

PHILOSOPHY OF BIOLOGICAL INDIVIDUALITY

ANNA MARIA DIELI*

THE present bibliography aims at illustrating the debate on individuality in biology in the last years. Raising the question of biological individuality amounts to asking what are the living individuals in our world; that is, what counts as an individual in the living world. The common sense answer to this question is that the living world is made of organisms: therefore, the organism is the biological individual. However, common sense fails when it tries to define individuals in more difficult cases, such as colonies, social insects, symbiosis and so on. Therefore, there is a huge debate in philosophy of biology on founding the criteria to define the biological individual.

In the last decades, several philosophers of biology, most prominently David Hull, have argued that the notion of a “biological individual” is much larger than that of an organism: the organism is only one level in the hierarchy of biological individuals, which may include genes, molecules, cells, organisms, groups, and species.¹ Therefore, a debate has arisen: how to define the biological individual in a way which includes all these entities.

Starting from these observations, some philosophers of biology have tried to define the biological individual as the unit of selection, which is the unit on which selection acts. The debate on individuality has then overlapped with the debate on what counts as a unit of selection, whether it is a gene, an organism, or a species.

According to other philosophers, we should look for a definition of individuality outside the evolutionary biology: for example, in developmental biology. Alternatively, they suggest abandoning the notion of individuality to look for a concept that is more useful in biological practice.

Through the following books, we are going to explore the main issues of this debate on individuality in biology.

* Università degli Studi di Roma Tor Vergata and Université Paris 1 Panthéon Sorbonne IHPST, 13 rue du Four, 75006 Paris; e-mail: annamariadieli@gmail.com

¹ Cfr. D.L. HULL, *Individual*, in E.F. KELLER & E. LLOYD (eds.), *Keywords in Evolutionary Biology*, Harvard University Press, Cambridge (Massachusetts) 1992.

A.C. LOVE, I. BRIGANDT, *Philosophical dimensions of individuality*, in L.K. NYHART and S. LIDGARD (eds), *E Pluribus Unum: Integrating Scientific, Philosophical, and Historical Perspectives on Biological Individuality*, University of Chicago Press, Chicago 2016.

The aim of this book is to analyse the concept of individual from an epistemological point of view. In this perspective, the conceptualization of individual is useful in order to reach scientific goals: the philosophical definition of a biological individual should come from the practice of biology. This epistemological-centred perspective refuses metaphysical debates, in order to focus on scientific practice. Through this view, the author analysis the debate on individuality and all the different criteria for biological individuality which have been proposed since now.

The classical debate aims at founding a monistic definition of individuality: this definition should be in a highly abstract framework, intended to cover all levels of biological complexity. However, the issue of this analysis is a huge variety of different definitions. The author suggests then that, rather than providing a monistic definition, the aim of the philosopher should be to provide a conceptualization of individuality in the toolkit of biologists available for pursuing different goals of inquiry.

This is a practical approach to philosophical problems in science, which has both positive and negative consequences. The positive aspect is that the practice of science is what matters the most: the philosophical inquiry should start from the reality of biological practice. This could help to eliminate some nonsense discussions. This also means that multiple definitions of biological individuality are all possible, according to the aim of the researcher. At the same time, the risk of this kind of conception is to consider the philosophy of science something superfluous to the scientific research, something that comes "a posteriori". Metaphysics is considered to be something which does not help to enquire the reality. The result of this approach risks to be a naïve pluralism on the notion of biological individuality. To the contrary, the philosophical reflection should guide and shade light on the practice of science. The aim of philosophical inquiry on biological individuality is to make a difference in biological practice: not all the definitions of individual are the same, because they have some differences on the scientific practice.

However, the book is quite fascinating, because it offers an up-to-date view of the debate on individuality; moreover, it suggests a perspective which really takes into account the epistemic goals of the researchers.

F. BOUCHARD, P. HUNEMAN (eds.), *From Groups to Individuals: Perspectives on Biological Associations and Emerging Individuality*, MIT Press, Cambridge (Massachusetts) 2012.

