section, the 'flag effect': any scientist's claims are part of socio-epistemological and socio-economical dynamics where he or she has needs, aims, open accounts.

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that plasticity is involved in the change of how evolutionary biology is practiced, we need to deal with how phenotypic plasticity is integrated in scientific practice, what is its incidence and role. How has the *understanding of* some concepts changed? And what is the *importance of* concepts in scientific work in different contexts and periods? In other words, how much research is theory-engaged and theory-driven (Scheiner 2013)?

While databanks of specific research objects (a gene, a species) are flourishing, scientists don't access meaningful and rigorous data *about* the scientific community. Yet, let me suggest that helpful methods and notions exist in different disciplines, and perhaps would only need to be applied and integrated to construct a metascientific view of evolutionary biology. What's the real trajectory of the consideration of phenotypes, or of ecology, in the community of evolutionary biologists? What is really happening to evolutionary biology in relation to what many people call 'evo-devo', or with what different groups call 'integration of evolution with ecology'? When and how, if ever, evo-devo changed the way evolutionary research is carried out in other parts of the field? Is epigenetic inheritance really related to new ways of doing science?

Conceptual analysis of theories, beloved by philosophers and by some scientists, must be complemented to achieve accounts that are more grounded and useful to biologists. Real substance of metascientific views are the diffusion of those concepts, the changing role of those concepts in scientific research, and the congruent partitioning and repartitioning of the scientific community relating to various ways of being evolutionary biologists.

Several studies already go in this direction. Scheiner (2013) performed some quick quantitative historical analyses of ecology to measure theory-engagement in that field. Something similar might be done to assess the integration between evolution and ecology. Love and colleagues (Love 2003; Raff and Love 2004) made interesting attempts to re-evaluate the received conviction that development was excluded by the MS. To this aim they mixed historical and conceptual methods: they dissected the different kinds of developmental studies that might have been excluded, looking for clues about possible exclusion of one or more of these 'embryologies'; they searched fields like morphology and paleontology that also were seemingly side-lined; they spelled out different kinds of exclusion. But even more can be done.

Information sciences have techniques for the automatic retrieval, analysis and representation in *corpora* of big data. Recent studies have focused on scientific/academic information, its search, recommendation and distribution (McCain et al. 2005, McCain 2008, 2009, Riviera 2013). Scientometrics, i.e. the quantitative study of science, can reveal relations between units such as authors, disciplines, institutions, semantic elements. Study of patterns in citations, texts, and user behaviors (McCain 2013) through time can trace 'lineages of ideas' and reveal phenomena about the scientific community, such as fields emergence and decline. The ongoing explosion of online journals and digital archives matches perfectly these techniques, although it also demands corrections and creative solutions as the analysis goes back in time – as it will always do, since as we have seen metascientific claims are almost always historical claims. The domain of analysis can also be expanded multilingually to conference programmes and abstracts, research protocols, official documents, and to alternative

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media that are becoming more important in the economy of scientific work: online tools, institutional websites, science news and blogs.

Synthesis, if any, must have scientometric correlates, provided that, although textual search is very powerful, it must be guided by the right queries. At the same time, work in the social sciences demonstrates that understanding scientific communities is broader than bibliometrics. For example, quantities about scientific papers should be related to the (changing) social function of scientific papers (Riviera 2013). White and McCain (1998) affirm that techniques such as 'authors co-citation analysis' are "no substitute for extensive reading and fine-grained content analysis": "they produce history of the cliometric sort, which leaves out almost all the good parts, [for example] what actually gave rise to the most significant work" (p. 327).

The job of biologists has certainly changed, and we want to understand how: laboratory ethnography and biographical research have methods to answer (see Caduff 1999, Hess 2001), and also to bring about reliable indicators to obtain large scale descriptions of evolutionary biology. Some prior, qualitative study of research and writing practice in biology will be necessary in order to extract significant clues, indexes, proxies, and patterns that can feed quantitative research and yield meaningful answers. Ethnographic work must be in turn informed by sound theoretical knowledge and epistemological hypotheses, if it has to provide quantitative analyses with meaningful search keys.

