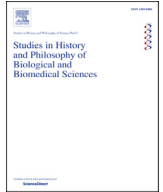




Contents lists available at ScienceDirect

Studies in History and Philosophy of Biological and Biomedical Sciences

journal homepage: www.elsevier.com/locate/shpsc

Understanding viruses: Philosophical investigations

Thomas Pradeu^{a,*}, Gladys Kostyrka^b, John Dupré^c^a UMR5164, CNRS & University of Bordeaux, France^b IHPST, UMR8590, CNRS & Paris 1 Pantheon-Sorbonne University, France^c Egenis, University of Exeter, UK

ARTICLE INFO

Article history:

Received 27 February 2016

Accepted 27 February 2016

Available online xxx

Keywords:

Individuality

Life

Microbe

Organism

Species

Virus

ABSTRACT

Viruses have been virtually absent from philosophy of biology. In this editorial introduction, we explain why we think viruses are philosophically important. We focus on six issues (the definition of viruses, the individuality and diachronic identity of a virus, the possibility to classify viruses into species, the question of whether viruses are living, the question of whether viruses are organisms, and finally the biological roles of viruses in ecology and evolution), and we show how they relate to classic questions of philosophy of biology and even general philosophy.

© 2016 Elsevier Ltd. All rights reserved.

When citing this paper, please use the full journal title *Studies in History and Philosophy of Biological and Biomedical Sciences*

1. Introduction

Viruses have been virtually absent from philosophy of biology. This is a quite surprising situation, because viruses probably constitute the most abundant and diverse biological entities in nature (Rohwer & Barott, 2013; Wasik & Turner, 2013). Viruses also successfully occupy a wide range of niches, are key players in evolutionary and ecological processes (Villarreal, 2005; Wasik & Turner, 2013), and, last but not least, have long been a matter of concern to medical doctors and epidemiologists. The situation is even more astonishing considering that several biologists have, over the years, produced a rich conceptual reflection on viruses (e.g., Burnet, 1945; Claverie & Abergel, 2010, 2012; Forterre, 2010a; Koonin & Dolja, 2013; López-García, 2012; Lwoff, 1957; Moreira & López-García, 2009; Raoult & Forterre, 2008; van Regenmortel, 2003; Stanley, 1957), and the philosophy of microbiology more broadly has blossomed in recent years (O'Malley, 2013, 2014; O'Malley & Dupré, 2007a, b). Meanwhile, both virologists and historians of biology have produced a detailed and rich history of

virology (e.g., Bos, 1999, 2000; Creager, 2002; van Helvoort, 1994a, 1994b, 1996; Hughes, 1977; Lustig & Levine, 1992; Sankaran, 2010; Summers, 2014; Waterson & Wilkinson, 1978).¹

Naturally, there have been important exceptions to the near absence of viruses from the domain of philosophy of biology, in particular the work of Gregory Morgan (Morgan, 2001, 2006, 2010; Morgan & Pitts, 2008), as well as a few other contributions by philosophers, or appearing in philosophical journals (e.g., Rohwer & Barott, 2013; Witzany, 2012). Yet it seems fair to say that, overall, the philosophy of virology has remained rather inchoate in recent years, at least in comparison with other branches of philosophy of biology. To our knowledge, the present issue of *Studies in History and Philosophy of Biological and Biomedical Sciences* is the first special issue of a history and philosophy of science journal specifically devoted to philosophical analyses of viruses. Now, in our view, it is all the more important to pay attention to viruses as their study raises crucial conceptual and philosophical questions – in addition to practical questions already discussed extensively in the

* Corresponding author.

E-mail address: thomas.pradeu@u-bordeaux.fr (T. Pradeu).

¹ This historical work has led to important discussions and controversies. On the tensions and disagreements among historical accounts of virology, see Méthot (this special issue).

medias (for example, recently, about Ebola and Zika viruses). In this editorial introduction, we mention some of these conceptual and philosophical questions, and show how the essays gathered in this special issue address them.

2. Philosophical questions raised by the study of viruses

The study of viruses raises pressing conceptual and philosophical questions, several of which can be directly related to classic issues in philosophy of biology, or even general philosophy. With no claims to exhaustiveness, we mention here six problems that seem to us of great philosophical significance. As suggested by Table 1, a first general problem, “What are viruses?” can be divided into three more specific problems (definition; individuality; taxonomy), while a second general problem, “What is the place of viruses in the biological world?” can be divided into three other specific problems (life; organismality; non-living biological roles).

