fined in its ability to differentiate from its context namely through the (self) reflective act of observation. Furthermore, observation takes place in the mind but is enacted by and within a body, which is in itself vehicle of additional information and variability at the same time. Secondly, the act of observation does not exist out of a context, which is not only the actual physical surroundings, but most especially (and long forgotten) cultural and historical ones. Finally the *observatum* never comes in total passivity, but most of the times and especially in biological research appears in action and inter-action with the observer. While the latter consideration hence opens the necessity of analyzing a complex deck of participation, communication, and recognition modes, under a perspective where bio-philosophy immediately equals to bio-ethics, the previous two show how relevant the opening of biological methodology could be to insights coming from other disciplines such as psychology and neurosciences in order to build a new epistemological framework.

«Frontiere della Biologia» is definitely a useful tool to all scholarly levels: while it can be the perfect guide to new directions of research for both experienced scholars and beginners, it does provide helpful insights in support of studies which already focus on bio-philosophical essays, while also executing a peculiar role of a boundary exploration. In fact, it brings many different backgrounds to the table, calling all further efforts in research towards a common ground, which will define, and orient all their individual differences.

(Elena Tripaldi)

ANDREA BORGHINI, ELENA CASETTA, *Filosofia della biologia*, Carocci, Milano 2013, 307 pages, ISBN 978-88-430-6951-4.

The idea behind the newly-published volume *Filosofia della biologia*, by Andrea Borghini and Elena Casetta, is that the fundamental concepts used by science remain unfulfilled in the sphere of scientific practice, which, from their viewpoint, implies the necessity to resort to philosophy. The authors appear to imply the above-mentioned position, as they take an interest in those no-

tions determining the field of biology, the definition of which seems to be still an open question.

The text presents itself as a freshly written, engaging introduction to the philosophy of biology, full of examples and precise explanations through which the authors lead the reader in the gradual comprehension of the relevance and implications of the main topics related to the life sciences.

Half a century ago a biologist's reference to philosophy – e.g. to Aristotelian naturalism – would still have been either proof of mere erudition or a rhetorical expedient. On the other hand, philosophy of science would exclude biology and its theories from its field of enquiry, favouring physics. Instead, the idea emerging from Borghini and Casetta's text is that the dialogue between the two disciplines – philosophy and biology – can be fruitful for both sides. As a matter of fact, the two can first of all find a meeting point in the philosophical roots from which biology is originated. Secondly, contrasting the idea that often saw philosophy and biology as antagonist to each other, one can also meet a common horizon in which the efforts of both harmonise under the guide of the famous delphic motto: as the authors recall, philosophers are not the only ones to ask what man is.

On the one hand, the text underlines how the revolution intrinsic to biology never really lingers as such, as it can heavily affect our lives by perturbing the idea we have of ourselves as human beings. Simple examples of the subversion that can be caused by biological theories could be Darwin's theory (which called into question the biological superiority of human beings) or the discovery of DNA. This, however, creates a breathing space for philosophy. Indeed, philosophy of biology finds its spot «in the intersection between the facts biologists make us aware of and the way in which those same facts end up influencing the understanding that we have of ourselves» (p. 23). On the other hand, as the authors highlight, there are different situations in which biology is influenced by philosophy. First, as *philosophy of science*, it can provide both important conceptual clarification and an inter-theoretical integration. Second, philosophy *assists* biology. One example could be the case of taxonomy, as «the contemporary ontological and metaphysical inquiry» aiming to «categorise

*what there is* in the world» and «an inquiry on the theories that are presupposed (often implicitly) by biological classifications» (p. 25) could provide a solid basis for an effective interaction between the results obtained in the philosophical field and the work of the taxonomists. Thirdly, philosophy *addresses* biology. Again, an example could be the case of biotechnologies, as biological research often enough touches topics of deep public interest (i.e. GMOs, research on stem cells or the debate on living will) or imposes decisions on the allocation of research funding and therefore causes the philosopher's role to becomes crucial. In fact, it is no coincidence that bioethics have a leading role in these matters. Moreover, philosophy *influences* biology by first valuing those theories that have become such an integral part of biological culture that they are no longer seen as theories. Also, those very same theories, remaining untold premises, could frustrate scientific research.