Then, if we really want to understand and explain, it will be necessary to involve knowledge and methods from, e.g., the sociology (Gieryn 1983, 1999, Bourdieu 1993, Riviera 2013) and the economics (Stephan 2012, Sent 1999, Thicke 2013) of science, that hold important keys to the reasons for conformism and innovation, stability and change in science. Talking about the MS as a 'constraining theoretical framework' is interesting, but many quarrels on the plausibility of such a constraint arise, probably, from the lack of serious consideration of other really constraining factors: policies, politics, culture, economic investments, technology, reward structure of science, the social role of the evolutionists, the structure of the community, and the like. After all, the scientific conformism that EES advocates attribute to the rigid theoretical framework they call the MS might well find appropriate pieces of explanation in the economic and social structure of science over the 20th Century. This is why we also need to ask economics and sociology to describe the social dynamics of evolutionary biology and the conditions and identities of evolutionary biologists over time and across geographical ranges. If these aspects are changing, considering them will be crucial in either the EES or other metatheoretical views we can build.

The birth of a field is also the birth of a new way of doing science, as well as a statement of identity, and is described by the changing conditions of the scientific community, not only by the map of involved concepts. What can or cannot be done in a science is constrained and channeled by cultural, social, and economic aspects of science, for example technological advances and costs, or cultural obstacles regarding training, job market and evaluation, grant systems, publication, language barriers (Sidlauskas 2009). Sociology, ethnography, economics and history have tools and knowledge for all these

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explanatory aspects that, moreover, are essential to any description of a scientific community.

Scientific methods can thus let us observe the metascientific change of evolutionary biology and, in face of their variety and heterogeneity, they should be themselves 'synthesized' in some way. The National Center for Evolutionary Synthesis (Sidlauskas et al. 2010) defines 'synthetic science' as an integration of different kinds of data from multiple sources. Various kinds of synthetic science, achieved in diverse ways, exist.

My humble methodological suggestions are, at this stage, only meant to help us imagine metascientific views that are built with a more scientific, interdisciplinary approach. Of course, we should not be naïve and imbued with the myth of 'data-driven', especially in this field: other complex issues about metascientific views call for a serious, constant philosophical reflection on scientific practice.

3. Philosophy

There are inherent difficulties in the achievement of any metascientific view. The vastness and complexity of the scientific field, seen in the previous section, is only one of them. Other difficulties are the insufficiency of conceptual analysis to capture the thickness of scientific research, the entanglement between empirical and metascientific concepts, between multiple chronologies, and between descriptive and normative needs, as well as the inevitable stakeholding of any reviewer involved in the reviewed field. To all these difficulties, a mature philosophy of science in practice can bring a decisive contribution.

Philosophy of science in practice has the task of reflecting upon the claims for synthesis in the first place, and upon their role in the scientific community. The self-representation of scientists claiming for synthesis is, in fact, an interesting object of philosophical reflection. Ernst Mayr wrote:

> The term "evolutionary synthesis" was introduced by Julian Huxley […] to designate the general acceptance of two conclusions: gradual evolution can be explained in terms of small genetic changes ("mutations") and recombination, and the ordering of this genetic variation by natural selection; and the observed evolutionary phenomena, particularly macroevolutionary processes and speciation, can be explained in a manner that is consistent with the known genetic mechanisms (Mayr in Mayr and Provine 1980, p. 1).

We should contrast Mayr's account of the MS – taken at face value by EES advocates – with what historians of biology have been discovering about the MS.[5] Cain (2009), for example, focuses on the pragmatic and strategic utility of claiming, back in the 1930s, to be part of a modernizing team (see also Provine 1992, cit. in Delisle 2011, Smocovitis 1996). To the 'architects', the claim was a strategic move in many ongoing battles, and personally useful to their careers. 'Outsiders', as well, employed the MS in 'David and Goliath' narratives to muscle their way through.