2.1. What are viruses?

Perhaps the most basic and essential problem raised by virus research concerns the definition of the concept of virus. Indeed, this seemingly naïve question has always been a crucial concern for virologists (Summers, 2014). Though some people include viruses in a very general category of “microbes”, others consider that viruses are very different from microbes. Historically, at the time of what is often described as their discovery at the end of the 19th century, viruses were conceived of as infectious agents that pass through a Chamberland–Pasteur filter, that is, a filter that blocks bacterial agents. In other words, viruses were mainly distinguished from bacteria by their filterability (van Helvoort, 1996). More than half a century later, in his highly influential paper “The Concept of Virus”, André Lwoff famously claimed that “*viruses are viruses*” – a way of stressing “the nature of the difference between viruses and other infectious agents, between viruses and micro-organisms” (Lwoff, 1957, p. 240). In his Nobel lecture in 1965, Lwoff still insisted that there is an “essential difference” between a virus and a microbe, a virus being defined by its capacity to reproduce itself solely from its genetic material (Lwoff, 1966). As has often been emphasized (Claverie & Abergel, this special issue; Summers, 2014), viruses have most of the time been defined *negatively*: viruses are conceived as entities lacking this or that feature (e.g., metabolism

or autonomous replication) found in other biological entities, especially bacteria, and it is clearly worth asking whether a positive definition of viruses can be offered.

Today, some biologists (e.g., Claverie & Abergel, this special issue; Forterre, this special issue; Koonin & Starokadomskyy, this special issue) consider that several of the criteria traditionally used to separate viruses from other biological entities have become fragile, or even sometimes obsolete. One aspect of this concerns the degree of “autonomy” exhibited by viruses. A very influential definition of viruses has been that viruses are intracellular obligate parasites, with a strong emphasis on their *dependency* on a host. Yet, the recent understanding that symbioses are ubiquitous in nature, added to the realization that at least certain viruses exhibit some degree of autonomy (Claverie & Abergel, 2010) while many bacteria live as obligate parasites, has led some biologists to adopt a much more *continuous* view of autonomy among biological entities. According to this view, far from distinguishing, in an absolute way, dependent from independent biological entities, the only thing one can do is to distinguish *degrees* of autonomy in the biological world (e.g., Claverie & Abergel, 2012; Dupré & O’Malley, 2009).

A related question is whether or not viruses are necessarily harmful. Viruses have generally been described as harmful (most often disease-causing, that is, pathogenic) entities, and it is undeniably true that some viruses can be devastating to their hosts. Nonetheless, recent research has shown that many viruses are neutral or even beneficial to their hosts (see Pradeu, this special issue, as well as Dupré & Guttinger, this special issue), so harmfulness could hardly be a defining feature of viruses.

Taken together, these observations suggest that it is today both crucial and at the same time extremely difficult to offer a precise and distinctive definition of the notion of virus. In this context, contributions to this special issue raise significant problems, such as to what extent a general definition of virus is possible, whether definitions of virus should necessarily be negative (i.e., descriptions of what viruses lack as compared to other biological entities), what definition of viruses could be compatible with scenarios that give an important role to viruses in the origins of life (Forterre, this special issue; Kostyrka, this special issue), and what kind of new conceptual distinctions could perhaps shed light on future virological research (e.g., Forterre suggests the distinction between “ribocells” and “virocells”; Claverie and Abergel offer a definition of a virus as any biological entity the genome of which is replicated by a system of macromolecules that it does not entirely encode, and disseminated using a metabolically inert structure the maintenance of which does not require energy; Koonin and Starokadomskyy propose to distinguish different forms and degrees of “replicators”, and conceive lytic viruses as extreme selfish replicators; in contrast, van Regenmortel defends a more “orthodox” view on viruses, which according to him is shared by a majority of virologists).

A second major set of problems concerns the individuality and diachronic identity of a virus. Indeed, it is extremely difficult to determine where and when a virus starts and ends, and what it means for one virus to remain the same through time. These seemingly philosophical and rather abstract questions are in fact related to a very practical issue, regularly met by working virologists: is a virus the viral particle (the virion), or is it the whole viral cycle? (See Fig. 1). Although every virologist takes into account the whole cycle of a virus in order to describe its features and explain how it works, many statements made by virologists about viruses suggest that their focus is most often the virion. For example, two of the traditional criteria of Lwoff, according to which typical cellular organisms contain both DNA and RNA while viruses only contain one type, and all microorganisms are reproduced from the integrated sum of their constituents while viruses are produced solely from their nucleic acid, make sense only if the virus is identified

Table 1

Some crucial philosophical problems raised by the study of viruses.

Problems for virology and philosophy of virology	Problems for philosophy of biology and general philosophy
What are viruses?	1. How to define a virus? Are definitions useful in science, and how are they constructed?
	2. Individuality and diachronic identity: where and when a virus starts and ends? What is a biological individual and what makes its identity through time?
	3. What is a virus species? What is a biological species? What are “natural kinds” in biology?
What is the place of viruses in the biological world?	4. Are viruses alive? What is life?
	5. Is a virus an organism? What is an organism?
	6. Whether or not considered living, what are the biological (especially evolutionary and ecological) roles of viruses? How to articulate the biological and the “living” dimensions? How biotic and abiotic elements interact and what can be the impact of the latter on living processes?

Download English Version:

<https://daneshyari.com/en/article/7552148>

Download Persian Version:

<https://daneshyari.com/article/7552148>

[Daneshyari.com](https://daneshyari.com)