The book is divided into three main parts. The first is entitled *Processes* and focuses on the processes of life and evolution with a historical perspective. The authors put us in touch with biology's main topics: the discovery of DNA, Darwin's theory of evolution and Mendelian genetics.

What does it mean to be alive? This is the question grounding the *first chapter* of the book. Tracing the boundaries of living and nonliving implies many theoretical issues, which mainly derive from the ambiguity of the terms in play. The idea is therefore to clarify the concept of *life*. The writers explain how nowadays we have discovered some chemical properties of the genetic material that crucially inscribe the biological systems. In 1943 Erwin Schrödinger formulated a conjecture, claiming that the aperiodic structure of the genetic material serves as division between the crystals we find in the living systems and those that compound the non-livings. This opened a new research trend which led to the 1953 discovery of the double helix by Watson and Crick and, later, to the unprecedented development of molecular biology. Ultimately, the aim of this chapter is to truly understand the importance of these discoveries and their philosophical consequences.

The *second chapter* is entirely dedicated to Darwin. «Nothing makes sense in biology – claims Dobzhansky – unless you see it

in the light of evolution»: the publishing of *The Origin of Species* on the 24th of November 1859, constitutes one of the most relevant events not just for biology, but also for human knowledge in general. In this chapter Charles Darwin and his works are contextualised with reference to the theoretical results of the pre-evolutionary thought (from Carl Linnaeus's taxonomy to Thomas Robert Malthus's studies on populations) and the figures that made the birth of evolutionism possible (from Jean-Baptiste Lamarck to Charles Lyell). From this starting point, the authors conduct an efficient exposition of the theory of evolution synthesizing it in four simple fundamental ideas and showing the philosophical and scientific richness intrinsic to the evolutionary paradigm. If however the theory of evolution is supported by a lot of empirical evidence (mostly provided by *The Origin* itself) there are also some theoretical problems Darwin himself was already aware of.

One of the above-mentioned problems in the Darwinian theory lays in the lack of a convincing explanation for hereditary mechanisms. In fact, Mendelian genetics will overcome this difficulty by explaining heredity according to quantitative principles and probabilistic laws. The *third chapter* is therefore dedicated to the presentation of Gregor Mendel's work in light of the development of the evolution theory after Darwin. The authors show how most of the early geneticists adopted an anti-Darwinian perspective: the problem was to harmonize the *continuity* of evolution by means of natural selection with the *discrete* changes observable in genetic experiments. Such harmonization was made possible by the scientific research undertaken in the first decades of the 20th century, thanks to which many scientists developed Mendel's principles for the hereditary mechanism, which also lead to the formulation of the so-called «New Synthesis» in the late 40s. This theory understands Mendelian heredity as an individual phenomenon and evolutionary selection as related to populations. Distinguishing the two levels allows the conceivability of both theories, but also their complementarity.

Another aspect of *Evolution after Darwin* (which is also the title of this third chapter) is that of the contemporary theory of evolution. This is also the topic of the last part of the chapter,

which distinguishes between *naturalists* and *ultra-Darwinists*. The former understand natural selection as one – but not the only one – of the means of modification of organisms: chance represents another fundamental element. The latter, on the other hand, affirm that evolution works in an algorithmic way, which allows it to explain alone the evidence that we encounter in nature. Ultra-Darwinists are however often methodological reductionists: for example, for Dawkins (author of *The Selfish Gene*) evolutionary phenomena can only be explained by considering genes as bearers of a leading role in evolution. The bone of contention regards the role of chance in evolutionary processes, both in the case of hereditary mechanisms and for natural selection. The chapter ends with a reference to two topics closely related to Darwinism: creationism and the argument of intelligent design.

The third chapter and, with it, the first section of the book, ends with a discussion on the developments of the post-Darwinian theory of evolution. The *second part* is defined by the writers themselves «more distinctly metaphysical» (p. 28). Its title, *Entities*, recalls the topic: the authors are here considering those entities generally admitted in the dominion of biology and problematizing the fundamental terms that normally guide both the biological theory and practice. The first entity to be taken into consideration in the *fourth chapter* is biodiversity. The word *biodiversity* was coined during a national forum in Washington in 1986. From that moment on, biodiversity and its safeguard have been a very popular topic, exceeding the scientific field and spreading in the public sphere. In cases like this, according to Borghini and Casetta, philosophy can play an important role, first of all by clarifying the meaning of the term. Secondly, biodiversity «is born together with its crisis» (p. 98), namely it arose in the very moment in which biologists considered its safeguard necessary. Consequently, biodiversity lays in the intersection of different disciplines – ecology, epistemology, ethics, politics – among which philosophy necessarily plays a leading role. In this chapter, so as to highlight the ambiguity of the word, the authors first of all analyse the nature of the concept *biodiversity*. They highlight how its elusiveness derives from the vagueness of *diversity* as a word itself, a concept both undefined from a formal perspective