[5] Enlightening examples, beside cited Joe Cain, are Sahotra Sarkar, Betty Smocovitis, Michael Dietrich, William Provine, David Depew, Richard Delisle.

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Cain (2009)[6] argues that traditional historiography, following the lead of MS claims, has been affected by *historical realism* on the MS, and that many historical studies of the synthesis period create forced links between anything that was happening and that alleged overarching object, the MS. The idea that the MS 'is there' as a certain object was born and cultivated for specific reasons in those years. Meanwhile – historians show – architects of the MS such as Huxley, Simpson, Dobzhansky, and Rensch held different research agendas or even "incommensurable epistemological frameworks" (Delisle 2011, p. 57; see also Cain 2003), and paradoxically the advertised narrow set of concepts ended up by being an obstacle to the advancement of these agendas.

History can actually be told differenly – for example, Cain thinks that while an evolutionary synthesis at the theoretical level was proclaimed, a synthesis of taxonomy and systematics (old and new) was substantially more important. The 'constructed' nature of the MS was epitomized already by Burian (1988) when he defined the MS as a ''moving target'', with regards to both the list of its possible 'architects' and the boundaries of its research agenda.

A step in the 'objectivization' of the MS was the 1980 *Conference on the Evolutionary Synthesis* whose proceedings are Mayr and Provine (1980). Ernst Mayr was a very influential figure throughout 20th Century evolutionary biology. He (1973) had battled to acknowledge "the naturalists" as he called them (e.g., zoologists, paleontologists) against an account of the MS that he saw as too imbalanced in favor of geneticists and mathematicians (targeting, e.g., Provine 1971). An important moment for the establishment of Mayr's own view of the MS was the 1980 Conference. Mayr wanted to clarify "the sequence of events [1936-1947] leading to the synthesis, and to identify the factors responsible for the preceding disagreements" (*Ibidem*). But despite Mayr's 'general acceptance' view of the MS, even a cursory reading of Mayr and Provine (1980) reveals a diversity of stories and visions of the MS across points of view, disciplinary backgrounds, geographical positions. As Provine noticed, the 1980 Conference and proceedings are not a great example of consensus and agreement on a small set of concepts, despite Mayr's efforts. In the Epilogue, Provine wrote:

> One note of unanimity at the conference may perhaps need to be revised. Although all participants seemed to agree that an evolutionary synthesis had occurred, they may have had different syntheses in mind. The evolutionary synthesis may therefore have appeared more cohesive during the conference than it actually was (Provine in Mayr and Provine, p. 408).

There is not much consensus on the proclaimed consensus, after all. 1980 was more the attempted construction of a consensus than it was the account of an already achieved agreement. We should probably derive two lessons for our interpretation of the EES debate.

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[6] Cain wrote many papers describing the overall situation in the MS period. He also published equally interesting monographic studies focused on personalities such as Simpson, Sewall Wright, Julian Huxley, Ernst Mayr, Theodosius Dobzhansky. Notice that, of course, Cain is just a telling example and that historians themselves are not monolithic at all in their consideration of the MS (cf., e.g., Sarkar 1992, 2004).

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First, Ernst Mayr, along with others, produced, iterated, and defended for specific purposes the view of the MS that is now adopted in the EES. The Modern Synthesis was, first of all, a useful flag. The 'conceptual pillars' must not be understood as a faithful account of the scientific community at any time, but rather a manifesto flag for the 'architects' in their respective times. This awareness, along with inconsistencies and shortages of the available descriptions of the MS, may make us more cautious in objectivizing the MS.