In biology, we often find a new individual formed by some sort of aggregation of former individuals: it is the case of multicellular organisms, formed by an aggregate of cells. Individuals are thought to aggregate under the pressure of natural selection. Therefore, the biological hierarchy did not spring into existence fully formed:

it is the outcome of a long process of evolution. This could explain the existence of different levels of individuality. There are simple, unaggregated individuals (for example bacteria) and more complex individuals (eukaryotic cells), and then very complex biological systems (such as ourselves!), which are composed of millions of cells. Therefore, the discussion on units of selection has particularly focused on the levels of selection: selection acts at different levels (i.e. on cells, tissues, organisms and so on) in different ways.

The discussion on the levels of selection² is especially linked to the concept of “evolutionary transitions”,³ a concept expressing the idea that complexity in nature increases with biological evolution, and smaller entities often form larger entities likely to live and reproduce by themselves. Entities that were capable of independent replication before the transition can only replicate as a part of the bigger entity after it. The major transitions in evolution happen in the following way: there are smaller entities that often come about together to form larger entities. For example, chromosomes form eukaryotes cells, which form multicellular organisms, which aggregate into groups, and so on. Then, smaller entities become differentiated as part of a larger entity (proteins, organelles, tissues...); and often the smaller entities are unable to replicate in the absence of the larger entity. For example, cells cannot reproduce outside the organism, while workers bees are sterile.

To sum up, the debates over evolutionary transitions try to answer the following question: how do evolutionary processes acting at the level of independent lower level entities produce new biological individuals at a higher level? This debate is crucial to solve in order to decide what counts as a biological individual. For example, do colonies or symbiosis count as individuals?

The book is composed by eleven essays, which explore the relation between individuality, evolution and organism. The aim is to overcome the idea that the only individual is the organism, leading the reader to consider the biological and philosophical implications of the emergence of these new collective individuals from associations of living beings. The topics included in this book range from metaphysics, to physiology to sociology. The book provides a good overview of the actual debate on individuality, as well as its epistemological and metaphysical consequences.

A. MINNELLI, T. PRADEU, *Towards a Theory of Development*, Oxford University Press, Oxford 2014.

One of the topics linked to the concept of individuality in biology is how an organism develops from a cell: since its origin, biology has been widely interested in the problem of development. This book offers an analysis of the role of theorization in developmental biology: it aims to understand whether it is possible, through the for-

² Cfr. E. SOBER, D.S. WILSON, *A Critical Review of Philosophical Work on the Units of Selection Problem*, «Philosophy of Science», 61, 4 (1994), pp. 534-555; S. OKASHA, *Evolution and the Levels of Selection*, Oxford University Press, Oxford 2006.

³ J. MAYNARD SMITH, E. SZATHMÁRY, *The Major Transitions in Evolution*, Oxford University Press, Oxford 1995.

mulation of theories, to predict the development of a living being. From this starting point, it analysis, then, which is the meaning of the word 'theory' in biology.

The aim of the book is to build a productive theory of development: that is, a theory which gives a general understanding of development in biology. From a philosophical point of view, development offers a variety of problems. First of all, the problem to define criteria for individuality for something that is always changing, like a living being. Then, there is the problem of how information is transmitted during reproduction and development; and also how to account for different living beings which are parts of an organism, such as the microbiota, but are not transmitted genetically.

All these problems are addressed, from several points of view, in this collection of essays. The book has been written by a variety of authors, from philosophers of biology to developmental biologists, from molecular geneticists to reproductive biologists, and it covers a wide literature. Thanks to these contributions, it offers a critical reading useful for the definition and the delineation of development, and on the concepts of identity and individuality in the living world, and for the understanding how organisms are continuously 'constructed' through time. The answer to these questions can help to define how an individual can develop and maintain its identity through time.

The major interest of this book is that it overcomes the evolutionary view of individuality, which has been the major framework for talking about individuality in biology for many years.