and intuitive, rooted in common sense. Moreover, preserving diversity mainly involves knowing *which diversities* are to be preserved. As the tight bond connecting biodiversity and taxonomy is now clear, the authors can present the fundamental ideas and questions of both Linnaean and post-Darwinian taxonomies. Starting from this analysis, the second part of the chapter takes into consideration the different approaches that have been proposed to describe biodiversity and tries to give an answer to two fundamental questions: *what to preserve?* And, *why preserve?*

As mentioned before, taxonomy is a fundamental element in biology and, among the entities it makes use of, an important role is played by the *species*. From a historical perspective, species appears to be a constant landmark for different epochs and scientific paradigms from Aristotle to Linnaeus, from 15th and 16th century herbariums to Buffon. But how should we define species? Is it just an expression or do species actually exist in the world? What kind of entity are they? The *fifth chapter* tries to address these questions, concerned with the so-called «problem of the species». On the one hand, the effort is that of retracing the history of the term, presenting the main concepts of species that are still in use. On the other hand, the authors attempt to confront the problems arising when trying to define the species, and the ontological matters deriving from *traditional realism*. The latter is effectively intrinsically monist and essentialist, features that do not really harmonise with an evolutionary anti-fixity understanding of the species. These problems can nevertheless be reconsidered by other position like *nominalism*, *pluralism* or the understanding of species as *individuals* (and, as such, subordinated to the evolutionary process).

The key entity considered in the *sixth chapter* is the *organism*. The reconstruction of the secular debate on *what organisms are* is left aside to concentrate on the difficulties that, to date, could inhibit any theory trying to explain the nature of organisms. The writers, therefore, critically present some solutions offered by contemporary authors. Asides from being fundamental in biology, the notion of organism is an important element in our everyday relation to the world. This is why, after outlining the tight connection bonding the notions of *life*, *organism* and *individual*, the

chapter focuses on our pre-scientific or phenomenal understanding of organisms. This understanding is mainly anthropocentric and proves to be insufficient when clarifying both the entities to be found out of the ordinary, where our intuition and our language are no longer solid guides, and in the most paradigmatic of all organisms, namely the *Homo sapiens*. Given this insufficiency, the last few pages of the chapter are dedicated to the exposition of a different theory of organism. Moving from *descriptive* to *prescriptive* metaphysics, the attempt is that of reconsidering our ordinary understanding of organisms, by analysing the *immunological theory* according to which the organism can be identified by the presence of an immune system.

When confronting the problem regarding the nature of organisms, the perspective adopted by the authors is that of reinserting it in the wider debate concerned with *biologic individuality*: organisms are biologic individuals among others (genes, cells, species, etc.). If, therefore, the *sixth chapter* is dedicated to *individual organisms*, the *seventh chapter* will be concerned with *biologic individuals* in general. The authors start off by considering the notion of *individuality*. They then follow a recent tendency adopted by biologic research and try to retrace the theoretical path that has led from the enquiry on organisms to that on biologic individuality. This path is twofolded. First of all, it has a philosophical profile, which recalls both Jack Wilson's pluralist theory (which individuates *six different types of biologic individualities*) and Robert A. Wilson's theory (which understands individuals as *biologic agents*). Secondly, it is related to the theory of evolution and tries to identify the biologic individuals with the unities of natural selection. The latter is also related to Peter Godfrey-Smith's theory of *Darwinian individuals*. We thus reach the end of the section dedicated to *entities*.