Second, EES claims may be analogized to MS claims: the EES can *itself* be seen as a useful flag, although obviously in a completely changed socio-political and scientific context. If the 'flag effect' is partly explanatory to the MS, there is no reason why we should not consider it when we think to the EES. A collection of conceptual pillars (Fig. 1) is not necessarily a good description of the status and tranformations of evolutionary biology, whereas apparently it does make an effective flag, an aggregating flag reminiscent of Mayr's ensign. The instabilities and disagreements we have described stand, in part, as symptoms for all these partiality aspects. On the other hand, the MS and the EES certainly represent more than partisan interests: they are pleas for the good of the field. With reference to the MS, Delisle (2011) talked about a "sociological synthesis" – made of transformations in the social configuration of science, exchange among disciplinary communities, institutional bridges – as something separate from conceptual unification that, for him and many others, was never quite achieved. The EES might represent a continuation of the struggle – already present in the MS – against disfunctional imbalance of prestige and resources granted to molecular methods vs. other methods, in an age of cheaper high-throughput sequencing that produces streams of publications.[7] Other redistributions might be at stake, for example between botanists and microbiologists vs. zoologists, or concerning new means of knowledge such as simulations.

The EES could be, today, a flag for many streams of study that have been suffering due to perceived scientific dominant tendencies or fashions, a flag recruited by an ongoing struggle for very basic needs of any scientist: funding, publication, consensus. Let us make some examples. Odling-Smee's suggestion of niche construction (1988) waited some ten years to be taken up by a few mainstream modelers and population geneticists (Laland et al. 1996), who, in turn, offered their models to call for a global rethinking of evolutionary biology (Laland et al. 2009), and still, it would appear, to date their effort have breached almost exclusively among philosophers and human scientists (e.g., Kendal et al. 2011). Jablonski's work on multilevel processes in macroevolution was part of the paleobiological revolution (Sepkoski 2012) since the 1980s (Jablonski 1986). Macroevolution is today a big and consolidated field, but the most radical implications for evolutionary mechanisms are still unsettled (Serrelli and Gontier 2014). Jablonka has been a vocal and harsh critic of the MS for many years (Jablonka and Lamb 1989). On the other hand, the evolutionary importance of epigenetics has been considered negligible due, for example, to the lability of epigenetically transmitted modifications

[7] One thing that becomes clear from a reading of the history of the MS is that it sought to present a unified front against the rise and usurpation of molecular biologists. This aspect of the story is quite relevant to understanding what's going on with the EES as evolutionary biologists face up to the fact that many of their tools today are molecular.

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over evolutionary time, and proponents like Jablonka have long been accused from overusing a few experimental cases (e.g., Haig 2007). David S. Wilson (e.g., 2009) describes the scientific battle over group selection spanning 150 years, beginning with Darwin. Wilson himself started a strenuous defense of group selection since 1970s (Wilson 1975; Sober and Wilson 1998). Notwithstanding peer-reviewed publications on the subject (Wilson and Wilson 2007), a multimedia battle still goes on with personalities such as Dawkins and Coyne that tirelessly deny any possibility of group selection in evolution. Kirschner and Gerhart started to defend evolvability in late 1990s (1998). Opponent, Lynch (e.g., 2007) keeps bringing back evolvability to its population genetics meaning (related to heritability) and defines other versions of evolvability as "speculation, which is almost entirely restricted to molecular and cell biologists and those who study digital organisms" (pp. 8602-3).

These are some of the various fierce streams of research that have decided to become associated with the EES. Notwithstanding the various reasons of the involved actors, just like the MS had helped the advancement of science, the EES really contains very important questions: biology has indeed been changing, and is changing, around us in many senses; we do want to know how, how fast, how uniformly, what scientists can and should do to second positive movements and contrast negative ones. Answers could, for example, orient economic investment, policy, curriculum planning, publication choices. But if the EES, like other pictures, is biased by 'flag effects', scientist-field disproportion, and all other complexity factors we have reviewed, where will we get those answers?