M. BERTOLASO, *Philosophy of Cancer. A Dynamic and Relational View*, Springer, Berlin 2016.

Another way to analyse levels of individuality is to look at pathologies in which the normal dynamics between one level and the others is destroyed: for example cancer. Cancer, also known as malignant tumour, is a disease involving aberrant proliferation of cells and the ability to invade other tissues. In cancer, cells grow out of control and become invasive: therefore, it is described as a cell disease. Therefore, the major interpretation of cancer has for long times been the *Somatic Mutation Theory* (SMT). However, cancer phenomenon cannot be described merely from a cellular point of view when considering the possibility of reverting the neoplastic phenotype of a tumour cell. For instance, it has been proved that transplanting a cancer cell in a normal tissue not always gives rise to a tumour. A tumour arises as a disruption of the interaction among cells, within a tissue and an organ and within the whole organism. The microenvironment has, therefore, a role in the development of cancer, which cannot be underestimated. Cancer cannot be considered just as a genetic or cell disease: the systemic perspective has to be taken into account. That is what the *Tissue Organization Field Theory* (TOFT) aims to do.

The essays contained in this book try to analyse the shift between these two interpretations of cancer. First of all, the challenging biological features of cancer are described: cancer is a multi-level and multi-causal phenomenon. The question which arises is then which is the best way to explain cancer: whether it should be described as a cellular or tissue phenomenon. This question needs to be based on more sol-

id grounds: by resolving the conflict between different explanatory frameworks, it should be understood what it has to be explained, that is cancer. A satisfactory explanation of a complex biological phenomenon like cancer implies different questions that are simultaneously present. Some are related with the dynamic organization of the system and others with the definition of the system itself.

Through the examination of the shift between SMT and TOFT, the book presents the theoretical challenges posed by cancer research. The volume offers a wide overview on cancer research connected to the main topics of philosophy of biology, from reductionism to theory of function. The effort to understand such a complex pathology as cancer might shed light on the complexity of biological organization and why a mereological account is not satisfactory to account for account for it.

J. DUPRÉ, *Processes of Life; Essays in the Philosophy of Biology*, Oxford University Press, Oxford 2012.

John Dupré explores recent revolutionary developments in biology and considers their relevance for our understanding of human nature and human society. Contrasting with the idea that life consists of a hierarchy of things, the author observes that it is more realistic to consider it as a hierarchy of processes. Just to make an example, in a typical cell in a human body, many thousands of chemical reactions are taking place every second. Molecules are continuously constructed, reshaped, or dissolved; moreover, the cells in which they reside, divide, develop, and die. All of these countless events take place within a much longer process, that is the life cycle of the organism: since the beginning, the development of the organism is a complex process. Moreover, as each living being gives rise to a new living being, it is still part of a huger process, that is evolution of the species. In conclusion, what characterizes life is to be a process.

Therefore, it is useless to look for a definition of biological individual as a thing, a substance: the biological individual is a process. The concept of individual is not the best to capture biological reality. This perspective of biological phenomena as processes also helps to overtake monism and to defend a kind pluralism which is a way to accept complexity and dynamicity in science.

This is done, in this book, through the emphasis on microbiology. Dupré shows the importance of microbiology for a proper understanding of the living world, and reveals how it subverts the simple traditional conception of the biological organism as a monistic individual.

The interest of this book, articulated into sixteen essays, is to look at very recent developments in science, in order to propose a definition of individuality which well suits with recent discoveries.

CONCLUSION

In conclusion, it seems that recent developments of the debate on individuality in biology show that what counts the most is the idea of individual as a complex organisation. Levels of organization are characterized in compo-

sitional terms by a high number of parts and their inter-actions; they have a hierarchical organization and the identity of parts depends on their interactions and on higher levels' effects. The core issue is thus to clarify how we should understand the dependency of identity of parts and their interactions on higher levels' effects, i.e. to characterize the kind of control that accounts for the maintenance of levels of organization and their derivation from other levels in biological systems. More than looking for a unique definition of individual, it seems that we need a 'relational ontology of levels',⁴ which will allow understanding how each level is the result of relations among underlying parts. The organizational integration among parts makes the identity of the whole. Without an understanding of how it can happen, a discussion on what is an individual in biology risks to be sterile.

⁴ M. BERTOLASO, *Breaking Down Levels of Biological Organization*, «Theoretical Biology Forum», 106 (2013), pp. 49-72.