The *third (and last) part* of this text, *Implications*, presents some general topics related to biologic studies that are particularly interesting from a philosophical perspective. Borghini and Casetta argue that a debate between biology and philosophy is both necessary and fruitful. This is also valid with regards to those topics that exceed the scientific field and interest civil society and public opinion. The *eighth chapter* addresses a particular aspect of evolutionary theory, namely *sex* and sexual selection. The writers

indicate six different meanings of the term *sex*, namely; *sexuality*, *process of mating*, *reproductive process*, *sexual character* (male/female), *genus*. The writers refer the terms to their semantic context and make them interact with each other. This interaction results in the following questions: what is the function of sex in the evolutionary process? Which criteria do we apply when we place an individual in a specific sexual category? Is it truly that easy to divide the human species in males and females? In the last part of the chapter the distinction between sex as *sexual character* and as *genus* is taken once again into account. As is known, this is a beloved topic in philosophy.

When presenting the first chapter, we mentioned the revolution brought by Schrödinger's ideas and by Waston-Crick's discovery of DNA. Thanks to the latter, *biotechnologies* were born in the 70s. From that moment on, biotechnologies represent a field of extraordinary scientific innovation and excite a lot of interest both from the scientific perspective and in public opinion. This has important philosophical implications and is the topic of the *ninth chapter*. First, Borghini and Casetta retrace the historical phases of the biotechnology revolution and analyse the results so far obtained thanks to its research. They thereby linger on some of the most important scientific endeavours, the most important of which by far is the Human Genome Project. This project, started in 1990 and ended in 2009, received a 3.8 billion dollar loan and aimed to identify and map the human genome. The next topic taken into account by the writers are the *biopatents*, which are one example of the cases in which philosophy of biology can play an important role and dialogue with politics. Next, they analyse the development of agroindustrial and pharmaceutical industries and thereby the birth of the scientist-businessman, allowing the often ambiguous relation between economy and science to emerge. Lastly, they take cloning into consideration.

The *tenth chapter*, *Other Evolutions*, confronts non-genetic evolutions. These can be divided into three typologies: epigenetic evolution, evolution of behaviour and symbolic evolution. The first opens to a concept of heredity that is not solely related to the genetic factor. Indeed, it engages those cases in which organisms provided with the same genetic material display phenotipic and

heritable diversities. The second is, on the other hand, related to «a transmissible modification, produced by the social interactions with other organisms usually belonging to the same species» (p. 243). Lastly, symbolic evolution is concerned with the human ability to manipulate symbols from an evolutionary point of view: the most relevant perspectives are Dawkin's *meme theory* and the 90's *module theory*, developed by some evolutionary psychologists. Another form of non-genetic evolution is *cultural evolution*. Starting from the analysis of these last two types of evolution – behavioural and symbolic – the writers reinterpret one of the most complex topics in philosophy of biology; namely, the relation between nature and culture. The adopted perspective is clear: «the culture of a human being is also his nature» (p. 258). Through the examples provided by *race* and the evolution of *altruism*, the writers come to reflect upon the most appropriate methodology to be applied when studying issues concerned with both nature and culture. The assumed standpoint is that which avails itself of the most recent biologic knowledge to make it interact with that provided by human sciences.

The way in which philosophy and biology come to interact in this text is exquisitely fecund. This is, first of all, because of the constant conceptual enquiry aimed to clarify the terms in play both from an ordinary and from a scientific perspective. The latter is intended to avoid the misunderstandings that can emerge from semantic ambiguities, both from the scientific and philosophical viewpoints. We however believe that the truly original element provided by Borghini-Casetta's book lays in the deep continuity established between philosophy and science. Indeed, once we overcome an idea of philosophy of science as meta-discourse on the methodological foundations of a particular scientific discipline, the philosopher can have access to the scientific practice and come to grips with the conceptual problems related to the *entities* the scientist has to deal with during his researches. As the authors say: «rather, what we are willing to underline it that philosophy has something to say *to* and *with* biology, and not only *about* biology» (p. 24).

What we have in front of us is therefore «a panoramic of the philosophical foundations of biology», panoramic that, as men-

tioned, is not historical, but rather conceptual. Indeed, apart from the first section, where the speculative implications of scientific topics are shown, the text aims to express biology's main *conceptual cores*. This is however combined with continuous and rigorous references to authors and texts that orient the reader historically. In conclusion, *Philosophy of Biology* is first of all an extremely useful tool for whoever is willing to approach the discipline through a nicely-flowing, up-to-date yet rigorous text. Last but not least, it is also a noteworthy and valuable work for the recent philosophical panorama.

(Daniele Bertoletti)