4. Conclusion

I have remarked the potential benefit of knowing 'what is it to do research' in a particular field: to plan biology training, to choose research lines in a lab, to navigate career development, to connect specific researches to broader contexts, and to make policy decisions on research funding and reward, all in order to make the field advance for the better. These are the high stakes and the promises of encompassing metascientific views, such as the EES, that, at the same time, encounter remarkable difficulties on their way. The EES is a metascientific claim in its being a statement about what's new *in how evolutionary biology is carried out*, not only a statement about what's new in evolution as we know it. A meaningful answer to questions like Pigliucci's "Do we need an Extended Evolutionary Synthesis?" (2007) demand a great deal of philosophical reflection and an interdisciplinary work with disciplines that can provide scientific models, data, and evidence *about* scientific communities. Philosophy of science and philosophy of biology are thus provoked by metascientific views not only to empower their attention to scientific practice, but also to revise and improve their own methods and their ability to integrate with other disciplines.

References

Akey JM and Shriver MD (2011) A grand challenge in evolutionary and population genetics: new paradigms for exploring the past and charting the future in the post-genomic era. *Front. Genet.* 2(July): 47.

Final version published as: Serrelli E (2017). Metascientific views: Challenge and opportunity for philosophy of biology in practice. Acta Philosophica 26(1): 65-82. ISSN 1121-2179 doi 10.19272/201700701005 [http://hdl.handle.net/10281/148832]

Ankeny, R. et al., 2011. Introduction: Philosophy of science in practice. European Journal for Philosophy of Science, 1(3), pp.303–307.

Boumans, M. & Leonelli, S., 2013. Introduction: On the Philosophy of Science in Practice. Journal for General Philosophy of Science, 44(2), pp.259–261.

Boto L (2010) Horizontal gene transfer in evolution: facts and challenges. *Proc. R. Soc. B* 277(1683): 819-27.

Bourdieu P (1993) *The Field Of Cultural Production*. Cambridge, UK: Polity Press.

Burian R (1988) Challenges to the evolutionary synthesis. Evol. Biol. 23: 247–269.

Brooks DR and Agosta SJ (2012) Children of time: the extended synthesis and major metaphors of evolution. *Zoologia (Curitiba)* 29(6): 497-514.

Caduff C (1999) Ethnographies of science: conversation with the authors and commentary. *Cultural Anthropology* 14(1).

Cain J (2009) Rethinking the Synthesis period in evolutionary studies. *Studies in the History of Biology* 42: 621-648.

Coyne J (2009) Are we ready for an extended evolutionary synthesis? In: Why evolution is true, 16 Feb 2009. Available at: http://whyevolutionistrue.wordpress.com/2009/02/16/are-we-ready-for-an-extended-evolutionary- synthesis/

Craig L (2010) The so-called Extended Synthesis and population genetics. *Biol. Theor.* 5 (2010): 117-123.

Craig L (2011) Criticism of the Extended Synthesis: a response to Müller and Pigliucci. *Biol. Theor.* 5: 395-396.

Danchin É, Charmantier A, Champagne FA, Mesoudi A, Pujol B and Blanchet S (2011) Beyond DNA: integrating inclusive inheritance into an extended theory of evolution. *Nat. Rev. Genet.* 12(7): 475-86.

Delisle RG (2011) What was really synthesized during the evolutionary synthesis? A historiographic proposal. *Stud Hist Philos Biol Biomed* 42(1): 50–9.

Dickins TE and Rahman Q (2012) The extended evolutionary synthesis and the role of soft inheritance in evolution. *Proc. R. Soc. B* 279(1740): 2913-21.

Eldredge N, Pievani T, Serrelli E, Tëmkin I (2016). Evolutionary Theory: A Hierarchical Perspective. Chicago: University of Chicago Press.

Futuyma DJ (2011) Expand or revise? The evolutionary synthesis today. *Q. Rev. Biol.* 86(3): 203-208.

Futuyma DJ (2014) Can modern evolutionary theory explain macroevolution? In: Serrelli E and Gontier N (eds) *Macroevolution: Interpretation, Explanation, Evidence*. Berlin: Springer.

Final version published as: Serrelli E (2017). Metascientific views: Challenge and opportunity for philosophy of biology in practice. Acta Philosophica 26(1): 65-82. ISSN 1121-2179 doi 10.19272/201700701005 [http://hdl.handle.net/10281/148832]

Gieryn TF (1983) Boundary-work and the demarcation of science from non-science: strains and interests in professional ideologies of scientists. *Am. Sociol. Rev.* 48(6): 781-795.

Gieryn TF (1999) *Cultural Boundaries Of Science: Credibility On The Line*. Chicago: University of Chicago Press.

Gould SJ (1980) Is a new and general theory of evolution emerging? *Paleobiology* 6: 119-130.

Gould SJ (1982) Darwinism and the expansion of evolutionary theory. *Science* 216(4544): 380-7.

Haig D (2007) Weissman Rules! OK? Epigenetics and the Lamarckian temptation. *Biol. Philos.* 22: 415-428.

Handschuh S and Mitteroecker P (2012) *Evolution - The Extended Synthesis*. A research proposal persuasive enough for the majority of evolutionary biologists? *Human Ethology Bulletin* 27(1-2): 18-21.

Hess DJ (2001) Ethnography and the development of science and technology studies. In: Atkinson P, Coffey A, Delamont S, Lofland J and Lofland L (eds) *The Sage Handbook of Ethnography*. Thousand Oaks, Ca.: SAGE Publications, pp. 234-245.

Jablonka E and Lamb MJ (1989) The inheritance of acquired epigenetic variations. *J. Theor. Biol.* 139: 69-83.

Jablonski D (1986) Background and mass extinctions: the alternation of macroevolutionary regimes. *Science* 231: 129-133.

Kendal J, Tehrani JJ and Odling-Smee J (2011) Human niche construction in interdisciplinary focus. *Philos. Trans. R. Soc. B* 366(1566): 785-92.

Kirschner M and Gerhart J (1998) Evolvability. *Proc. Natl. Acad. Sci. U. S. A.* 95: 8420-8427.

Laland, K. et al., 2014. Does evolutionary theory need a rethink? Nature, 514(7521), pp.161–164.

Laland, K.N. et al., 2015. The extended evolutionary synthesis: its structure, assumptions and predictions. Proc. R. Soc. B, 282(1813), p.20151019.

Laland KN, Odling-Smee FJ and Feldman MW (1996) On the evolutionary consequences of niche construction. *J. Evol. Biol.* 9: 293-316.

Laland KN, Odling-Smee FJ, Feldman MW and Kendal J (2009) Conceptual barriers to progress within evolutionary biology. *Found. Sci.* 14(3): 195-216.

Laubichler MD (2010) Evolutionary developmental biology offers a significant challenge to the neo-Darwinian paradigm. In: Ayala FR and Arp R (eds) *Contemporary Debates in Philosophy of Biology*. Malden, MA: Wiley-Blackwell, pp. 199-212.

Final version published as: Serrelli E (2017). Metascientific views: Challenge and opportunity for philosophy of biology in practice. Acta Philosophica 26(1): 65-82. ISSN 1121-2179 doi 10.19272/201700701005 [http://hdl.handle.net/10281/148832]

Love AC (2003) Evolutionary morphology, innovation, and the synthesis of evolutionary and developmental biology. *Biol. Philos.* 18: 309-345.

Love AC (2009) Marine invertebrates, model organisms, and the modern synthesis: epistemic values, evo-devo, and exclusion. *Theor. Biosci.* 128(1): 19-42.

Lynch M (2007) The frailty of adaptive hypotheses for the origins of organismal complexity. *Proc. Natl. Acad. Sci. U. S. A.* 104: 8597-8604.

Mayr E and Provine WB (eds) (1980) *The Evolutionary Synthesis: Perspectives on the Unification of Biology*. Harvard University Press, Cambridge and London.

McCain KW (2008) Assessing an author's influence using time series historiographic mapping: the oeuvre of Conrad Hal Waddington (1905–1975). *J. Assn. Inf. Sci. Technol.* 59(4): 510-525.

McCain KW (2009) Using tricitation to dissect the citation image: Conrad Hal Waddington and the rise of evolutionary developmental biology. *J. Assn. Inf. Sci. Technol.* 60(7): 1301-1319.

McCain KW (2013) Game theory in the healthcare literature: a contextual co-descriptor analysis of MeSH term assignments. In: *ASIST 2013*, November 1-6 2013, Montreal, Quebec, Canada. Available at: www.asis.org/asist2013/proceedings/submissions/posters/12poster.pdf

McCain KW, Verner JM, Hislop GW, Evanco W and Cole V (2005) The use of bibliometric and knowledge elicitation technqiues to map a knowledge domain: Software Engineering in the 1990s. *Scientometrics* 65(1): 131-144.

Medina ML (2010) Two "EvoDevos". *Biol. Theor.* 5(1): 7-11.

Mesoudi A, Blanchet S, Charmantier A, Danchin É, Fogarty L, Jablonka E, et al. (2013) Is non-genetic inheritance just a proximate mechanism? A corroboration of the Extended Evolutionary Synthesis. *Biol. Theor.* 7(3): 189-195.

Minelli A (2010) Evolutionary developmental biology does not offer a significant challenge to the neo-Darwinian paradigm. In Ayala FR and Arp R (eds) *Contemporary Debates in Philosophy of Biology*. Malden, MA: Wiley-Blackwell, pp. 211-226.

Müller GB (2007) Evo-devo: extending the evolutionary synthesis. *Nat. Rev. Genet.* 8(12): 943-9.

Noble D (2011) Neo-Darwinism, the Modern Synthesis and selfish genes: are they of use in physiology? *J. Physiol.* 589(Pt 5): 1007-15.

Odling-Smee FJ (1988) Niche constructing phenotypes. In: Plotkin HC (ed) *The Role Of Behavior In Evolution*. Cambridge, MA: MIT Press, pp. 73-132.

Pigliucci M (2007) Do we need an extended evolutionary synthesis? *Evolution* 61(12): 2743-9.

Pigliucci M and Müller GB (eds) (2010) *Evolution: The Extended Synthesis*. Cambridge, MA: MIT Press.

Plutynski A (2011) *Evolution: The Extended Synthesis* edited by Massimo Pigliucci and Gerd Müller. *Reports of the National Center for Science Education* 31(3).

Provine WB (1971) Origins Of Theoretical Population Genetics. Chicago: University of Chicago Press.

Provine WB (1992) Progress in evolution and meaning in life. In Waters C and van Helden A (eds.) *Julian Huxley: Biologist and statesman of science*. Houston: Rice University Press, pp. 165-180.

Raff RA and Love AC (2004) Kowalevsky, comparative evolutionary embryology, and the intellectual lineage of evo-devo. *J. Exp. Zool.* 302B: 19-34.

Reiss JO (2011) Footnotes to the Synthesis? *Metascience* 21(1): 163-166.

Riviera E (2013) *Mapping Scientific Literature. Structuring Scientific Communities Through Scientometrics*. PhD thesis in Applied Sociology and Methodology of Social Research, Università degli Studi di Milano-Bicocca. Available at: http://hdl.handle.net/10281/40095.

Sarkar S (ed) (1992) *The Founders of Evolutionary Genetics: A Centenary Reappraisal*. Boston Studies in the Philosophy of Science, 142. Dordrecht: Kluwer Academic Publishers.

Sarkar S (2004) Evolutionary theory in the 1920s: the nature of the "Synthesis". *Philos. Sci.* 71(5): 1215-1226.

Scheiner SM (2013) The ecological literature, an idea-free distribution. *Ecol. Lett.* 16: 1421-1423.

Schrey AW, Richards CL, Meller V, Sollars V and Ruden DM (2012) The role of epigenetics in evolution: the extended synthesis. *Genet. Res. Int.* DOI: 10.1155/2012/286164.

Sent E-M (1999) Economics of science: survey and suggestions. *Journal of Economic Methodology* 6(1): 95-124.

Sepkoski D (2012), *Rereading the Fossil Record: The Growth of Paleobiology as an Evolutionary Discipline*. Chicago: University Of Chicago Press.

Serrelli E (2015). Visualizing macroevolution: from adaptive landscapes to compositions of multiple spaces. In Serrelli E, Gontier N, eds., Macroevolution: explanation, interpretation and evidence. Interdisciplinary Evolution Research series, Springer, pp. 113-162.

Serrelli E (2016a). Removing barriers in scientific research: concepts, synthesis and catalysis. Concluding Remarks to Panebianco F, Serrelli E, eds., Understanding cultural

Final version published as: Serrelli E (2017). Metascientific views: Challenge and opportunity for philosophy of biology in practice. Acta Philosophica 26(1): 65-82. ISSN 1121-2179 doi 10.19272/201700701005 [http://hdl.handle.net/10281/148832]

traits. A multidisciplinary perspective on cultural diversity. Springer, Switzerland, pp. 403-410.

Serrelli E (2016b). Philosophy of biology. The Internet Encyclopedia of Philosophy, http://www.iep.utm.edu/.

Serrelli E and Gontier N (2014) Uniting micro-and macroevolution into an Extended Synthesis. In: Serrelli E and Gontier N (eds) *Macroevolution. Explanation, Interpretation and Evidence*. Springer.

Sidlauskas B, et al. (2009) Linking big: the continuing promise of evolutionary synthesis. *Evolution* 64(4): 871–880.

Smocovitis VB (1996) *Unifying Biology*. Princeton: Princeton University Press.

Sober E and Wilson DS (1998) *Unto Others: The Evolution and Psychology of Unselfish Behavior*. Cambridge, MA: Harvard University Press.

Soler, L. et al. eds., 2014. Science after the Practice Turn in the Philosophy, History, and Social Studies of Science, New York: Routledge.

Stebbins GL (1950) *Variation and Evolution in Plants*. New York: Columbia University Press.

Stebbins GL (1983) Mosaic evolution: an integrating principle for the modern synthesis. *Experientia* 39: 823-834.

Stebbins GL and Ayala FJ (1981) Is a new evolutionary synthesis necessary? *Science* 213(4511): 967-71.

Stephan PE (2012) *How Economics Shapes Science*. Harvard University Press.

Thicke M (ed) (2013) *Economic Aspects of Science*. *Spontaneous Generations. A Journal for the History and Philosophy of Science* 7(1).

Travis J (2011) The Modern Synthesis and its postmodern discontents. *Evolution* 65(5): 1517-1520.

Weber BH (2011) Extending and expanding the Darwinian synthesis: the role of complex systems dynamics. *Stud. Hist. Phil. Biol. Biomed. Sci.* 42(1): 75-81.

White HD and McCain KW (1998) Visualizing a discipline: An author co-citation analysis of information science, 1972–1995. *J. Assn. Inf. Sci. Technol.* 49(4): 327-355.

Wilson DS (1975) A theory of group selection. *Proc. Natl. Acad. Sci. U. S. A.* 72(1): 143-146.

Wilson DS (2009) Truth and reconciliation for group selection. In: Scienceblogs. 19 posts from October 23 to November 17, 2009. Available at: http://evolution.binghamton.edu/dswilson/wp-content/uploads/2010/01/Truth-and-Reconciliation.pdf

Final version published as: Serrelli E (2017). Metascientific views: Challenge and opportunity for philosophy of biology in practice. Acta Philosophica 26(1): 65-82. ISSN 1121-2179 doi 10.19272/201700701005 [http://hdl.handle.net/10281/148832]

Wilson DS and Wilson EO (2007) Rethinking the theoretical foundation of sociobiology. *Q. Rev. Biol.* 82(4): 327-348.

Witteveen J (2011) The softening of the Modern Synthesis. *Acta Biotheor.* 59(3-4): 333-345.

Final version published as: Serrelli E (2017). Metascientific views: Challenge and opportunity for philosophy of biology in practice. Acta Philosophica 26(1): 65-82. ISSN 1121-2179 doi 10.19272/201700701005 [http://hdl.handle.net/10281/148832]